Opposite: Examples of artists' pigments. Top row, left to right: lapis lazuli ultramarine; a high grade natural azurite; medium grade natural azurite; natural malachite. Second row; smalt; blue verditer (equivalent to artificial azurite); indigo; green verditer (equivalent to artificial malachite). Third row: lac lake; cochineal lake; green earth; verdigris. Fourth row: madder lake; kermes lake; a brazilwood lake; vermilion (below green earth); realgar. Fifth row: Naples – lead antimonate – yellow; lead-tin yellow 'type II'; red lead (below vermilion); orpiment (below realgar). Sixth row: weld lake (below Naples yellow and lead-tin yellow 'type II'); a synthetic red ochre (below lead-tin yellow 'type II'); lead-tin yellow 'type I' (below red lead). Bottom row: yellow ochre; a natural red earth; raw umber; lead white.

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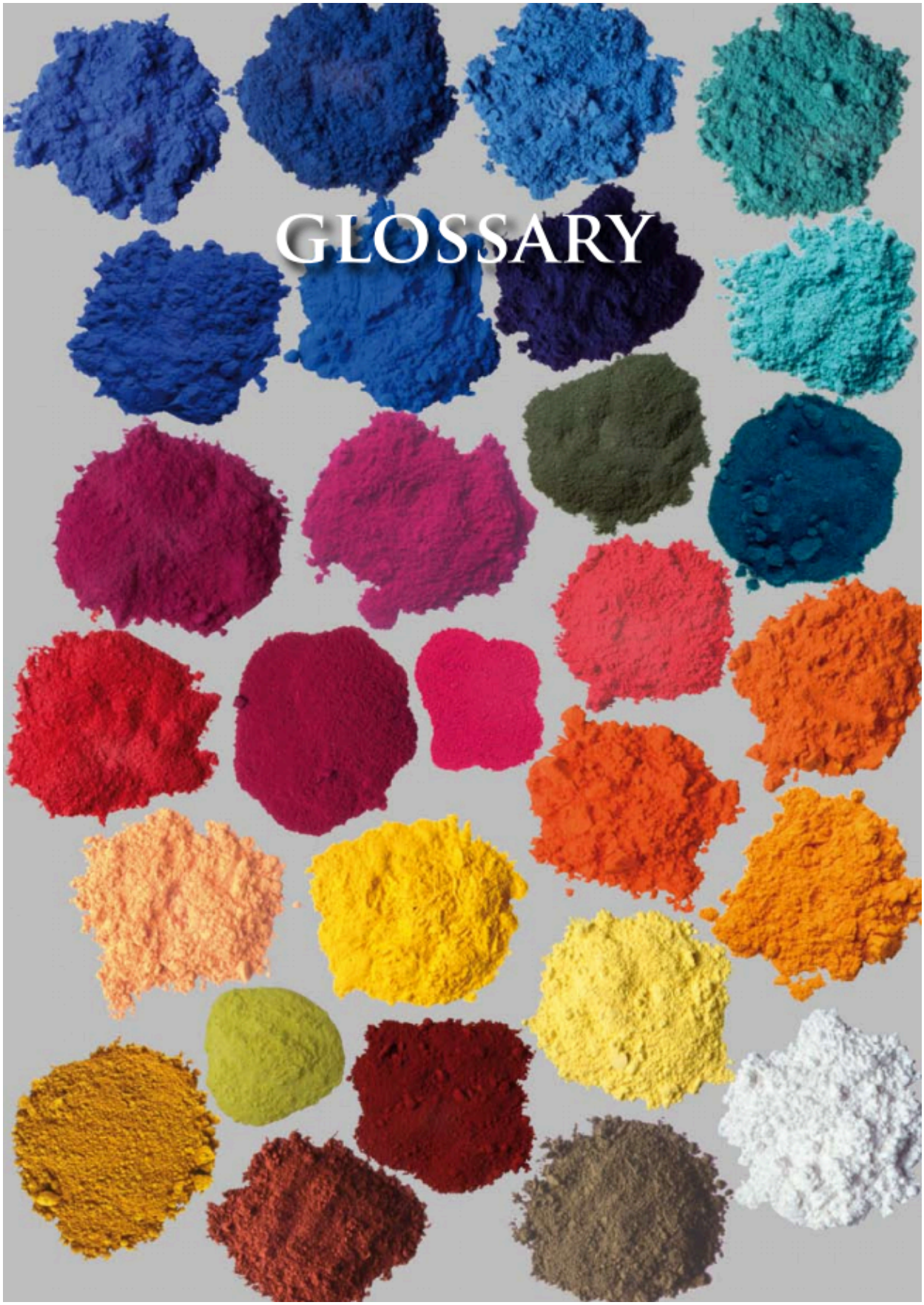
GLOSSARY

Glossary

Abbayal biancha*, *albayalde de Venecia: see Lead white

Aerinite: A rare, sky-blue, carbonate-containing iron magnesium calcium aluminium silicate mineral, structural formula $Ca_{2.1}Na_{0.5}(Fe^{3+}AlFe^{2+}_{1.7}Mg_{0.3})(Al_{2.1}Mg_{0.7})[Si_{12}O_{30}(OH)_{12}H]\cdot[(CO_3)_{1.2}(H_2O)_{12}$, occurring principally in the southern Pyrenees and other parts of Spain.

Alabaster: A fine-grained, white stone, a variety of gypsum, hydrated calcium sulphate ($CaSO_4\cdot 2H_2O$); important sources in central England (Nottinghamshire, Derbyshire, Staffordshire), also found in Germany, Spain and other parts of Europe.

Alkanet: Purplish-red dye obtained from the roots of *Alkanna tinctoria* Tausch., found in sandy soils all round the Mediterranean basin, central and southern Europe. The dyeing principle, alkannin, is soluble in alcohol and oils, but almost insoluble in water.

Alum (***Alaun*, *Aluminis*, *lume* (*allume*)**): A class of double sulphates of which the most common was (and is) potash alum, potassium aluminium sulphate ($KAl(SO_4)_2\cdot 12H_2O$). Uses included papermaking, dyeing, tawing leather and making lake pigments. The principal sources were the mineral alunite, found in the eastern Mediterranean and Tolfa in Italy, and alum shales, found in the United Kingdom, Belgium, southern Germany and Bohemia (Czech Republic). Aluminium sulphate itself can be used similarly and occurs as the mineral alunogen (feather alum) ($Al_2(SO_4)_3\cdot 17H_2O$). Plume alum (*lume di piuma*): fibrous or feather-like form of potash alum (also incorrectly used for asbestos). Roche alum (*lume di rocca*): potash alum in fragments or large crystals; the name is said to derive from Rocca in Syria. *Allume zuccarino*, *lume zucharina*: roche alum ground with rose water, egg white and sugar. *Allume di feccia*, *lume de feza*: potassium tartrate from wine lees (q.v.) heated to give potassium carbonate. *Lume scagiola* and similar, see Gesso; Gypsum

Amayll*, *amellum: see Enamel

Amber (***Börnstein* (*gelb*, *weiss*), *Succini* (*citrini*, *albi*), *vernice d'ambra*, *Weißer Agtstein***): Fossil resin derived from extinct conifer trees; translucent or cloudy, usually pale yellow to orange-brown in colour, sometimes much darker. The best-known variety is Baltic amber (succinite), found principally around the eastern Baltic Sea. Used for jewellery, in medicine and for varnish-making (*vernice d'ambra*).

Ancorca: see Lake, yellow

Antimony (***Spiessglass***): Over the period covered by this book, 'antimony' would refer to stibnite (Sb_2S_3), a grey mineral found in central Europe, north-west Germany, France, north Italy, United Kingdom; may be in the form of clusters of pointed rods. Antimonite is another name for stibnite; it also refers to the class of compounds derived from the reaction between antimony(III) oxide (Sb_2O_3) and an alkali. Glass of antimony: stibnite calcined (giving the oxide) and vitrified, used as an emetic. Also an ingredient in pottery glazes, notably a deep yellow. See also Lead antimonite

Aqua de rasa: see Turpentine

Argente vive*, *argento uiuo: see Mercury

Argol: Crude potassium hydrogen tartrate from wine lees (q.v.).

Arsenic (***Arsinecho*, *arsinicho cristallino*, *arsinicho masenado*, *arsenyk*, *ersnek*, *Hüttenrauch***): Apart from the arsenic sulphide pigments orpiment and realgar, the best-known form of arsenic was white arsenic, arsenic(III) oxide (As_2O_3), obtained as poisonous whitish fumes smelling of garlic when roasting ores of metals such as lead and copper; in solid form as white crystals.

Arzica*, *azicha: see Lake, yellow

Asafoetida (***Gummi Asae foetid.*, *Teuffelsdreck***): Gum-resin from the stems of *Ferula assa-foetida* L. and related species with pungent, onion-like smell, obtained from Persia (Iran); used in cooking and as a digestive, it also has antimicrobial and antispasmodic properties.

Asbestos: Silicate minerals with long, fibrous crystals; white asbestos, chrysotile ($Mg_3(Si_2O_5)(OH)_4$) is derived from serpentine.

Ash, ashes, blue (***Assen*, *Bergasch*, *caerulei cineritii*, *caerulei factitii vulgaris*, *ceneraccio oltremarino*, *cenere turchina*, *asches*, *çenizas azules*, *Duytsche assen*, *Engelsche assen*, *Eschblaw*, *lichte Lasur*, etc.**): (1) Low-grade natural ultramarine or azurite containing considerable white mineral impurity: *ceneraccio oltremarino* (Italian) – ultramarine ash; *Caerulei cineritii*, *Bergasch*, *Eschblaw* (German) – azurite ash; see also *Biadetto*. (2) In Spanish sources *cenizas azules*, blue ashes, indicates azurite (q.v.). (3) A synthetic basic copper carbonate blue, essentially a synthetic form of azurite ($2CuCO_3\cdot Cu(OH)_2$), bright to pale greenish-blue in colour: *assen* (Flemish); see also Verditer, blue, which is another (English) name for the same pigment type. There is a continuum between this form and the closely related green ashes (green verditer), (q.v.). The blue variety perhaps became generally available in the very late sixteenth century (the green variety is earlier) and citations seem to occur from the early seventeenth century onwards; for earlier artificial copper-containing blues see Azure. The context in which the name occurs may provide evidence for the identity of the pigment: names such as English ashes – *Engelsche assen* (Flemish) – probably refer to a pigment of this type, as do *caerulei factitii vulgaris*, *lichte Lasur* in German. The Italian *cenere d'azzurro* may, however, refer to an ultramarine ash. The price quoted may give an indication.

Ashes, green (***Berde de Inglaterra*, *verdetto***): Usually refers to a pale green, synthetic basic copper carbonate pigment, essentially artificial malachite ($CuCO_3\cdot Cu(OH)_2$), available in the sixteenth century; see also Verditer, green, another (English) name for the same pigment type. As mentioned above, there is a continuum

Glossary

Abbayal biancha, albayalde de Venecia: see Lead white Aerinite: A rare, sky-blue, carbonate-containing iron magnesium calcium (Fe3+AlFe2+ occurring aluminium principally 1.7 Mg 0.3)(Al silicate 5.1 in Mg the 0.7 mineral,)[Si southern 12 O 36 structural (OH) Pyrenees 12 H]·[(CO formula and 3 other) 1.2 Ca (H 5.1 2 parts O) Na 12 0.5 , of Spain. Alabaster: A fine-grained, white stone, a variety of gypsum, hydrated calcium England sulphate (Nottinghamshire, (CaSO 4 ·2H 2 O); Derbyshire, important Staffordshire), sources in central also found in Germany, Spain and other parts of Europe. Alkanet: Purplish-red dye obtained from the roots of Alkanna tinctoria Tausch., found in sandy soils all round the Mediterra- nean basin, central and southern Europe. The dyeing principle, alkannin, is soluble in alcohol and oils, but almost insoluble in water. Alum (Alaun, Aluminis, lume (allume)): A class of double sulphates of which the most common was (and is) potash alum, potas- sium papermaking, aluminium dyeing, sulphate tawing (KAl(SO leather 4 and) 2 ·12H making 2 O). Uses included lake pigments. The principal sources were the mineral alunite, found in the eastern Mediterranean and Tolfa in Italy, and alum shales, found in the United Kingdom, Belgium, southern Germany and Bohemia (Czech Republic). Aluminium sulphate itself can be used similarly and occurs as the mineral alunogen (feather alum) or feather-like (Al

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between the green and the chemically closely related blue ashes (q.v.).

Asphaltum (***Appalto, Asphalti s. Bituminis Judaic., expalto, Juden=Pech, spaltain, spalte, spalto***): Naturally occurring black or dark brown material derived from crude petroleum after evaporation of volatile constituents, found in outcrops in areas often associated with volcanic activity or hot springs. Asphaltum and bitumen are chemically similar; bitumen is almost entirely organic, while asphaltum contains a percentage of mineral matter. Used in oil painting as a translucent, dark brown pigment.

Auricalcum: Brass, a gold-coloured copper-zinc alloy, or similar; see also *Orsade*

Avolio abrugiato: see Bone black, Ivory black

Azul desmalte: see Smalt

Azure (***Aiseur, Azur, azzurro, azzurrum, Lasur***): (1) It is not always possible to determine if a blue pigment referred to simply as 'azure' is ultramarine or azurite; it may, however, be clear that the pigment is the highest quality blue obtainable – the best shade of blue. In sixteenth-century Germany, for example, ultramarine blue was rarely obtainable and prohibitively expensive, but very high quality azurite was available. Under these circumstances, references to *Lasur* are probably to azurite and a high quality *Lasur* probably indicates an azurite of particularly pure blue colour. Similarly, in English documents, apparent distinctions between pigments (bice and azure) may indeed be distinctions between azurite and ultramarine, but the important distinction is between two shades of blue: in practice, the artist may not have had the choice of buying ultramarine and thus bought two grades of azurite, one bluer than the other. (2) Pre-sixteenth-century recipes for 'azures' using copper, impure silver, brass or a copper salt such as verdigris, with sal ammoniac (ammonium chloride) and, frequently, lime or chalk, gave blue or deep blue (cuprammonium) copper-containing pigments, similar in type to blue ashes/verditer (q.v.). Loss of ammonia from the cuprammonium salt would result in a change in colour to a greener blue, although the pigment would be to some extent stabilised by the addition of lime.

Azurite (***Asur d'Alemaigne, azul de Santo Domingo, azul de Indias, azurro d'Alamangnia, azurro todesco, azzurri fini, azzurro della magna*** **(etc.),** ***azzurro di Spagna, Bergblaw, biadetto, bice, byse*** **(etc.),** ***Caerulei native fini, plau [di] spania, rotsblauw*** **(rock blue),** ***steinadzur, turchinetto*** **(etc.)**): Blue basic copper carbonate mineral ($2CuCO_3{\cdot}Cu(OH)_2$), often occurring with the green malachite (q.v.); brownish-red cuprite (Cu_2O) may also be present. The colour varies from pure, deep blue to green-blue; coarsely ground pigment has a stronger colour, but can be gritty and difficult to use. Its sources were often associated with silver mines and varied over time as one was exhausted and another opened. They included mountainous regions of north-east and southern Germany and the present-day Czech Republic (Saxony, Bohemia), Slovakia and Hungary, eastern France, Switzerland, Austria, northern Italy, Spain and, in early times, Armenia. The pigment was also imported into Spain from the New World. The variety of sources is reflected in the names for the pigment – *asur d'Alemaigne* (French), *azul de Santo Domingo* (Spanish), *azzurro della magna*, *azurro todesco* (Italian), *Bergblaw* (mountain blue, German) – and the changes in name over time. Some names – *azzurri di bosoli*, *turchinetto* – are hard to interpret and may refer to artificial copper-containing blues; blue verditer, for example, is a synthetic form of the same basic copper carbonate. It should be borne in mind that, locally, other less well-known copper-containing blue minerals could have been sold, presumably under some name such as *Lasur*; the copper sulphate mineral posnjakite ($Cu_4(SO_4)(OH)_6{\cdot}H_2O$) is a possible example. See also Ash, ashes, blue; *Biadetto*; Verditer, blue

Beenswert: see Bone black

Berde de Inglaterra: see Ashes, green; Verditer, green

Bergasch: see Ash, ashes, blue

Bergblaw: see Azurite

Bergzinnober: see Cinnabar

Bezetto: see Clothlet

Biacca, biacha, bianco da Venecia: see Lead white

Biadetto **(*Azzurro basso/ biadetto, azzurro de magna/ biadetto, beadeta, biadetto fine di Spagna, biadetto oltremarino*)**: Light sky blue, so in Italian sources often assumed to refer to a pale or low-grade azurite, as in *biadetto fine di Spagna*; however, it may also refer to a lower grade of ultramarine with considerable white or colourless impurity, so ultramarine ash: *biadetto oltremarino*. See also Ash, ashes, blue.

Bianco di san Giovanni: Slaked lime, calcium hydroxide ($Ca(OH)_2$), about two-thirds converted to calcium carbonate ($CaCO_3$), by absorption of carbon dioxide; particularly suitable for use as a white pigment in fresco.

Bianco santo: Perhaps the same as *bianco di San Giovanni*.

Bice, ***byse***: see Azurite

Bismuth (***Wießmuth, Marcasitae officinarum***): A brittle white metal; one of its uses was in type metal.

Bismuth white (***Silberweis***): Bismuth nitrate oxide ($Bi(O)NO_3$), prepared by adding water to a solution of bismuth in nitric acid; or sometimes bismuth oxychloride (bismuth(III) chloride oxide) (BiClO). After the early seventeenth century the name 'silver white' transferred to a grade of lead white.

Bistre, bister: Blackish-brown pigment prepared by burning wood to give soot with a high proportion of tarry material.

Bitumen: see Asphaltum

Black balsam (***Gummi Balsami Indici nigri***): Peru balsam, from the South American tree *Myroxylon balsamum* Harms. (*Toluifera balsamum* L.), similar to Tolu balsam.

Bladders: Pieces of pigs' or cows' bladders used as containers for small quantities of pigment ground with oil ready for use as paint; also for small quantities of oil. They were also used to cover containers of prepared paint or oil.

Blanc de Puille: Medieval sources refer both to a white calcareous earth and a grade of lead white by this name. Its identity may well have changed over time.

Blanc plonc: see Lead white

Blauwsel: see Zaffre

Blauwswert: see Charcoal

Bley gelb: see Lead-tin yellows

Bleyweiss, blywif: see Lead white

Bluttstein: see Haematite

Bole, Armenian (***Armenien Bolus, bol' armenio, boularmini***): A soft, greasy red clay containing aluminium silicates and deriving its colour from the red iron oxide it also contains. Mixed with animal skin glue, it is ideal as a substrate for gilding as it is not too hard, can be polished and its slippery surface allows the leaf to move into position. Other clay-containing earths can, however be used as boles perfectly well: Armenian bole was indeed originally obtained from Armenia, but by the sixteenth century a similar red clay was obtained from Portugal, the isle of Elba or Germany. It was also used medically as an astringent and in ceramic glazes.

Bone black (***Avolio abrugiato, beenswert, corna di cervo abrugiato, osso di corno***): A dense, often slightly brownish-black, made from charred bone, ivory or animal horns, consisting largely of calcium phosphate – hydroxyapatite – perhaps with some residual organic matter from collagen in the bone. See also Ivory black.

Bone white: Ground bone: largely calcium phosphate in the form of hydroxyapatite ($Ca_{10}(PO_4)_6(OH)_2$).

Borax (***Borazo fin, borazo di Venetia, Sal. Borracis Venet., Borras***): Sodium borate ($Na_2B_4O_7{\cdot}10H_2O$), used as a flux when welding, or soldering gold or silver; also used in glassmaking, ceramics and in glazing enamels.

Börnstein: see Amber

Børstels: see Brushes

Bourre de fine esclarte vermeille: The shearings obtained from a fine red-dyed scarlet, ie a woollen cloth of sufficiently high quality to be dyed with expensive kermes dye, as part of the cloth finishing process; *bourre* is equivalent to the Italian *cimatura*, the Dutch *vlokken* and the later Dutch *vollegrein*. Shearings were used as a source of red dye for pigment preparation, certainly from the fourteenth century, and for dyeing small or cheap items; also to make coloured flock for flock printing. See also Lakes, red

between the green and the chemically closely related blue ashes (q.v.). Asphaltum (Appalto, Asphalti s. Bituminis Judaic., expalto, Juden=Pech, spaltain, spalte, spalto): Naturally occurring black or dark brown material derived from crude petroleum after evaporation of volatile constituents, found in outcrops in areas often associated with volcanic activity or hot springs. Asphaltum and bitumen are chemically similar; bitumen is almost entirely organic, while asphaltum contains a percentage of mineral matter. Used in oil painting as a translucent, dark brown pigment. Auricalcum: Brass, a gold-coloured copper-zinc alloy, or similar;

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Sal. Borracis Venet., Borras): Sodium soldering borate gold or (Na

silver; 2 B

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used O), used in glassmaking, as a flux when ceramics welding, and or

in glazing enamels. Börnstein: see Amber Borstels: see Brushes Ash, ashes, blue; (SO

Biadetto; 4

)(OH)

Verditer, 6

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O) is blue

a possible example. See also

Bourre de fine esclarte vermeille: The shearings obtained from a fine red-dyed scarlet, ie a woollen cloth of sufficiently high quality to Beenswert: see Bone black

be dyed with expensive kermes dye, as part of the cloth finishing Berde de Inglaterra: see Ashes, green; Verditer, green

process; bourre is equivalent to the Italian cimatura, the Dutch Bergasch: see Ash, ashes, blue

vlokken and the later Dutch vollegrein. Shearings were used as Bergblaw: see Azurite

a source of red dye for pigment preparation, certainly from the Bergzinnober: see Cinnabar

fourteenth century, and for dyeing small or cheap items; also to Bezetto: see Clothlet

make coloured flock for flock printing. See also Lakes, red

Bozzetto: Small wax or clay model of a proposed sculpture.

Brass (*Latoenen*, latten): Alloy of copper and zinc.

Brazilwood (*Brasill*, *Bresilgenholtz*, *bresin*, *brunsilien holtz*, *Lignum Brasiliensis*, *presilge*, *verzino*, *mondiglia di verzino*, *verzino almeri*, *verzino colombino*, *verzino mondo*, etc.): A dyewood yielding a bright red dye, used for dyeing, pigment-making and inks, brilliant in colour, but of poor permanence. The names for the wood – *brexilium* (Latin), brasil (English), *presilge* (German), *verzino* (Italian) – related the similarity of the dye colour to that of burning embers in a fire. Until about 1500, the wood available in Europe was from *Caesalpinia sappan* L., sappanwood, from central and southerm India, Malysia, Sri Lanka (Ceylon) and other parts of the Far East. Shortly after 1500, the Portuguese and Spanish began to import the wood of South American species including *Caesalpinia echinata* Lam., brazilwood or Pernambuco wood. The dye is easily soluble and by the addition of vinegar or alkalis gives a range of colours from orange to an impermanent violet, useful for inks. With alum and alkalis, red, brown or purple lake pigments could be made; with alum and a calcium salt, such as chalk, a vivid rose-pink pigment. See also Lake; Roset

Braunrot*, *brown red*, *bruno d'Inghilterra*, *bruyn rood: see Earths, brown

Brushes (*Borstels*, *peneli*, *pinseelen*, *plechin pensel*): Brushes were of two types: coarser bristle brushes – the Flemish *borstels*, and fine hair brushes – *pensills* (etc) (English), *pinceelen* (Flemish). Both could be of various sizes: *middelbaere* (Flemish – medium) or *penneborstels* (small) bristle brushes; *peneli grosi* (Venetian Italian – large brushes), *peneli da mazo* (very large brushes for walls). Bristle brushes were made of hogs' hair – *sede da peneli brute* (Italian: hogs' hair for large brushes) – and the brushes could be ready-made, as in *peneli di sede mezani* (medium, ready-made, hogs' hair brushes). Hairs for fine work (sable, squirrel and others) were tied and inserted into quills, such as those of goose – *pena de occha* (Italian) – or quail (*ortigini*) but those of other birds were used depending on the size required. The use of metal ferrules, as in the late sixteenth-century German *plechin pensel*, appears later. Brushes could also be made for particular purposes, such as *peneli da marche* (for painting on trading goods), *peneli in lama* (in blades, for decorative work).

Buckthorn (*Spinzerbino*): Berries from the common buckthorn (*Rhamnus cathartica* L., *spincervino* in Italian), found over most of Europe, were used in medicine as a purgative, also as the source of dye. Berries from the evergreen buckthorn (*R. alaternus* L.) from southern Europe, and the Mediterranean species *R. saxatilis Jacq.* (dyer's or rock buckthorn), *R. infectoria* L. and *R. tinctoria* Waldst. & Kit. (both very closely related to *R. saxatilis*) were also used, different species being utilised according to local availability. In commerce, Avignon berries could refer to any of these. Persian berries, imported from Aleppo or Smyrna, were the dried unripe berries of *R. saxatilis* and other species. Unripe berries, fresh or dried, gave a golden yellow dye, used in the preparation of yellow lakes; the juice of the ripe berries gave sap green. See also Lake, yellow; Sap green

Caerulei native fini: see Azurite

Caia di piombo: see Litharge

Canvas (*Toille de lin*): Support for painting; usually linen (q.v.), bleached or unbleached, of various qualities; usually plain weave, but sometimes twill or other more complex weaves. The canvas is stretched in a frame or over a supporting frame or panel during painting. Occasionally hemp, silk or other fabrics were used as painting supports.

***Caput mortuum* (*Todtenkopff*, *Vitrioli caput mortuum*)**: Dark reddish-brown, synthetic iron(III) – ferric – oxide (Fe_2O_3), similar to haematite, obtained as a by-product during the manufacture of sulphuric acid (for example, by the distillation of green vitriol ($FeSO_4{\cdot}7H_2O$).

Carta: In medieval sources, *carta* (or *membrana*) indicated parchment, unless the word *carta* was qualified by another word, as in *carta stampada*, printed waste paper, *cartapesta*, *papier mâché*. Otherwise paper was indicated by the word *folio*.

Cellulose: The substance of linen fibres, a polysaccharide forming a rotating straight chain made up from β-D-glucose units. The fibres are 6–60 mm long and 0.012–0.026 mm wide.

Ceneraccio*, *cenere*, *cenizas: see Ash, ashes, blue

***Cera rosa* and similar**: see Sealing wax

Ceruse (*Cerussa*, *cyreus*, *serruys*): Usually a variety of lead white (q.v.). Some authorities, particularly in the late sixteenth and early seventeenth century, describe it as a mixture of lead white and chalk; others use it as a synonym, or to indicate a high grade of lead white.

***Cerussa citrina Anglica* ('English yellow ceruse')**: see Lead-tin yellows

Chalk (*Cretae*, *croye*, *praeparirte Kreiden*, whiting): Naturally occurring calcium carbonate ($CaCO_3$), a soft, porous, sedimentary rock found in thick beds in England and western Europe, formed from the fossilised remains of unicellular marine algae; these are in the form of minute discs or platelets of calcite, coccoliths, which may be bound together, forming a shell for the organism. Details of their structure are useful for dating sedimentary deposits. A great many white pigments with names such as *blanc de Troyes* were chalk deposits. Chalk was widely used for the preparatory layer or ground (q.v.) in northern European panel paintings, as an ingredient in the preparation of several pigments (lakes, blue and green verditers, some woad indigo-containing pigments) and as an extender.

Chalk, black (*Lapis negro/nero*): A soft natural earth, rich in clay minerals, gaining its black colour from an inclusion of carbon, or sometimes manganese dioxide. Sources include France and northern Italy. Also sometimes used to refer to graphite (carbon – the 'lead' in pencils).

Charcoal (*Blauwswert*): Wood burnt in the absence of oxygen to give a light, soft, brittle, black material used for drawing and, powdered, as a blue-black pigment. Charcoal for drawing was commonly prepared from twigs of willow or vine.

Cinabrese chiara: see Ochre, red

Cinnabar (*Bergzinnober*, *cinabro sodo*, *Cinnabaris fossilis*, *Cinnabaris metallica nativa*, *Cinnabaris nativ.*, *Minium nativum*): Red mercury(II) – mercuric – sulphide (α-HgS), used as a pigment and also as a source of mercury. The best-known source was Almaden, Spain; other sources include western Germany, Austria and Slovakia. Demand for the ore increased from the mid-sixteenth century due to the use of mercury in the extraction of silver from ore. The pigment was prepared artificially from the eighth century and it is not always clear from the names in documents whether the natural or artificial form is intended: *cinabro* could refer to either; *cinabro sodo* (= hard) could well be the mineral. In addition, following Roman precedent, the word minium (used for red lead, q.v.) is occasionally referred to as cinnabar/vermilion (and in very early times the word cinnabar sometimes designated dragonsblood resin, q.v.). See also Vermilion

Cinoppe*, *cynople: see Lake, red

Cire: see Wax

Clothlet (*Bezetto* (*pezzetto*)): A convenient way to store or carry colours based on dyes, usually plant dyes, for use in watercolour or manuscript illumination, a clothlet was a piece of clean cloth, soaked several times in the juice of flowers, such as cornflowers, with or without the addition of, for example, ammonium chloride to 'blue' the colour, alum and gum, and dried in between each soaking. For use, the clothlet was simply soaked in a little water, releasing the colouring matter.

Coal (*Secoll blak*): Sea coal could refer to coal washed up or exposed on or near the seashore, so easily collected, but also might refer to coal in general. See also Earths, black.

Cochineal (*Coccinellae*, *cochenille*, *Coschenill*): A source of crimson dye, used in dyeing and the preparation of lake pigments, the scale insect cochineal (*Dactylopius coccus* Costa, 1829) was imported from Mexico by the Spanish soon after the 1520s. Its use in dyeing spread across Europe from about 1540, eventually replacing the use of kermes (q.v.) and the Old World cochineal insects of the genus *Porphyrophora*, often referred to in documents as *chermisi*, *cremese*, *cremexin* (crimson): Polish cochineal (*Porphyrophora*

GLOSSARy

Bozzetto: Small wax or clay model of a proposed sculpture. Brass (Latoenen, latten): Alloy of copper and zinc. Brazilwood (Brasill, Bresilgenholtz, bresin, brunsilien holtz, Lignum Brasiliensis, presilge, verzino, mondiglia di verzino, verzino almeri, verzino colombino, verzino mondo, etc.): A dyewood yielding a bright red dye, used for dyeing, pigment-making and inks, brilliant in colour, but of poor permanence. The names for the wood – brexilium (Latin), brasil (English), presilge (German), verzino (Italian) – related the similarity of the dye colour to that of burning embers in a fire. Until about 1500, the wood available in Europe was from Caesalpinia sappan L., sappanwood, from central and southerm India, Malysia, Sri Lanka (Ceylon) and other parts of the Far East. Shortly after 1500, the Portuguese and Spanish began to import the wood of South American species including Caesalpinia echinata Lam., brazilwood or Pernambuco wood. The dye is easily soluble and by the addition of vinegar or alkalis gives a range of colours from orange to an impermanent violet, useful for inks. With alum and alkalis, red, brown or purple lake pigments could be made; with alum and a calcium salt, such as chalk, a vivid rose-pink pigment. See also Lake; Roset Braunrot, brown red, bruno d'Inghilterra, bruyn rood: see Earths,

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yellows Chalk (Cretae, croye, praeparirte Kreiden, whiting): Naturally occur-

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chermisi, Cellulose: The substance of linen fibres, a polysaccharide forming a

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polonica Linnaeus, 1758), Armenian cochineal (*Porphyrophora hameli* Brandt, 1833) and other lesser known species. Like the *Porphyrophora* insects, Mexican cochineal contains carminic acid, the principal constituent of the dye, but in far greater quantity; it was considerably more efficient and economical to use, hence its rapid success. Its use in pigment-making was, as with kermes, indirectly related to its use in dyeing; only very late in the seventeenth century is there reference to direct use of the insect as a source of dye to make a pigment. It is occasionally referred to as *grana*, the term used for kermes. See also Kermes; Lake, red

Code de pene de cesano: see Quills

Cologne earth (***Ceulse aerde***): A dark brown, translucent pigment, largely organic, derived from lignite or peat, with traces of manganese and iron oxides.

Colophonia, colophony: see Pine resin

Copper, burnt copper (***Aeris ust, Gebrand Kupfer***): Copper panels were used as a support for painting. Burnt copper was probably a mixture of copper oxides.

Copper scale (***Aeris squamae, Aeris squama tenuis, Kupferschlag, Kupfferbraun***): A brown mixture of copper oxides, red copper(I) – cuprous – oxide (Cu_2O), and black copper(II) – cupric – oxide (CuO), formed as a scale during the beating of copper and/or the residue of oxide or slag left after melting copper. See also Kettle brown

Copperas (***Coperose, coporoza, coppe rose, copperos***): Green vitriol, iron(II) – ferrous – sulphate ($FeSO_4$·7H2O), blue-green crystals, used in making iron-gall ink and as a mordant in dyeing.

Corna di cervo abrugiato: see Bone black; Ivory black

Cotton: Used in gilding for pressing down metal leaf, polishing and removal of excess gold.

Crocus martis: Red iron oxide made by oxidising iron or steel, often by treating the metal with acid, then drying and powdering the product. See also Iron oxide pigments, synthetic.

Cupellation: A method of separating non-oxidisable precious metals, such as gold and silver, from base metals such as lead. On a large scale, the mixture of metals was heated on an open hearth (made of porous material such as bone ash) to about 900 °C in a current of air. The lead oxidised to litharge, which was absorbed by the porous hearth materials, leaving the pure precious metal. On a smaller scale, the process was carried out in a shallow dish made of bone ash or similar material, called a cupel. The method was also used for assaying gold and silver.

Cyperus: Sedge-like plants, including papyrus; some were used medicinally and in toiletries: *Cyperus longus* L. – so-called sweet cyperus; *Cyperus rotundus* L., the source of cyperus nuts. The irregularity of sixteenth-century English spelling can result in confusion between this, cypress and cypre (henna, *Lawsonia inermis* L.), also used in toiletries.

Cypress: Cypress wood (from *Cupressus* sp.) was occasionally used as a support for painting. Trees of the Cupressaceae family, including juniper, cypress and the sandarac tree (*Tetraclinis articulata* Mast., citron-wood tree), yield a rather insoluble resin used in varnish-making: see Sandarac

Dendrochronology: A method of dating wood based on the fact that growing trees lay down a new layer of wood annually under the bark. As growth is affected by factors such as climate, rings vary in width according to local conditions that year, and trees growing in a region at the same time exhibit similar characteristics. By collecting a long, continuous sequence of ring measurements and patterns from living trees, buildings, archaeological sites and other sources it is possible to build up chronologies of data for countries or regions, to which the tree ring pattern of a plank under study can be compared. An estimate of the felling date of the tree can thus be obtained. An accurate date can only be given if the layer of wood immediately under the bark is present; frequently this and other outer layers of sapwood have been removed, giving a greater margin of uncertainty to the estimated date. Allowance must also be made for the seasoning of the wood (although in buildings it was sometimes used green). The method is most commonly applied to oak, but has been applied successfully to other species such as beech.

Desmaltes açules: see Smalt

Diluents: Broadly speaking, a liquid added in small quantity to a paint or varnish to increase its fluidity and allow it to be applied more easily, eg turpentine spirit (*aqua de rasa, Ol. Terebinthinae, Terpentinöl*). Many of these liquids are also used as solvents for resins in the preparation of varnishes. Other examples are oil of spike lavender (*olio di spigot*) and stone oil (*olio di sasso*).

Dogfish skin (***Peau de chien de mer***): Used as an abrasive, for sanding down or polishing the ground applied to a panel or sculpted wood before painting.

Draganti: see Gum tragacanth

Dragonsblood (***Auserlesen Drachenblut, Drachenblut vulg., Gummi Sangvinis draconis, Gummi Sangvinis draconis elect., sangue di draco/ drago, sanguineus draconis, sanguis draconis***): A red resin obtained from *Dracaena draco* L., from the Canary Islands, *Dracaena cinnabari* Balf. f., found on Socotra off the Yemeni coast, and related species. Resin is also produced by the south-east Asian *Daemonorops draco* Blume, found in Sumatra. So-called 'Mexican' dragonsblood, from *Croton draco* Schltdl., would not have been available in Europe before the sixteenth century. Different coloured components are present in the three varieties of resin, which have a very complex constitution. Very few instances of the use of dragonsblood in painted art works have been confirmed to date.

Dyer's broom: *Genista tinctoria* L., the source of a yellow dye, obtained from all parts of the plant except the roots. The dye was used in the preparation of rather acid lemon to brownish-yellow lake pigments, very similar to those made from weld (q.v.). The plant was found all over Europe. See also Lake, yellow

Earth, green (***Griener Ogar, terra verde, terre vert, verde terra***): Dull green, siliceous clay minerals of which the best known are glauconite ($(K,Na)(Fe^{3+},Al,Mg)_2(Si,Al)_4O_{10}(OH)_2$), sometimes known as greensand, which occurs widely as small, dark-green pellets, and celadonite ($K(Mg,Fe^{2+})(Fe^{3+},Al)[Si_4O_{10}](OH)_2$), which occurs in rocks of volcanic origin. The colour is derived from the content of iron as Fe(II) and Fe(III) present. Green earth is very widespread, but sources vary in the quality of colour, the deposits of celadonite in Monte Baldo, near Verona, being of notably good colour.

Earths (***Hockers*** **(ochres in general),** ***ocra*** **(unspecified),** ***ocre, ockere, ogar***): Naturally occurring iron oxide pigments, varying in colour from yellow to almost black; the name ochre is also often used, although strictly this should be reserved for those also containing quartz and kaolinite. The yellows contain oxide hydroxides of iron, commonly goethite (α-FeOOH), the reds commonly haematite (α-Fe_2O_3). Umbers contain manganese dioxide in addition to iron oxide. Frequently other minerals, such as quartz, calcite and clays including kaolinite, vermiculite and illite, are present so that the proportion of iron oxide may vary from as little as 20% in some yellow ochres to over 90% in some reds. Variations in particle size and composition, including the associated minerals, give rise to the different transparencies and tinting strengths of the pigments. See also Earths, brown, red and yellow; Ochre, red; Ochre, yellow; Umber

Earths, black (***Noire terre, terra negra, terra near***): A term referring to several materials in which the black component is often carbon, including black chalk (a carbonaceous shale) and coal. It may also have included certain mineral blacks, such as the manganese dioxide mineral pyrolusite (MnO_2).

Earths, brown (***Braunrot, brown red, bruno d'Inghilterra, bruyn rood or root, Spanish brown***): Reddish or brown iron oxide pigments; see Earths in general. England was a noted source for red and brown earths; in the seventeenth century one source of Spanish brown, apparently a burnt red earth, was the Forest of Dean, Gloucestershire. It is uncertain how brown red and English red were prepared; they may have been manufactured pigments, made by calcining iron(II) – ferrous – sulphate, or have had a natural yellow or red earth source from which they were prepared by calcination.

Earths, red (***Terra rossa***): Red iron oxide pigments, deriving their colour from haematite (α-Fe2O3) as a rule, but also containing a proportion of other minerals; see Earths. As well as occurring

polonica Linnaeus, 1758), Armenian cochineal (Porphyrophora hamelii Brandt, 1833) and other lesser known species. Like the Porphyrophora insects, Mexican cochineal contains carminic acid, the principal constituent of the dye, but in far greater quantity; it was considerably more efficient and economical to use, hence its rapid success. Its use in pigment-making was, as with kermes, indirectly related to its use in dyeing; only very late in the seventeenth century is there reference to direct use of the insect as a source of dye to make a pigment. It is occasionally referred to as grana, the term used for kermes. See also Kermes; Lake, red Code de pene de cesano: see Quills Cologne earth (Ceulse aerde): A dark brown, translucent pigment, largely organic, derived from lignite or peat, with traces of manga- nese and iron oxides. Colophonia, colophony: see Pine resin Copper, burnt copper (Aeris ust, Gebrand Kupfer): Copper panels were used as a support for painting. Burnt copper was probably a mixture of copper oxides. Copper scale (Aeris sqvamae, Aeris squama tenuis, Kupferschlag, Kupfferbraun): A brown mixture of copper oxides, red copper(I) – cuprous – oxide (Cu

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Corna di cervo abrugiato: see Bone black; Ivory black

pigments, very similar to those made from weld (q.v.). The plant Cotton: Used in gilding for pressing down metal leaf, polishing and

was found all over Europe. See also Lake, yellow removal of excess gold.

Earth, green (Griener Ogar, terra verde, terre vert, verde terra): Dull Crocus martis: Red iron oxide made by oxidising iron or steel, often

green, siliceous clay minerals of which the best known are glauco- by treating the metal with acid, then drying and powdering the product. See also Iron oxide pigments, synthetic.

nite ((K,Na)(Fe3+,Al,Mg)

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Cupellation: A method of separating non-oxidisable precious metals, such as gold and silver, from base metals such as lead. On a large scale, the mixture of metals was heated on an open hearth (made of porous material such as bone ash) to about 900 °C in a current of air. The lead oxidised to litharge, which was absorbed by the porous hearth materials, leaving the pure precious metal. On a smaller scale, the process was carried out in a shallow dish made of bone ash or similar material, called a cupel. The method was also used for assaying gold and silver. Cyperus: Sedge-like plants, including papyrus; some were used medicinally and in toiletries: Cyperus longus L. – so-called sweet cyperus; Cyperus rotundus L., the source of cyperus nuts. The irregularity of sixteenth-century English spelling can result in confusion between this, cypress and cypre (henna, Lawsonia inermis L.), also used in toiletries. Cypress: Cypress wood (from Cupressus sp.) was occasionally used as a support for painting. Trees of the Cupressaceae family, including juniper, cypress and the sandarac tree (Tetraclinis articulata Mast., citron-wood tree), yield a rather insoluble resin used in varnish- making: see Sandarac Dendrochronology: A method of dating wood based on the fact that growing trees lay down a new layer of wood annually under the bark. As growth is affected by factors such as climate, rings vary in width according to local conditions that year, and trees growing in a region at the same time exhibit similar characteristics. By collecting a long, continuous sequence of ring measurements and patterns from living trees, buildings, archaeological sites and other sources it is possible to build up chronologies of data for countries or regions, to which the tree ring pattern of a plank under study can be compared. An estimate of the felling date of the tree can thus be obtained. An accurate date can only be given if the layer of wood immediately under the bark is present; frequently this and other outer layers of sapwood have been removed, giving a greater margin of uncertainty to the estimated date. Allowance must also be made for the seasoning of the wood (although in buildings it was sometimes used green). The method is most commonly applied to oak, but has been applied successfully to other species such as beech.

greensand, which occurs (Si,Al) widely 4

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celadonite rocks of volcanic (K(Mg,Fe2+)(Fe3+,Al)[Si origin. The colour 4

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2 from), which occurs in the content of iron as Fe(II) and Fe(III) present. Green earth is very widespread, but sources vary in the quality of colour, the deposits of celadonite in Monte Baldo, near Verona, being of notably good colour. Earths (Hockers (ochres in general), ocra (unspecified), ocre, ockere, ogar): Naturally occurring iron oxide pigments, varying in colour from yellow to almost black; the name ochre is also often used, although strictly this should be reserved for those also containing quartz and kaolinite. The yellows contain oxide hydroxides of iron, commonly goethite (α-FeOOH), the reds commonly haem- atite to iron (α-Fe

oxide. 2

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3). Frequently Umbers contain manganese dioxide in addition other minerals, such as quartz, calcite and clays including kaolinite, vermiculite and illite, are present so that the proportion of iron oxide may vary from as little as 20% in some yellow ochres to over 90% in some reds. Variations in particle size and composition, including the associated minerals, give rise to the different transparencies and tinting strengths of the pigments. See also Earths, brown, red and yellow; Ochre, red; Ochre, yellow; Umber Earths, black (Noire terre, terra negra, terra near): A term refer- ring to several materials in which the black component is often carbon, including black chalk (a carbonaceous shale) and coal. It may also have included certain mineral blacks, such as the manga- nese dioxide mineral pyrolusite Earths, brown (Braunrot, brown red, (MnO

bruno 2).

d’Inghilterra, bruyn rood or root, Spanish brown): Reddish or brown iron oxide pigments; see Earths in general. England was a noted source for red and brown earths; in the seventeenth century one source of Spanish brown, apparently a burnt red earth, was the Forest of Dean, Gloucestershire. It is uncertain how brown red and English red were prepared; they may have been manufactured pigments, made by calcining iron(II) – ferrous – sulphate, or have had a natural yellow or red earth source from which they were prepared by calcination. Earths, red (Terra rossa): Red iron oxide pigments, deriving their colour from haematite (α-Fe2O3) as a rule, but also containing a proportion of other minerals; see Earths. As well as occurring

naturally, for example in southern France, Spain, Greece, Italy, Germany and England, they were also made by burning yellow earth pigments. See also Iron oxide pigments, synthetic; Ochre, red

Earths, yellow (*Spreus okker, terra gialla*): Yellow to brown iron oxide pigments, deriving their colour from goethite (α-FeOOH) or a similar mineral; clay minerals and quartz are also often present. Although these pigments occur very widely, certain regions, including France and central Italy, were the source of yellow ochres of particularly good colour so that yellow ochre is found as an item of international trade. See also Ochre, yellow

Ebony: A very dense, hard, black wood, obtained from *Diospyrus ebenum* Koen. and related species, and also other trees. It was sometimes used as a support for painting and for finely carved decorative wares and cabinets.

Energy-dispersive X-ray spectroscopy (EDX or EDS): A method of analysis carried out in the scanning electron microscope (SEM), whereby a beam of electrons applied to the sample generates X-rays of energies characteristic of the chemical elements present.

Emery (*Schmirgel, Smiridis lap.*): Hard rock consisiting of corundum (aluminium oxide (Al_2O_3)) with (usually) spinel ($MgAl_2O_4$) and/or the iron oxides magnetite (iron(II,III) oxide) (Fe_3O_4) and haematite (Fe_2O_3). Used as an abrasive.

Enamel (*Amayll, amellum, enamyll*): Enamelling is a method of decoration whereby opaque or transparent coloured glass is fused to the surface of a metal such as copper, bronze or silver by firing at a temperature high enough to melt the glass, around 800 °C. The powdered glass (as coloured glass or as the ingredients for glass with appropriate metal oxides) may be applied as a paste. The fact that enamel as a 'blue stone' (*Blew enamyll*) was imported into fifteenth-century England for the use of goldsmiths suggests that the ingredients were available ready-prepared in solid form to be ground for use, much like the blue glass used for smalt or the colours used on Italian maiolica.

Epithyme: The parasitic plant dodder, *Cuscuta epithymum* Murr., found on thyme, but also other plants. Used as a purgative for urinary and liver complaints.

Ersnek: see Arsenic

Eschblaw: see Ash, ashes, blue

Esmalte, esmalti: see Smalt

Etching: A method of producing a design in a metal surface by the action of acid, widely used for the production of prints. A metal plate, commonly copper, is coated with an acid-resistant ground (a mixture containing, for example, beeswax, pine resin, bitumen, oil or other fats) and the design is scratched through this ground revealing the metal. Immersing the plate in acid allows the metal to be attacked in the incised lines only; the longer the exposure to acid, the deeper the 'bite'. The ground is removed, the plate inked and its surface wiped, leaving the ink in the etched grooves; like engraving on metal plates, this is an intaglio printing method. The paper is then placed on the plate which is passed through a roller press, protected with materials such as blanket to give some cushioning against the pressure.

Expalto: see Asphaltum

Eysen farb, Eisen Farb: Iron colour: presumably an iron oxide and perhaps derived by the rusting of iron, either naturally or artificially induced: see Iron oxide pigments, synthetic

Färberröthe: see Madder

Flax: *Linum usitatissimum* L., an annual herbaceous plant, native to a region extending from the eastern Mediterranean to India, but also cultivated all over Europe from early times for its seeds which, when pressed, yield linseed oil, and its fibres, obtained from the bast or skin of the stem of the plant and spun to give linen thread.

Fleischleim: see Sarcocolla

Florey (various spellings: *Fleurer, floree, florry, flouret, froury*): Indigo pigment from the dark blue foam and scum on the surface of the woad (or indigo) dyeing vat; in French sources *florée*. *Flouret* is probably the same thing. See also Indigo

Flour (*Farin. Amyli, Krafftmehl*): A source of starch; many uses, including as a paste or adhesive. Flour could also be used as a substrate for dyestuff in the making of lake pigments.

Fluorite: Calcium fluoride (CaF_2), found in Bohemia (Czech Republic), the mountainous region of present-day Slovakia and northern Hungary, Germany, the United Kingdom and other regions. It occurs in various, not particularly intense colours, including green and purple. The purple variety has been identified in painted works of art.

Frankfurt black: A black pigment made from charred wine lees (q.v.).

Frankincense (*Gummi Olibani, Weyrauch*): Also known as olibanum; a pleasant-smelling gum-resin from *Boswellia carterii* Birdw. (*Boswellia sacra* Flueck.) and other *Boswellia* species, found in Arabia, notably the Yemen, and north-east Africa. It was used in incense and perfumery; also medicinally as an anti-inflamatory.

Galbanum: A musky-smelling gum-resin extracted from *Ferula galbaniflua* Boiss. & Buhse and *F. rubricaulis* Boiss. from Iran; see also Gum sagapen or serapini

Galena: Lead sulphide (PbS), the most important lead ore, occurring widely, for example in parts of Germany, Poland, Italy, France and the United Kingdom.

Galls (*Gala de puglia, gala d'istria, gala masenada, gala vernia, Gallarum Turcic., Türckisch Gallus*): Abnormal growths on plant tissues caused by parasitic attack; those most useful in the present context are often found on species of oak and are caused by the females of certain parasitic wasps puncturing the plant tissue to lay their eggs. These galls, also called gallnuts, are sources of tannin used in dyeing, mordanting, tanning leather and, with the addition of green vitriol (iron(II) sulphate), to make black ink. The richest in tannin are the irregularly shaped Aleppo, Turkish or Levant galls (*Gallarum Turcic., Türckisch Gallus* in the German *Taxae*) that form on the buds of the gall oak (*Quercus infectoria* Oliv.) as the result of attack by the wasp *Andricus infectorius* (Hartig 1843). Possibly the Venetian *gala masenada* refers to these galls. The small, pale yellow Istrian galls (*gala d'istria*) form on the home oak (*Quercus ilex* L.) and, like *gala de puglia*, acquired their name from the region from where they came; *gala vernia*, from Apulia, was picked in autumn. Various galls, including the round marble galls caused by *Andricus kollari* (Hartig 1843) and the oddly shaped acorn galls, are also found on other oak species. See also Valonian oak (*ualonia* in Venetian sources)

Gamboge (*Ghitta, Gummi Guttae, Jemou*): A bright yellow gum-resin tapped from incisions in the bark of *Garcinia hanburyi* Hook.f. and related species, found in Cambodia, Malaya and other parts of south-east Asia. About a quarter of the substance is water-soluble gum, permitting gamboge to be used directly for watercolour painting; the remainder is the yellow resinous material.

Garance: see Madder

General, generall: Mentioned in English sources, certainly from the fifteenth century, and described as dark yellow. Probably a darker yellow variety of lead-tin yellow. If it was the 'type I' form (Pb_2SnO_4), it was perhaps a warmer hue resulting from a lower temperature preparation, but it may have been one of the other forms. The name may or may not be connected with the Spanish *génuli* or *genoli*. See Lead-tin yellow

Gesso (*Zeso da oro, zeso da prisa, zeso da sartor*): The Italian for gypsum (q.v.). In Italian painting practice, gesso also refers to the preparatory layers of calcium suphate in (usually) glue applied to the support to provide a smooth surface for painting, the ground. In northern Europe, calcium carbonate (commonly in the form of chalk) was generally used for this purpose, or sometimes other white minerals if these were more easily available locally. The coarse-crystalled *gesso grosso* contains anhydrous calcium sulphate (anhydrite), perhaps with a proportion of hemihydrate ($CaSO_4{\cdot}0.5H_2O$), prepared by roasting the gypsum. Prolonged soaking of anhydrous calcium sulphate (or crude gypsum) in water gives the soft, silky *gesso sottile*, chemically gypsum ($CaSO_4{\cdot}2H_2O$), which provides a particularly smooth and slightly soft surface, ideal for complex gilding patterns. This may well be *zeso da oro*. When the hemihydrate, better known as plaster of Paris, is rehydrated, calcium sulphate dihydrate is re-formed rapidly and sets, expanding very slightly during the process, then contracting as it sets hard. It is thus ideal for making moulds and was widely used in sculpture, hence the name *gesso da presa* or *zeso da prisa*. *Zeso da sartor* (tailor's

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chalk) could have been a hard chalk, steatite (soapstone), magnesium silicate or talc ($Mg_3Si_4O_{10}(OH)_2$): see Talc, talcum

Ghelde masticoet: see Lead-tin yellows

***Gialdolino, giallolino, giallorino* and similar**: see Lead-tin yellows

Giallo santo: see Lake, yellow

Glast: see Woad

Glue (*Cola carau[v]ella, cola todescha, colla cartarum, colla cerbune, glux de noe*): Glues were prepared from animal skins, leather (white leather was used for *colla cerbune*), parchment clippings (*colla cartarum*), horn, bone and other matter by soaking, then boiling them in water, giving a solution containing gelatin derived from the collagen in the skin or leather. Horn and hoof, like hair and wool, contain keratin which has a certain proportion of cross-linking sulphur compounds; these produce a very strong glue. Sturgeon glue is prepared from the swim bladder of the fish.

Gold (*Auri [foliati] fini, or, oro*): Used as extremely thin leaf, beaten from gold of high purity, sometimes from coinage.

Goldglette: see Litharge

Grain, grana: see Kermes

Graphite (*Plumbi Metallici Sciptorii, Wasserbley* (*geschnitten*)): A form of carbon with a layered structure, soft and leaves a black mark on surfaces to which it is applied. Used for drawing (and from the late sixteenth century to make pencils) so perhaps sometimes supplied cut into convenient pieces. Sources include northern England, Austria, Germany, southern France, Italy and other parts of Europe.

Griener Ogar: see Earth, green

Gripola: see Wine lees

Ground: In easel painting the preparatory layers of paint, white (calcium carbonate, calcium sulphate and others) or coloured (earths, clays and other pigments), in animal skin glue or oil binders applied to the panel or canvas support to provide a suitably smooth surface for painting.

***Gomlak, gomma lacca, Gummmi laccae* and variants**: Gum lac: see Lac

Gualda: see Woad

Gum (*Goma grosa*): Water-soluble or water-miscible polysaccharide material exuded by certain trees and other plants, used as an adhesive and as a binding medium in watercolour painting or manuscript illumination. Examples include gum arabic or gum acacia (from *Acacia senegal* Willd. and related species) and cherry gum (from *Prunus cerasus* L.). The word 'gum' is also erroneously and confusingly attached to the names of resins and other materials that contain no water-miscible components and are not gums at all: mastic resin is a good example. Gum-resins, such as gamboge and gum ammoniac, do contain a proportion of water-miscible polysaccharide as well as terpenoid or other resinous components.

Gum ammoniac (*Gumme armoniacke*): A brownish, waxy gum-resin exuding as a milky sap from the stem of *Dorema ammoniacum* D.Don, but hardening rapidly into brownish 'tears', found in Persia (Iran). Used as a ground for gilding in manuscript illumination and also for decorative purposes on leather and other materials; also used medicinally for bronchial infections.

Gum anime (*Gummi anime*): In the seventeenth century this probably referred to a resin from *Hymenaea coubaril* L. and/or *Hymenaea oblongifolia* Huber from Mexico and Brazil, so a type of soft copal. Later the term was extended to refer to the harder African, Zanzibar, copals from *Hymenaea verrucosa* Gaertn.

Gum arabic (*Arabisch Gummi, goma alesandrina, goma rabicha, Gummi Arabici el.*): Gum obtained from *Acacia senegal* Willd. and other species of *Acacia*, also known as gum acacia and widely used for watercolour painting.

Gum benzoin (*Gummi Asae dulc. s. Benzoes, Wolrichend Asand*): A pleasant-smelling balsamic resin used in medicine and perfumery, it can be dissolved in alcohol to make a spirit varnish and recipes for this appear from the sixteenth century onwards. Siam benzoin is obtained from *Styrax tonkinensis* Craib ex Hartwich, found in Thailand, Laos, Cambodia and Vietnam, Sumatra benzoin from *Styrax benzoin* Dryand., from Indonesia.

Gum elemi (*Gummi Elemi, Wildt Ohlbaum Gummi*): Soft resin produced by several members of the family Burseraceae, including *Canarium* spp. (found across east and south-east Asia and Africa) and the Central and South American *Bursera*, *Amyris* and *Protium* spp. It is hard to say which would be more likely in the seventeenth century: possibly a *Canarium* species. The name is now usually restricted to the resin from *Canarium luzonicum* Miq., found in the Philippines.

***Gummi Cerasorum* (*Kirschbaum Gummi*)**: Cherry gum, from *Prunus cerasus* L. Swells, rather than dissolves, in water.

Gummi Hederae: see Ivy gum

Gummi Olibani: Olibanum: see Frankincense

Gum opoponax (*Gummi Opopanacis*): A gum-resin closely related to myrrh, from *Commiphora erythrea* Engl., growing in Arabia, Somaila and Ethiopia, and related species. See also Myrrh

Gum sagapen (*Gummi Sagapeni, Serapini*): A foetid-smelling gum-resin obtained from *Ferula szowitziana* DC.; other species give galbanum (q.v.).

Gum tragacanth (*Draganti, Gummi Tragacanthi vulg., Gemein Tragant*): Gum produced by *Astragalus adscendens* Boiss. & Hausskn., ex Boiss., *A. gummifer* Labill., *A. tragacantha* L., and *A. microcephalus* Willd. from Iran and other parts of the Middle East; exudes in twisted ribbons or flakes rather than tears and can be harvested from incisions in the upper part of the taproot of the plant. Only partially soluble in water.

Gummi Sangvinis draconis: see Dragonsblood

Gypsum (*Lume di chaiola, lume scagiola (scagliuolo, scajola, schacola), zeso*): Hydrated calcium sulphate ($CaSO_4{\cdot}2H_2O$), the Italian gesso, used in the preparation of grounds particularly in Italian paintings. Selenite is a particularly clear, pure variety in which very large plate-like crystals have been able to form. This is named *Marienglas* or *Frauenglas* – *lume di chaiola* or *scagiola* (*scagliuolo*) and similar. See also Gesso; Ground.

Haematite (*Bluttstein, lapis rosso*): Iron(III) oxide (α-Fe_2O_3), the source of red colour in red earths. Mineral haematite, which occurs in various forms and colours from dark red to black, is extremely hard, but was ground and used as a deep-red or purplish-red pigment, particularly useful in wall painting. See also Earths, red; Iron oxide pigments, synthetic; *Paonazzo*.

Hammerscale: Hammerscale usually refers to an iron oxide pigment made from iron scale, slag or rust formed on iron artefacts or as a result of iron forging; it is sometimes described as black, or a very dark red-brown. A similar material, made up of copper oxides, may be formed from working copper: see Copper scale; Kettle brown

Hogs' hair (*Sede da peneli, soyes de porc*): For bristle brushes; see Brushes

Horsedew: see Orsade

Hüttenrauch: see Arsenic

Impiastro: A poultice of some sort.

Indigo (*Endego, indacho grosso i fino, indacho mezano, indaco, indaco Alessandrino, indaco bacadeo, indaco bagodetto, indaco golfo, indaco Sacafe, inde, indebaudias, indich, indien blaw, ynde, ynde de gonf*): Indigotin, the deep-blue, insoluble dyestuff obtained from the indigo plant, *Indigofera tinctoria* L. and related species, found from Arabia to south-east Asia and much of Africa; from woad, *Isatis tinctoria* L. and related species, found across Europe; from dyer's knotweed, *Persicaria tinctoria* (Aiton) Spach, found in China, Japan and Vietnam; and from other plants. Indigo is so dark in colour that it was generally mixed with white in use; it was also mixed with yellow pigments, including orpiment, to make greens. Dyeing with indigo involves the formation of a reduced, soluble form in the dye vat so that the cloth or yarn can be dyed. When this is oxidised – for example, by beating the liquid in the vat to aerate it – the insoluble blue indigo is precipitated as a slurry and can be formed into a paste, shaped into cakes and dried. In this form, indigo was exported from India and the East Indies in medieval times through Baghdad and other cities, reflected in names such as *indaco bagodetto*, *indebaudias*, *indaco bacadeo*, *indaco Alessandrino*, *bacade*, *golfo* and so on. Indigo 'of the rif' came from Africa. This deliberate oxidation process was

chalk) could have been a hard chalk, steatite (soapstone), magne- sium silicate or talc (Mg

3

Gum elemi (Gummi Elemi, Wildt Ohlbaum Gummi): Soft resin Ghelde masticoet: see Lead-tin Si 4

yellows O

10

(OH)

2

): see Talc, talcum

produced by several members of the family Burseraceae, including Canarium spp. (found across east and south-east Asia Gialdolino, giallolino, giallorino and similar: see Lead-tin yellows

and Africa) and the Central and South American Bursera, Amyris Giallo santo: see Lake, yellow

and Protium spp. It is hard to say which would be more likely in Glast: see Woad

the seventeenth century: possibly a Canarium species. The name Glue (Cola carau[v]ella, cola todescha, colla cartarum, colla

is now usually restricted to the resin from Canarium luzonicum cerbune, glux de noe): Glues were prepared from animal skins,

Miq., found in the Philippines. leather (white leather was used for colla cerbune), parchment clip-

Gummi Cerasorum (Kirschbaum Gummi): Cherry gum, from Prunus pings (colla cartarum), horn, bone and other matter by soaking,

cerasus L. Swells, rather than dissolves, in water. then boiling them in water, giving a solution containing gelatin

Gummi Hederae: see Ivy gum derived from the collagen in the skin or leather. Horn and hoof,

Gummi Olibani: Olibanum: see Frankincense like hair and wool, contain keratin which has a certain propor-

Gum opoponax (Gummi Opopanacis): A gum-resin closely related tion of cross-linking sulphur compounds; these produce a very

to myrrh, from Commiphora erythrea Engl., growing in Arabia, strong glue. Sturgeon glue is prepared from the swim bladder of

Somaila and Ethiopia, and related species. See also Myrrh the fish.

Gum sagapen (Gummi Sagapeni, Serapini): A foetid-smelling gum- Gold (Auri [foliati] fini, or, oro): Used as extremely thin leaf, beaten

resin obtained from Ferula szowitziana DC.; other species give from gold of high purity, sometimes from coinage.

galbanum (q.v.). Goldglette: see Litharge

Gum tragacanth (Draganti, Gummi Tragacanthi vulg.,

Gemein Grain, grana: see Kermes

Tragant): Gum produced by Astragalus adscendens

Boiss. & Graphite (Plumbi Metallici Sciptorii, Wasserbley (geschnitten)):

Hausskn., ex Boiss., A. gummifer Labill., A. tragacantha L., and A form of carbon with a layered structure, soft and leaves a black

A. microcephalus Willd. from Iran and other parts of the Middle mark on surfaces to which it is applied. Used for drawing (and

East; exudes in twisted ribbons or flakes rather than tears and can from the late sixteenth century to make pencils) so perhaps

be harvested from incisions in the upper part of the taproot of the sometimes supplied cut into convenient pieces. Sources include

plant. Only partially soluble in water. northern England,

Austria, Germany, southern France, Italy and

Gummi Sangvinis draconis: see Dragonsblood other parts of

Europe.

Gypsum (Lume di chaiola, lume scagiola (scagliuolo,

scajola, Griener Ogar: see Earth, green Gripola: see Wine lees

schacola), zeso): Hydrated calcium sulphate (CaSO

4

Ground: In easel painting the preparatory layers of paint, white (calcium carbonate, calcium sulphate and others) or coloured (earths, clays and other pigments), in animal skin glue or oil binders applied to the panel or canvas support to provide a suit- ably smooth surface for painting. Gomlak, gomma lacca, Gummmi laccae and variants: Gum lac: see

Lac Gualda: see Woad Gum (Goma grosa): Water-soluble or water-miscible polysaccha- ride material exuded by certain trees and other plants, used as an adhesive and as a binding medium in watercolour painting or manuscript illumination. Examples include gum arabic or gum acacia (from Acacia senegal Willd. and related species) and cherry gum (from Prunus cerasus L.). The word ‘gum’ is also erro- neously and confusingly attached to the names of resins and other materials that contain no water-miscible components and are not gums at all: mastic resin is a good example. Gum-resins, such as gamboge and gum ammoniac, do contain a proportion of water- miscible polysaccharide as well as terpenoid or other resinous components. Gum ammoniac (Gumme armoniacke): A brownish, waxy gum-resin exuding as a milky sap from the stem of Dorema ammoniacum D.Don, but hardening rapidly into brownish ‘tears’, found in Persia (Iran). Used as a ground for gilding in manuscript illumination and also for decorative purposes on leather and other materials; also used medicinally for bronchial infections. Gum anime (Gummi anime): In the seventeenth century this prob- ably referred to a resin from Hymenaea coubaril L. and/or Hymenaea oblongifolia Huber from Mexico and Brazil, so a type of soft copal. Later the term was extended to refer to the harder African, Zanzibar, copals from Hymenaea verrucosa Gaertn. Gum arabic (Arabisch Gummi, goma alesandrina, goma rabicha, Gummi Arabici el.): Gum obtained from Acacia senegal Willd. and other species of Acacia, also known as gum acacia and widely used for watercolour painting. Gum benzoin (Gummi Asae dulc. s. Benzoes, Wolrichend Asand): A pleasant-smelling balsamic resin used in medicine and perfumery, it can be dissolved in alcohol to make a spirit varnish and recipes for this appear from the sixteenth century onwards. Siam benzoin is obtained from Styrax tonkinensis Craib ex Hartwich, found in Thailand, Laos, Cambodia and Vietnam, Sumatra benzoin from Styrax benzoin Dryand., from Indonesia.

Italian gesso, used in the preparation of grounds particularly ·2H

2

O), the in Italian paintings. Selenite is a particularly clear, pure variety in which very large plate-like crystals have been able to form. This is named Marienglas or Frauenglas – lume di chaiola or scagiola (scagliuolo) and similar. See also Gesso; Ground.

Haematite (Bluttstein, source of lapis red colour in red rosso): earths. Iron(III) Mineral oxide haematite, (α-Fe

2

O

3 which), the

occurs in various forms and colours from dark red to black, is extremely hard, but was ground and used as a deep-red or purplish-red pigment, particularly useful in wall painting. See also Earths, red; Iron oxide pigments, synthetic; Paonazzo. Hammerscale: Hammerscale usually refers to an iron oxide pigment made from iron scale, slag or rust formed on iron artefacts or as a result of iron forging; it is sometimes described as black, or a very dark red-brown. A similar material, made up of copper oxides, may be formed from working copper: see Copper scale; Kettle brown Hogs' hair (Sede da peneli, soyes de porc): For bristle brushes; see

Brushes Horsedew: see Orsade Hüttenrauch: see Arsenic Impiastro: A poultice of some sort. Indigo (Endego, indacho grosso i fino, indacho mezano, indaco, indaco Alessandrino, indaco bacadeo, indaco bagodetto, indaco golfo, indaco Sacafe, inde, indebaudias, indich, indien blaw, ynde, ynde de gonf): Indigotin, the deep-blue, insoluble dyestuff obtained from the indigo plant, Indigofera tinctoria L. and related species, found from Arabia to south-east Asia and much of Africa; from woad, Isatis tinctoria L. and related species, found across Europe; from dyer's knotweed, Persicaria tinctoria (Aiton) Spach, found in China, Japan and Vietnam; and from other plants. Indigo is so dark in colour that it was generally mixed with white in use; it was also mixed with yellow pigments, including orpi- ment, to make greens. Dyeing with indigo involves the formation of a reduced, soluble form in the dye vat so that the cloth or yarn can be dyed. When this is oxidised – for example, by beating the liquid in the vat to aerate it – the insoluble blue indigo is precipi- tated as a slurry and can be formed into a paste, shaped into cakes and dried. In this form, indigo was exported from India and the East Indies in medieval times through Baghdad and other cities, reflected in names such as indaco bagodetto, indebaudias, indaco bacadeo, indaco Alessandrino, bacade, golfo and so on. Indigo 'of the rif' came from Africa. This deliberate oxidation process was

not carried out with the woad vat in Europe at this time (dried, processed woad was stored and transported as balls); oxidation of indigo at the surface of the vat did take place, however, and the blue precipitate formed was collected and sold as the pigment florey (various spellings) (q.v.). Although it was clear that woad blue and indigo blue were similar, sufficiently so to create antagonism to indigo from European woad industries in the sixteenth century, it was the following century before it was accepted that the two were in fact the same dyestuff.

Ink (*Inchiostro*): Black writing ink was made from galls, which contain tannins, and green vitriol (iron(II) – ferrous – sulphate) ($FeSO_4 \cdot 7H_2O$), dissolved in water, wine or vinegar to make an iron tannate complex. The addition of a little gum improved the suspension of the pigment particles and the performance of the ink.

Intaglio printing: A printing method whereby the design is etched or engraved into a metal plate and the ink held in the grooves formed (once the plate is inked) is transferred to the damp paper under high pressure provided by a roller press. See also Etching

Iron oxide pigments, synthetic (*Minio ferro da Gostatinopoli, paonazzo di sale*): Red and orange iron oxide pigments could be made by burning yellow earths: the Italian *ocria abrugiata* being an example. Red , brown and purplish pigments were also made by the calcination of iron(II) sulphate (green vitriol) (FeSO4·7H2O) – the result is sometimes called colcothar – or from oxidised metallic iron. This might be naturally corroded to rust, anchors and the metal pans used in the preparation of salt being described as good sources, or deliberately treated: for example, treating iron filings with acid, then drying and powdering the product; or heating filings with sulphur. The association with salt may explain names such as *paonazzo di sale*. See also *Crocus martis*; Earth pigments, brown, red and yellow; Hammerscale; Vitriol

Isotope: A chemical element may be made up of atoms with the same number of protons in their nuclei, but a different number of neutrons; they therefore have a different atomic mass and different mass numbers: oxygen-16 (written ^{16}O) is the familiar isotope of oxygen, but oxygen-17 and oxygen-18 also exist. Different isotopes of an element can be used to label compounds during a chemical reaction, or the relative abundance of each isotope can be used for dating purposes (as in radiocarbon dating) or to characterise a metal ore or the source of a metal geograpically. This is assisted by the fact that unstable isotopes of an element are radioactive and decay over time; the presence or absence of an unstable isotope, or the product of its decay, can therefore be very informative. On the whole the isotopes of an element do not differ in their chemical properties.

Ivory (*Eboris ust. s. spodii, Gebrandt Elffenbein, Spodii*): Traditionally refers to the tusks of elephants, but the dentine of the teeth or tusks of any large mammal, or extinct mammals such as mammoths, can serve as ivory. It consists largely of hydroxyapatite ($Ca_{10}(PO_4)_6(OH)_2$), a form of calcium phosphate: hard, white, close-grained; suitable for fine carving and also used as a support for miniature painting. Charred or burnt ivory is ivory black, similar to bone black (q.v.).

Ivy gum (*Ephew Gummi, Gummi Hederae*): A red gum sometimes found exuding from the stems of species of *Hedera* (ivy).

Juden-Pech: see Asphaltum

Kermes (*Grain, grana, Grana chermes, grana da vermini, grana paradisa, granum, Scharlachbeeren* and others): The scale insect *Kermes vermilio* Planchon, 1864, the source of a crimson dye, used in dyeing across Europe and usually referred to in documents as *grana*, *granum*, or *grain* in English. The rich crimson colour is slightly less blue than that produced by *cremese* or *chermisi*, the Old World *Porphyrophora* species or, later, Mexican cochineal (q.v.). The dye was also used in the preparation of lake pigments and, although there are early references to the direct use of the insect itself for this purpose, from the fourteenth century shearings or clippings of dyed textile were generally used as the source of dye (hence names such as *lacca di cimatura di grana*). In economy and efficiency of use it could not compete with the New World cochineal insect, which gradually supplanted it and the other Old World insects in use. See also Cochineal; Lake, red

Kettle brown (*Kesselbraun, Khessel praun*): (1) A mixture of copper oxides, red copper(I) (cuprous) oxide (Cu_2O), and black copper(II) (cupric) oxide (CuO), formed as a scale during the beating of copper and/or the residue of oxide or slag left after melting copper. (2) Iron oxide (Fe_2O_3), formed under the flat pans of brine which were heated to evaporate water, leaving salt. It is not certain which of these two candidates is kettle brown. See also Copper scale

Kreide: see Chalk

Kupferschlag, Kuppferbraun: see Copper scale; Kettle brown

Labdanum (*Gummi Ladani vulg.*): A brown resinous material from Mediterranean species of rock rose (*Cistus ladanifer* L. and *Cistus creticus* L.) used in perfumery and medicine.

Lac (*Gomlak, gommalacca, Gummi Laccae Crudae, Gummi Laccae ablutae, lacca* (meaning stick lac), *lacca acerba, lacca matura*): A brown, resin-like material secreted as a protective coating by the lac insect (*Kerria lacca lacca* Kerr) and some other species, a scale insect found in India and across south-east Asia to southern China. The thick, resin-like matter completely encrusted the twigs of the host trees, with the insects embedded in it. This so-called stick lac was broken from the twigs and exported or sold under names such as *lacca*, or *lacca acerba*, *lacca matura* (different grades), or gum lac. Stick lac was used as the source of crimson lac dye, also produced by the insect, very important for the preparation of crimson lake pigments in Europe up to the fifteenth century and still in use two centuries later. *Lacca* the raw material thus gave its name to *lacca* the red pigment, which can lead to confusion in the interpretation of documents. From about the seventeenth century, the resin-like material also gradually found a use in varnish-making as shellac – here *Gummi Laccae ablutae*. See also Cochineal; Kermes; Lake, red

Lake, red (*Cynople, Florentinerlack, Kugellack, lacca, laca/ lacca/ laccha di grana, lacca di grana mezzana, lacha di pittori, laca de verzin, lacca di verzino, lacha di verzino in palle, lacca fine di chermisi, lacca impalle, lacca muffa, Lacc. pictor. vulg., gemein Kugellack, lack, lacre cremesin, Maler lacca, parifirot, senaper, synoper/sinoper, synoper/sinoper tappes/toppes*): A translucent crimson or scarlet pigment made by precipitating a red dye onto a suitable substrate, commonly amorphous hydrated alumina, but white calcareous earths, chalk, flour and other white materials could also be used. The slightly less translucent chalk-containing pigments, such as roset (q.v.), were usually made from cheaper dyes such as sappanwood (brazilwood). Apart from brazilwood (*verzino*), other dyes used were lac (extracted from stick lac), kermes, cochineal and that extracted from madder root. From the fourteenth to the late seventeenth century, kermes, cochineal and madder dyes were largely obtained indirectly from clippings or shearings of cloth: *bourre de fine esclarte* (q.v.) refers to shearings of fine woollen cloth so used *pour faire cynopple*. *Lacca* or lake thus refers to a crimson pigment with particular properties of translucency. Sometimes, to indicate the superior quality associated with the use of a very expensive dye, the dyestuff was named *lacca di grana mezzana* (kermes), *lacca fine di chermisi* (*Porphyrophora* species or Mexican cochineal). *Cynople*, *senaper*, *synoper* are names used principally in English or French-speaking regions, also referring to a dark red lake pigment (not the red earth known in classical Roman times as sinopia), rarely used after the sixteenth century. *Parifirot* (Paris red), was viewed as being not such a high quality (it was possibly a less purple red), but the dye it contained could be brazilwood, madder or even kermes. *Sinoper toppes* (topaz) may refer to the more orange-red madder lake. *Lacca di verzino in palle* and *Kugellack* refer to the fact that the pigment was made into small balls for sale. See also Brazilwood; Cochineal; Kermes; Lac; Madder

Lake, yellow (*Ancorca, arzica, azicha, giallo santo, pincke, pynck, pynke, scheijtgeel, Schietgelb, schijtgeel, Schitt Gelb, Schüttgelb, Spinzerbino*): Yellow translucent pigment made by precipitating a yellow dye extracted from a plant source onto a suitable substrate, commonly calcium-containing, but other white materials and also hydrated alumina could be used. The plant sources used included those important for dyeing: weld, *Reseda luteola* L. and dyer's broom, *Genista tinctoria* L., which grew all over Europe.

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3

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for sale. See also Brazilwood; Cochineal; Kermes; Lac; Madder Lake, yellow (Ancorca, arzica, azicha, giallo santo, pincke, pynck, pynke, scheijtgeel, Schietgelb, schijtgeel, Schitt Gelb, Schüttgelb, Spinzerbino): yellow translucent pigment made by precipitating a yellow dye extracted from a plant source onto a suitable substrate, commonly calcium-containing, but other white materials and also hydrated alumina could be used. The plant sources used included those important for dyeing: weld, Reseda luteola L. and dyer's broom, Genista tinctoria L., which grew all over Europe. wine or vinegar to make an iron little gum improved the suspen- sion of the pigment particles and the performance of the ink. Intaglio printing: A printing method whereby the design is etched or engraved into a metal plate and the ink held in the grooves formed (once the plate is inked) is transferred to the damp paper under high pressure provided by a roller press. See also Etching Iron oxide pigments, synthetic (Minio ferro da Gostatinopoli, paonazzo di sale): Red and orange iron oxide pigments could be made by burning yellow earths: the Italian ocria abrugiata being an example. Red , brown and purplish pigments were also made by the calcination of iron(II) sulphate (green vitriol) ($FeSO_4 \cdot 7H_2O$) – the result is sometimes called colcothar – or from oxidised metallic iron. This might be naturally corroded to rust, anchors and the metal pans used in the preparation of salt being described as good sources, or deliberately treated: for example, treating iron filings with acid, then drying and powdering the product; or heating filings with sulphur. The association with salt may explain names such as paonazzo di sale. See also Crocus martis; Earth pigments, brown, red and yellow; Hammerscale; Vitriol Isotope: A chemical element may be made up of atoms with the same number of protons in their nuclei, but a different number of neutrons; they therefore have a different atomic mass and different mass numbers: oxygen-16 (written 16O) is the familiar isotope of oxygen, but oxygen-17 and oxygen-18 also exist. Different isotopes of an element can be used to label compounds during a chemical reaction, or the relative abundance of each isotope can be used for dating purposes (as in radiocarbon dating) or to characterise a metal ore or the source of a metal geograpically. This is assisted by the fact that unstable isotopes of an element are radioactive and decay over time; the presence or absence of an unstable isotope, or the product of its decay, can therefore be very informative. On the whole the isotopes of an element do not differ in their chemical properties. Ivory (Eboris ust. s. spodii, Gebrandt Elffenbein, Spodii): Tradition- ally refers to the tusks of elephants, but the dentine of the teeth or tusks of any large mammal, or extinct mammals such as mammoths, can serve as ivory. It consists largely of hydroxyapa- tite close-grained; ($Ca_{10}(PO_4)_6$ suitable $(OH)_2$), for a form fine of calcium phosphate: hard, white, carving and also used as a support for miniature painting. Charred or burnt ivory is ivory black, similar to bone black (q.v.). Ivy gum (Ephew Gummi, Gummi Hederae): A red gum sometimes found exuding from the stems of species of Hedera (ivy). Juden-Pech: see Asphaltum Kermes (Grain, grana, Grana chermes, grana da vermini, grana paradisa, granum, Scharlachbeeren and others): The scale insect Kermes vermilio Planchon, 1864, the source of a crimson dye, used in dyeing across Europe and usually referred to in docu- ments as grana, granum, or grain in English. The rich crimson colour is slightly less blue than that produced by cremese or chermisi, the Old World Porphyrophora species or, later, Mexican cochineal (q.v.). The dye was also used in the preparation of lake pigments and, although there are early references to the direct use of the insect itself for this purpose, from the fourteenth century shearings or clippings of dyed textile were generally used as the source of dye (hence names such as lacca di cimatura di grana). In economy and efficiency of use it could not compete with the New World cochineal insect, which gradually supplanted it and the other Old World insects in use. See also Cochineal; Lake, red