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Trial Index to Some Unpublished Sources for the History of Mediaeval Craftsmanship

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public affairs generously and nobly. The capacity to produce men of this type is, as Fortescue saw, the supreme test of an educational system. Such a system can never be built once and for all; each age must build the institutions to produce its own men. Europe has more than once, in the crisis of a new age, created systems of schools that have made men braver, better, and less helpless; the West faces the problem of building such a system for the twentieth century.

THE UNIVERSITY OF TEXAS.

TRIAL INDEX TO SOME UNPUBLISHED SOURCES FOR THE HISTORY OF MEDIAEVAL CRAFTSMANSHIP

BY DANIEL V. THOMPSON, JR.

THE literature of mediaeval science falls broadly into two great divisions: the theoretical and the practical. A great deal of mediaeval writing upon scientific subjects is probably almost entirely without any experimental basis. A great deal, however, represents genuine acquaintance with the physical phenomena discussed. Of the practical experimental treatises, those dealing with the materials used by craftsmen are not the least numerous or the least significant in the development of scientific thought and procedure. They are, however, so far little known, and the present *Index* undertakes to extend acquaintance with the literature of art-technology up to 1500 by a summary analysis of a number of unpublished texts.

This analysis is far from final. Its intention is to deal primarily with texts on painting. Other arts are included, but only incidentally, as they occur in connection with the manufacture and use of colors. It comprises, furthermore, only a small part of the unstudied literature of mediaeval craftsmanship.[1] It leaves out of account (1) published manuscripts, (2) unpublished copies of published texts, (3) text-families of which unit-publications are immediately in prospect.[2] Texts, on the other hand, which reproduce portions of published works, in other contexts, are included here. The criterion (loosely observed) has been: Is the text in hand so far identical with a published work that it would be dealt with in a normal full critical apparatus? If so, it is generally omitted here, or extracted only partially, as it differs from the familiar version.

Exceptions have been made also in favor of including very short texts whose

[1] Only, in fact, what could be worked over in eight months of the author's term as Research Fellow of the American Council of Learned Societies.

[2] The *Mappae clavicula*, which is being edited actively by three independent scholars, Dr Hermann Degering (Münster), Dr R. P. Johnson (Brown University), and Dr Hjalmar Hedfors (Djürsholm), whose edition of the Sélestat recension is shortly to appear as a sequel to his publication of the *Compositiones* (Upsala, 1932); the independent text, sometimes associated with the *Mappae clavicula*, as in Cheltenham, Fenwick Collection, *MS. Phillipps 3715*, to which I have assigned the name *De coloribus et mixtionibus* (see my article, 'Artificial Vermilion in the Middle Ages,' *cit. n. 6, infra*) and the family of the *Secretum philosophorum* which I am in process of editing, may represent these.

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publications are inaccessible or obscure (as when they are simply quoted in footnotes, for example). Considerable latitude has been taken in deciding what should be included and what omitted, and much fault may be found in the result. If, however, it serves as a first step toward a unit *index rerum* to all the literature of mediaeval craftsmen's methods, or calls attention to a neglected instrument of study, useful to the historians of art and science, publication of this preliminary *Trial Index* may be justified.

The texts dealt with here are found in manuscripts in England, France, Germany, and Italy. In England, only the libraries of London, Oxford, and Cambridge are represented, but thanks to the monumental *Catalogue of Alchemical Manuscripts* compiled by Mrs Singer for the British Academy and the U.A.I.,[1] the list (as far as painting goes) is probably within some measurable distance of completeness. The census of manuscripts in Florentine libraries was made as thoroughly as conditions allowed; but further search would doubtless be rewarded. The resources of Rome, Paris, and Munich are hardly tapped.[2] Far more remains to be done than is even indicated here before the extent of this literature, even with respect to painting, can be estimated.[3]

Considerations of space make it impossible to indicate here the nature of the

[1] Dorothea Waley Singer, *Catalogue of Latin and Vernacular Alchemical Manuscripts in Great Britain and Ireland dating from before the XVI Century* (Brussels, U. A. I., 1930). Part E, 'Chemical Crafts and Natural Magic,' II, 590–738, especially §XVII, 'Pigments,' and the miscellaneous 'Alchemical and Technical Recipes,' Part F, II, 741–745, contain the greater part of the English-owned manuscripts studied here. Some texts listed by Mrs Singer elsewhere in her catalogue have been included, and a few which are omitted altogether. Rarely, as in the case of §915, *Versum colores*, technological interest proves absent. Aristotelian tracts on the theory of color, such as §876, *Liber de coloribus*, in Cambridge, Fitzwilliam Museum, *McClean Bequest MS. 154*, fol. 248^{v} (and many other MSS, especially in Paris), are omitted from this index.

[2] The Vatican MS. catalogues are being replaced, with as much rapidity as the excellence of the work permits, by a card index which will eventually make searching there as easy as it now is difficult and uncertain. Mr James Corbett of the École des Chartes is actively preparing a check-list of the alchemical MSS at the Bibliothèque Nationale. The German MSS in this index were studied from photostats supplied through the good offices of Dr Georg Leidinger of the Bayerische Staatsbibliothek upon indications drawn chiefly from Lynn Thorndike, *Magic and Experimental Science* (2d ed., New York: Macmillan, 1929), and Ernst Berger, *Beiträge zur Entwicklungsgeschichte der Maltechnik* (2d ed., Munich, 1912).

[3] The importance of a general survey along the lines so well initiated by Mrs Singer's work in British libraries cannot be exaggerated. In the publications which we have (and they represent a meagre fraction of the whole) editors have not always chosen the most valuable texts to deal with, or the best manuscript sources to work from, simply because of the lack of perspective with which this uncharted field must be viewed.

Several copies of the *Schedula* of Theophilus have escaped the notice of editors, copies particularly of Book I. For the purpose of this Index, they are taken as equivalent to the published text, and consequently not extracted in detail. (For a review of some of the complete MSS of the *Schedula*, see my bibliographical study in SPECULUM, VII [1932], 199–220. A good deal may now be added to the information given there.) When single chapters from the *Schedula*, or other well-known works, occur in other contexts, the case is different: whatever its relation to what we regard as the parent text, a chapter isolated in this way has an independent existence of its own, operating *in parvo* on its own transmission lines (see also my review of W. Theobald, *Technik des Kunsthandwerks*, in SPECULUM, X (1935), pp. 437–440.

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individual recipes. Several of the texts listed below are being edited separately; photostats of others await attention; and the card index of chapters and *initia* from which this Index was prepared is at the service of anyone who wishes more detailed information about any of the subjects which it deals with.

For the sake of brevity, *sigla* have been employed for the manuscripts, as shown in the list below.[1] Single manuscripts sometimes contain two or more independent texts, but they are treated here as bibliographical units. Cross-references have been reduced to a minimum: and commonplaces of practice (as, for example, the use of white lead to make light mixtures) have generally been omitted.

References to manuscripts are given by folio numbers following the *sigla*. When the manuscript is paged, the page number is preceded by 'p.' References are grouped under each subject according to date, the dates being those assigned to the manuscript in which they occur.

DATES AND *SIGLA*

Cambridge

XII Century:
- C-1, St John's Coll. Lib., *MS. 79*

XIII Century:
- C-2, Corpus Christi Coll. Lib., *MS. 297*
- C-3, Trinity Coll. Lib., *MS. 1149*

XIV Century:
- C-4, Trinity Coll. Lib., *MS. 1109*
- C-5, Trinity Coll. *Lib. MS.1451*

XV Century:
- C-6, Gonville and Caius Coll. Lib., *MS. 413*
- C-7, Trinity Coll. Lib., *MS. 1081*
- C-8, Trinity Coll. Lib., *MS. 1351*
- C-9, Trinity Coll. Lib., *MS. 1363*
- C-10, University Lib., *MS. Dd.VI.29*
- C-11, University Lib., *MS. Ee.I.13*
- C-12, University Lib., *MS. Ii.III.17*

Erfurt

XIV Century:
- E-1, Stadtbücherei, *MS. Amplonius Quarto 189*[2]

Florence

XIII Century:
- F-1, Bibl. Laurenziana, *MS. XXX, 29*

XIV Century:
- F-2, Bibl. Nazionale, *MS. Palatina 951*
- F-3, Bibl. Riccardiana, *MS. 119*
- F-4, Bibl. Riccardiana, *MS. 933*

XV Century:
- F-5, Bibl. Laurenziana, *MS. Ashburnhamiana 190*
- F-6, Bibl. Laurenziana, *MS. Ashburnhamiana 349*
- F-7, Bibl. Laurenziana, *MS. Ashburnhamiana 891*

[1] The following abbreviations are used in the notes which accompany the index:

CH Cennino d'Andrea Cennini, *Il Libro dell'Arte*, ed. D. V. Thompson, Jr., II, *The Craftsman's Handbook* (New Haven: Yale University Press, 1933).

DAI D. V. Thompson, Jr and G. H. Hamilton, *An anonymous fourteenth-century treatise De Arte Illuminandi: The Technique of Manuscript Illumination, translated from the Latin of Naples MS. XII. E. 27* (New Haven: Yale University Press, 1933).

DCM *De coloribus et mixtionibus* (see n. 2, above).

AV D. V. Thompson, Jr, 'Artificial Vermilion in the Middle Ages,' *Technical Studies*, II (1933), 62–70.

MCM D. V. Thompson, Jr, 'Medieval Color-Making: *Tractatus qualiter quilibet artificialis color fieri possit* from Paris, B.N., *MS. latin 6749b*,' *Isis*, XXII (1935), 456–468.

NED *New English Dictionary*.

[2] See my article, '*De coloribus, naturalia exscripta et collecta* from Erfurt *MS. Amplonius Quarto 189* (xiii–xiv Cent.),' *Technical Studies*, III (1935), 133–145.

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F-8, Bibl. Laurenziana, *MS. Ashburnhamiana 1448*
F-9, Bibl. Nazionale, *MS. Magliabecchiana XV.8 bis*
F-10, Bibl. Nazionale, *MS. Magliabecchiana XV.76*
F-11, Bibl. Nazionale, *MS. Magliabecchiana XVI.74*
F-12, Bibl. Nazionale, *MS. Magliabecchiana XVI.80 bis*
F-13, Bibl. Nazionale, *MS. Palatina 792*
F-14, Bibl. Nazionale, *MS. Palatina 850*
F-15, Bibl. Nazionale, *MS. Palatina 851*
F-16, Bibl. Nazionale, *MS. Palatina 857*
F-17, Bibl. Nazionale, *MS. Palatina 916*
F-18, Bibl. Nazionale, *MS. Palatina 934*
F-19, Bibl. Riccardiana, *MS. 1177*
F-20, Bibl. Riccardiana, *MS. 1243*
F-21, Bibl. Riccardiana, *MS. 1246*
F-22, Bibl. Riccardiana, *MS. 1247*
F-23,[1] Bibl. Riccardiana, *MS. 2182*
F-25, Bibl. Riccardiana, *MS. 3056*
F-26, Bibl. Riccardiana, *MS. 2264*

HEIDELBERG (Universitätsbibl.)

XV Century:
H, *MS. Pal. germ. 558*
H-1, *MS. Pal. germ. 620*
H-2, *MS. Pal. germ. 676*
H-3, *MS. Pal. germ. 678*
H-4, *MS. Pal. germ. 211*

LONDON (British Museum)

XII Century:
L-1, *MS. Cotton Nero A.VII*
L-2, *MS. Cotton Titus D.XXIV*
L-3, *MS. Royal 7.D.II*
XIII Century:
L-4, *MS. Cotton Julius D.V*
L-5, *MS. Egerton 840 A*
L-6, *MS. Harley 3915*
L-7, *MS. Lansdowne 397*
L-8, *MS. Sloane 342*
XIV Century:
L-9, *MS. Additional 18752*
L-10, *MS. Additional 32622*
L-11, *MS. Egerton 2852*
L-12, *MS. Harley 273*
L-13, *MS. Harley 913*
L-14, *MS. Harley 2253*
L-15, *MS. Royal 17.A.III*
L-16, *MS. Royal 12.B.XXV*
L-17, *MS. Royal 12.C.XII*
L-18, *MS. Royal 12.E.XV*
L-19, *MS. Sloane 323*
L-20, *MS. Sloane 1754*
L-21, *MS. Sloane 1933*
L-22, *MS. Sloane 2135*
L-23, *MS. Sloane 2584*
XV Century:
L-24, *MS. Additional 15549*
L-24a, *MS. Additional 16566*
L-25, *MS. Additional 18566*
L-26, *MS. Additional 18216*
L-27, *MS. Additional 21431*
L-28, *MS. Arundel 507*
L-29, *MS. Cotton Julius D.VIII*
L-30, *MS. Harley 218*
L-31, *MS. Harley 2375*
L-32, *MS. Harley 2390*
L-33, *MS. Harley 3151*
L-34, *MS. Sloane 4*
L-35, *MS. Sloane 73*
L-36, *MS. Sloane 122*
L-37, *MS. Sloane 276*
L-38, *MS. Sloane 282*
L-39, *MS. Sloane 345*
L-40, *MS. Sloane 416*
L-41, *MS. Sloane 419*
L-42, *MS. Sloane 513*
L-43, *MS. Sloane 692*
L-44, *MS. Sloane 747*
L-45, *MS. Sloane 962*
L-46, *MS. Sloane 964*
L-47, *MS. Sloane 976*
L-48, *MS. Sloane 1091*
L-49, *MS. Sloane 1313*
L-50, *MS. Sloane 1698*
L-51, *MS. Sloane 2401*
L-52, *MS. Stowe 850*

MUNICH (Bayer. Staatsbibl.)

XV Century:
M-1, *MS. germ. 822*
M-2, *MS. lat. 2942*
M-3, *MS. lat. 27063*

OXFORD

X Century:
O-1, Bodleian Lib., *MS. Rawlinson D.893*
XIII Century:
O-2, Bodleian Lib., *MS. Bodley 679*
O-3, Bodleian Lib., *MS. Digby 11*

[1] The siglum F-24 is applied to seventeenth-century Bibl. Riccardiana *MS. 1164*.

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O-4, Bodleian Lib., *MS. Digby 86*
O-5, Bodleian Lib., *MS. Digby 162*
XIV Century:
O-6, Bodleian Lib., *MS. Ashmole 1397*
O-7, Bodleian Lib., *MS. Digby 37*
O-8, Bodleian Lib., *MS. Digby 71*
O-9, Bodleian Lib., *MS. Digby 119*
O-10, Bodleian Lib., *MS. Digby 147*
O-11, Bodelian Lib., *MS. Digby 153*
O-12, Bodleian Lib., *MS. Fairfax 22*
O-13, Bodleian Lib., *MS. Rawlinson C.7*
O-14, Corpus Christi Coll. Lib., *MS. E.1.2.*
O-15, Magdalen Coll. Lib., *MS. 173*
XV Century:
O-16, Bodleian Lib., *MS. Ashmole 750*
O-17, Bodleian Lib., *MS. Ashmole 1382 (II)*
O-18, Bodleian Lib., *MS. Ashmole 1391*
O-19, Bodleian Lib., *MS. Ashmole 1393*
O-20, Bodleian Lib., *MS. Ashmole 1448*
O-21, Bodleian Lib., *MS. Ashmole 1480*
O-22, Bodleian Lib., *MS. Ashmole 1491*
O-23, Bodleian Lib., *MS. Ashmole 1494*
O-24, Bodleian Lib., *MS. Bodley 487*
O-25, Bodleian Lib., *MS. Canon. Ital. 183*
O-26, Bodleian Lib., *MS. Canon. Misc. 128*
O-27, Bodleian Lib., *MS. Canon. Misc. 178*
O-28, Bodleian Lib., *MS. Canon. Misc. 524*
O-29, Bodleian Lib., *MS. Digby 23(I)*
O-30, Bodleian Lib., *MS. Digby 88*
O-31, Bodleian Lib., *MS. E Museo 52*
O-32, Bodleian Lib., *MS. Rawlinson C. 211*
O-33, Bodleian Lib., *MS. Rawlinson C. 212*
O-34, Bodleian Lib., *MS. Rawlinson C. 506*
O-35, Bodleian Lib., *MS. Rawlinson D. 1066*

PARIS (Bibl. Nat.)

XIII Century:
P-1, *MS. latin 6830-F*
P-2, *MS. latin 12212*
XIV Century:
P-3, *MS. latin 6514*
P-4, *MS. latin 7400-A*
P-5, *MS. latin 7156*
P-6, *MS. latin 8654-B*
XV Century:
P-7, *MS. latin 6749-B*
P-8, *MS. latin 7105*
P-9, *MS. latin 7149*
P-10, *MS. latin 7161*
P-11, *MS. latin 14005*

ROME

XIII Century:
R-1, Bibl. Apostol. Vat., *MS. Vat. lat. 598*
XIV Century:
R-2, Bibl. Apostol. Vat., *MS. Pal. lat. 1267*
R-3, Bibl. Casanatense, *MS. 1477*
XV Century:
R-4, Bibl. Apostol. Vat., *MS. Pal. lat. 1272*
R-5, Bibl. Apostol. Vat., *MS. Pal. lat. 1330*
R-6, Bibl. Apostol. Vat., *MS. Reg. lat. 1192*
R-7, Bibl. Apostol. Vat. *MS. Vat. lat. 244*
R-8, Bibl. Apostol. Vat., *MS. Vat. lat. 6852*
R-9, Bibl. Casanatense, *MS. 1793*
R-10, Bibl. Casanatense, *MS. 2265*
R-11, Bibl. Vittorio Emanuele, *MS. 377*

TOURS

XII Century:
T-1, Bibl., *MS. 388*
XIII Century:
T-2, Bibl., *MS. 605*

SUBJECT INDEX

[1] Corn cockle. *Coquelo*, L-40, 25r, is perhaps the same, perhaps *Festuca ovina.*

[2] For paternosters, etc. Many rules for artificial amber seem to have no application in craftsmanship.

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[1] *Schel oder rintten dÿ ynnern von opfel paum . . . ; epfel schelen:* an exceptional source of yellow color, noted so far only in two fifteenth-century German texts.

[2] See also art. *Reseda luteola,* below; and *CH,* p. 30, n. 1, and *DAI,* p. 35, n. 43.

[3] Various forms of carbon. See *DAI,* pp. 32, 33, n. 37. The applications of black pigments are too universal to be listed here.

[4] Here are grouped recipes which clearly deal with azurite. Recipes in which the mineral is called 'German blue' are listed separately below. Azurite is used to translate *terra azura* or *lazula; mena azuri; mena a.* containing a green color (cf. *CH,* p. 31, n. 1); *vena azurii* found *semper cum vena argenti* or which *non oportet nimis terri* (cf. *CH,* pp. 35, 36, and *ibid.,* nn. 1, 2); *vena azurii* inferior to ultramarine, found *apud Vulterras et Massam . . . etiam in Calabria apud Grossentiam et apud Neapolim; prieta azurina la quale si truova in massa di minera;* a color unable to withstand the action of fire (cf. *MCM,* p. 463, n. 31) and prepared like *verde azurro.* By inference from these indications we may safely read azurite for *azurum hispanicum sive grossum; lazurium montanum; vena de Montorio; azurium ungaricum* or *ragusinum;* and *a. nostranum.* For the equivalent *a. citramarinum* and *a. lombardicum,* and other terms, see *MCM,* pp. 461 and 462, n. 27, where they are identified with *a. de Alamania,* the *azurro della Magna* of Cennino, *CH, loc. cit. supra.*

[5] *Lapis almaine; azuro grosso d'alemagna* or *tedesco; laçurum de Alemania; azuro di Magnia; a. todisco; lapis lazuli de Alamagna* (cf. *MCM,* pp. 461, 462, n. 26). See also art. *Azurite,* and n. 6, above.

[6] That is, blues other than the natural copper carbonates, and occasionally *azurium* in the sense of Arabic *açifur* (cf. *AV,* p. 67, n. 25), described as if they were azurite.

[7] In the fourteenth-century recipes the term seems to be adjectival: 'azure bys' and 'a. byse.' In the fifteenth century, it appears as a substantive: 'asure and bise,' 'azour or elles bys,' 'Grynde þe byse.' It is normally a copper blue, generally artificial (as from verdigris in o–31, 67r) but sometimes equivalent to azurite (as in L-35, 201v: 'lapis almaine of whiche men maken a blewe biȝes azure'). In o–16, 67v, it appears to be a green, probably malachite (cf. the modern 'Green bice'). L-36, 70r, gives a rule "Ffor to make bise' out of 'blywe flokkys'; and in o–21, 12r, 'Byse' is confused with *azurium*-vermilion (cf. n. 8, above).

[8] These include various acetates, carbonates, chlorides, etc., of doubtful value but enormous popularity. Blues made from verdigris, generally with sal ammoniac, lime, and 'oil of tartar' (cf. art. *Preparations,* below), and blues composed of eggshells tinctured with copper salts are listed separately here, though they belong to the general category of artificial copper blues. Probably also the

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recipes for 'silver' blues depend for their effectiveness upon copper alloyed with the silver, and their products may be regarded as members of this group of pigments. It is often assumed of blue pigments in old manuscripts and paintings that those which are not ultramarine are azurite, and vice versa, but taken together recipes for artificial copper blues of one kind or another form an impressive total, and present a challenge to the analytical investigator of mediaeval colors.

[1] See note immediately preceding and *DAI*, p. 40, n. 58; also *MCM*, pp. 465, 466, §XIV, and *ibid.*, n. 37.

[2] See also *Clothlets, Eggshell, Indigo Iris,* and *Turnsole,* below. Included here are blue colors made from *violae,* from the indefinite *flores blavos,* 'blewe flours'; from the 'blewe flour þat groweþ in corn in somer,' *blavereule,* and *kornpluemen,* probably *Centaurea cyanus, q. v., art. infra;* from *haidelper* (probably a *Vaccinium;* cf. the 'plo Tornisal' of Valentin Boltz, *Illuminierbuch* [Basel, 1549], as reprinted by C. J. Benziger in Ernst Berger's *Sammlung maltechnischer Schriften* [Munich, 1913], p. 78), and from numerous other plant products, including *filices coloris azuri;* the *erbio che si done al vino* (possibly a *Salvia*); the *fiore d'ochio pulcino; diana; novella; fioraliso* (i.e. fleur-de-lis—cf. art. *Iris,* below); *quinquefolium,* etc.

[3] Unclassified, either because of uncertainty in interpretation or inadequate data.

[4] See also art. *Clothlets,* below. 0–22 deals at length with inks of various colors.

[5] These recipes deal chiefly with giving the esteemed violet cast to ultramarine (see *CH*, p. 37, n. 1), generally with brazil; but some other *Schönungsmittel* appear, notably soluble copper blues for staining inferior grades of natural azure.

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[1] See also art. *Ultramarine, Tests*, below, and cf. *MCM*, p. 463, §x, and *ibid.*, n. 32.

[2] See *DAI*, pp. 53–55, nn. 120, 122. Some of the recipes for 'washing' probably apply to the purification of natural azurite by decantation as well as to the salvaging of blues from tempered mixtures. Occasional rules for adulterating blues or detecting adulterations are included here (cf. *MCM*, p. 463, §§xi, xii.

[3] Temperas of parchment size and fishglue are sufficiently unusual to be noted apart from the commoner systems of tempering with egg and gums. See *DAI, loc. cit.* n. 6, *supra*.

[4] The solitary reference given here deals with the sources and characters of boles. 'Armenian' bole is a commonplace in gilding recipes. A standard element in medical practice (cf. *NED. s.v.* 'Bolus ' 1), it was readily available to craftsmen, who consequently gave it little thought (see *DAI*, p. 51, n. 97).

[5] Probably of medical, rather than technological, significance.

[6] See also art. *Ivory*, below. Bone and ivory were dyed most commonly red with brazil and green with verdigris. Among the uses to which the dyed bone was put are mentioned handles (*manubria*) and the knobs of croziers.

[7] See *DAI*, pp. 44, 45, nn. 77–79.

[8] See also the subdivisions immediately following. For other uses of brazil, see artt. *Blues, to improve color of; Bone; Horn; Ivory; Textiles; Wood.*

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[1] See *DAI*, pp. 7–10, §§12, 13, and p. 44, n. 76. In general, preparations of brazil for writing, flourishing and ruling are *incorporeae*, transparent. Only recipes which have these special functions immediately in view are listed here; though no doubt the products of other recipes were used also in the pen

[2] See *DAI*, pp. 8, 9, and p. 47, n. 88.

[3] To produce a violet color.

[4] *Brunum* (possibly bole used as a pigment) is commonly discussed by texts of the *DCM* family (see p. 410, n. 2, above) and rarely elsewhere.

[5] *Eglagel* of L-12, 212r, may be an equivalent.

[6] *Caulis* and *succus oleris*, used as temperas for greens.

[7] Cf. also recipes in R-9, 18v–19v, *per lavorare di rilievo.*

[8] See p. 416, n. 2, above.

[9] Including many coloring elements. See also art. *Turnsole*, below.

[10] See *DAI*, p. 35, n. 42.

[11] Spelled variously, but referring always to a pigment which owes its color fundamentally to gum lac, often with the addition of *grana*, brazil, and occasionally of madder. In L-15, 172v, a recipe for 'Cynopre' calls for all these, 'mader and greyne . . . and brasil and lak.' The spelling 'Cynople' is chosen here to distinguish this product from any of those defined as 'Sinople' by the *NED*, and to emphasize the identity of a red lac pigment current under this name in the fourteenth and fifteenth centuries.

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[1] See *DAI*, p. 47, n. 89.

[2] See art. *Arzica* and note, above, and art. *Reseda luteola*, below. This recipe is designed to produce a pigment known as 'arzica.'

[3] The milky sap of a *Euphorbia*, called *lac tritimalli, latte di totomagho*, etc. <L. tĭthўmălus <Gk. τιθύμαλος used generally with verdigris, apparently for its hydrofuge properties.

[4] Used in red and green inks, probably as a mordant, reflecting the dyers' practice.

[5] Here are listed in great variety rules for the imitation of precious stones, pearls, etc., with base materials; the sophistication of crystal and semi-precious stones; making large pearls or stones from small; and a large number of operations incidental to the manufacture of false gems, including their subsequent detection. The register of recipes of this sort here does not pretend to be complete.

[6] Dyer's broom, ME. *brom*, L. *Genista*.

[7] See *DAI*, pp. 28, 29, n. 24. It is noticeable that all these recipes are Italian (seventeenth-century Florence *MS. Riccardi 2264*, fol. 4r and 7v, contains rules for making *Zalolin*.) o–26, 18v, lists *zenolino* as one of the colors which, *per la loro dureza*, must be ground on porphyry.

[8] Chiefly chrysography or argyrography. Silver is not treated separately in this *Index*, as it almost invariably follows the order of procedure for gold.

In this section are grouped substitutes for gold and silver exclusive of mosaic gold (see art. *Gilding with mosaic gold*, below). The counterfeits depend chiefly on mercury, tin, chalk, orpiment, sulphur, bile, chelidony, and saffron. Other vegetable elements are the juice of the *cauda equina* (see art. *Hippuris*, below) and of poppy flowers. Recipes for an emulsion of egg-yolk and mercury, thickened or dried by slow heat, enjoyed considerable popularity, and many are represented here.

[9] See *DAI*, pp. 37, 38, n. 50, and *CH*, p. 101, n. 3. F-25, 71v, exhibits an exceptional rule for a *porporina d'argento*. These recipes for mosaic gold are common, but F-2 alone of the manuscripts in which they occur displays embellishments wrought with the color which they are designed to produce.

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[1] See also art. *Gilding by Attrition*, and n. 45, below. Most of these recipes apply to writing. Letters of copper, brass, bronze, tin, lead, and even iron, seem to have engaged the attention of their authors. See *MCM*, pp. 466, 467, §§xv, xvi, and *ibid.*, nn. 41, 43. The code numbers attached to these articles on gilding refer to the table in *DAI*, p. 50 (see *ibid.*, p. 49, n. 95).

[2] Cf. *MCM*, pp. 466, 467, §xix. The principle of this class of 'gilding' (used as often for base metals as for gold or silver) is to lay with the pen what amounts to a pattern of fine sandpaper—powdered glass, crystal, or some equivalent, bound with mixtures of gums, glair and size. Over this 'sandpaper' surface a bit of metal is rubbed, until, by attrition, the grain of the surface is filled with metal. It may then be burnished smooth.

All these recipes apply to writing, with the exception of F-22, 23v, 'Fare parere di che metalo voi una assa o tavola.' Gold, silver, and base metals are generally to be used at will.

[3] Chiefly for chrysography, with some recipes for argyrography. The metal is reduced to powder by grinding filings or leaf, by amalgamation, or otherwise, and mixed with a binding medium to form a sort of ink.

[4] See *DAI*, pp. 48, 49, n. 95, and *ibid.*, pp. 59, 60, n. 141. Chalk, white bole, gesso, plaster, and white lead, colored with bole (red or yellow), saffron, lampblack, aloes (caballine or hepatic), ocher, vermilion, red lead, black earth, hematite and sinoper, and bound with size, fish-glue, and glair in various stages of putrefaction, beer, gums (arabic, ammoniac, tragacanth), with additions of sugar, honey, sal ammoniac, and incense, are used in hundreds of combinations to hold the leaf and allow it to be burnished.

[5] See *DAI*, p. 60, n. 142. Garlic juice, onion juice, gum ammoniac, gum *sagapenum* (serapin), sugar,

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honey, beer, incense, colored or 'bodied up' with white lead, vermilion, litharge, verdigris, saffron, or ink, are used as adhesives for gold and silver leaf. The mixtures are usually designed to contain enough hygroscopic material to make them sticky when they are breathed on. Mordants of this sort seem to have been widely used for diapering or ornamenting on color, both in manuscripts and on panels. They produce as good an effect as oil mordants, are quicker and easier to handle, especially for delicate works; and oil mordants are, of course, not suitable in books. The hygroscopic nature of the water mordants makes them useless in damp places (see *CH*, p. 98).

[1] Cf. *CH*, pp. 62, 63. The relation of oil mordant gilding to vermeils (*q. v.*, *art. infra*) is discussed briefly there.

[2] That is, the further embellishment of burnished gold.

[3] The identity of the mediaeval L. *gladiolus* is a little uncertain, but it probably corresponds with the modern botanical genus of the same name. *Gaçuolo*, in R-8, 16v is perhaps *gladiolus*, perhaps *cardiolum* (cf. W. Meyer-Lübke, *Romanisches etymologisches Wörterbuch* [Heidelberg, 1911], §1683). *Flabre, i.e. gladen*, in C-2, 138v, is taken for *gladiolus* here.

[4] Drawing of a *Fornis vitrariorum*.

[5] The rules listed here are probably mostly of dubious value in practice. The favorite formulas are based on the blood of goats and geese, as in Heraclius, *De coloribus et artibus Romanorum*, I, 6, ed. M. P. Merrifield, *Original Treatises . . .* (London, 1849, I, 189–191), *Liber de coloribus*, §IX, ed. D. V. Thompson Jr, SPECULUM, I (1926), 298, etc. In connection with the type represented by the Heraclius verses, Dr A. C. Seward, Master of Downing College, Cambridge, has called to my attention an early thirteenth-century capital at Southwell (Nt) upon which a lean goat is represented feeding upon ivy (unmistakably *Hedera helix*). The connection between a Gothic capital and a somewhat fanciful recipe for carving gems is not clear; but Mr W. L. Cuttle, of Downing, points out a passage in Pliny, '*N.H.*, XXXVII, Chapter 4, in Philemon Holland's translation (1634),' from which both probably derive.

James Fowler, 'On the Process of Decay in Glass,' *Archaeologia*, XLVI (1880), 17, n. 2, suggests a rational explanation for a description (there quoted) of finding buried glass so soft that it could be kneaded or cut. Dr A. P. Laurie, Professor of Chemistry to the Royal Academy (London) suggests in conversation that blood may have been used, as it is occasionally nowadays, to prevent the glass from splintering while being cut. More practical methods for cutting, etc., are listed in the following section.

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[1] The recipes cited here are probably more representative of the methods actually used than those in the preceding section For the treatment of tools for cutting glass and gems, see art. *Metals, tempering*, below.

[2] See *DAI*, pp. 30, 31, n. 30.

[3] See *DAI*, pp. 31, 32, n. 31, and cf. also art. *Blues, tempered with fish-glue*, above.

[4] See *DAI*, pp. 46, 47, n. 87. Dr R. Zaunick, in a review in the *Mitteilungen zur Geschichte der Medizin, der Naturwissenschaften, und der Technik*, XXXIII (1934), 254, kindly points out that the zoological description of the 'polnische Kermes-Schildlaus . . . nicht "Porphyrophora Frischii," sondern Margarodes polonicus (L.) Ckll. ist, wozu man meine Angaben in der Neuausgabe von J. Frankes *Hortus Lusatiae* (Bautzen, 1930), S. 25 f. vergleiche.'

For dyeing with *grana*, see R-10, 73r. For dyeing with brazil to produce what was called *grana*, see F-6, 60r and F-40, 25r. In F-9, 6r, F-17, 60r, 64r, and L-40, 95v, 124v–127v, also, brazil masquerades as *grana*. From these recipes it appears that *cimatura di grana* may at times have meant the shearings of a stuff dyed with brazil, and not true 'grain' or kermes at all.

[5] A small unclassified remainder.

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[1] *Cocchole di velatro.*

[2] *Cauda equina:* probably a *Hippuris*, possibly an *Equisetum*. See *NED*, *s.v.* 'Horsetail,' 2, a, *sub anno* 1538. See also p. 419, n. 8 above.

[3] *Mirabolanos citrinos:* perhaps the *myrobalanus* of Pliny. For references, see Andrews-Freund, *Latin Dictionary*, ed. Lewis and Short, *s.v.* 'Balanus,' II, A, 3.

[4] *Ysapo:* used for a blue color.

[5] See *DAI*, pp. 40, 41, n. 59. Included here are all pigments called 'indigo' (including Lat. *indacum*, *It. endego*, *MHG. endich*, etc.) '*spuma*,' '*guatum*,' 'florey'; such sources as *batizofora*, *waydplum*, *wode;* and, by extension, *succus de bacis ebuli* (=*Sambucus*, *q.v. art. infra*) and numerous other vegetable products yielding blues called 'indigo.'

[6] See *MCM*, pp. 464, 465, §XIII, and *ibid.*, n. 34.

[7] Iron-gall ink.

[8] Including a little code-writing (more fully treated in the *Secretum philosophorum*).

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[1] To these many solutions for removing old writing from parchment, so that it may be written on again, or made into serviceable leather, one rule in R-7, 137[1], <*Ad r*>*eficiendum librum caducum*, presents a happy contrast (essentially, it calls for treatment of the faded ink with gall-water). The destruction of old writing for the sake of the leather value of the parchment is not unheard of in the present day. Some years ago Professor R. P. Blake of Harvard informed me that on one of his expeditions to Asia Minor one of his native servants exhibited proudly some chamois trousers of his own manufacture, upon which Dr Blake detected with sorrow traces of mediaeval writing. Questioning revealed that the 'chamois' had been made from the pages of an ancient folio parchment codex (I believe that the text was salvaged).

[2] Pens, pumice, stanchgrain, etc.

[3] See *DAI*, pp. 6, 7, and *ibid.*, p. 44, n. 71.

[4] F-6 calls for removing from the flowers *quelli zali ch'e dentro.*

[5] A *colore zalo da tocar lettere* is made from the *granelli di zilii bianchi*, dried and mixed with glair (A sort of imitation saffron.) *Zilii bianchi* may be *Iris*, or equally *Lilium.*

[6] See also art. *Bone*, above.

[7] F-22, 24v–25v, includes a description of the gum. Gum lac is combined with brazil in o–26 and o–34. See also art. *Cynople* and p. 418, n. 11, above.

[8] Specified for glazing tin red.

[9] See also, of course, particularly art. *Brazil*, above.

[10] Used for 'silvering' metals.

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[1] See *CH*, p. 31, nn. 1, 2. The preparation of this color follows so closely the procedure for azurite that it receives little separate notice. It is far more common in use than specific references to it in recipes would suggest.

[2] Metallurgy lies beyond the province of this *Index*, for its literature is extremely large; but a sample reference or two to some of the metallurgical operations indispensable to general craftsmanship may be included.

[3] These rules for etching (chiefly inscriptions) apply almost entirely to objects made of iron and steel. Hermann Williams, 'The Beginnings of Etching,' *Technical Studies*, III (1934), 16–18, gives the texts of recipes in L-45, 171r, and Oxford, Bodleian Library, *MS. Ashmole 1397*, fol. 119r (*ibid.*, p. 17, n. 4, for 'live oak,' read 'male oak').

F-6, 57v, contains a recipe for etching stone with vinegar, using a wax resist.

[4] Most of the recipes listed here are designed to produce a golden effect upon iron or copper without the use of genuine gold.

[5] See also art. *Vermeils*, below.

[6] Especially 'pickles' for gilded work.

[7] See also art. *Metals, etching*, above.

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[1] Used to preserve tempered vermilion from flies and putrefaction.

[2] See also art. *Varnishes*, below.

[3] For applications, see also artt. *Greens, mixed* and *Gilding without real gold*, above.

[4] See *DAI*, p. 52, n. 110.

[5] For the texts of L-6 and L-29 cited below, see my article, 'Medieval Parchment-Making,' *Transactions of the Bibliographical Society*, N.S. XVI (1935), 113–117.

[6] Used for tracing, and for windows, plain or painted. Cf. also F-12, 30v: 'Carte bombacine tinguntur aut pinguntur hoc modo . . .' ; and R-10, 100r,v, 'A tingere carte bonbaxine over papiro in ogni colore . . .'

[7] See also art. *Glue, fish, for mending parchments*, above.

[8] Only a few arbitrary examples are listed here of texts dealing with the preparation of chemical reagents used in the arts. To do more would involve going far beyond the range of this paper; but to do less would leave a useful source of definitions and secondary information unindicated.

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[1] *Minium, sericon, stupium,* etc. See *DAI,* pp. 33–35, n. 41. Powdered brick seems to be called '*minium*' in M-1, 95v, 96r.

[2] See *DAI,* p. 35, n. 43. Included here are recipes employing various terms for weld, e.g. the *liagrimone, i.e. cerretta* of F-20, 35r. Their identification is, of course, provisional. See art. *Arzica,* above.

[3] See *DAI,* p. 43, n. 68.

[4] *Scotano* or *scodano,* 'fustic.'

[5] *Oricello,* 'orchil,' the lichen *Roccella tinctoria,* much used by dyers (the family name of the Ruccellai is said to derive from the dyestuff through which their fortune was built up). *Fucet* of P-8, 142v, is possibly, but not at all certainly, this lichen.

[6] Cf. art. *Parsley,* above.

[7] See *DAI,* pp. 57, 58, n. 132.

[8] *Ebbio, mora gelsi;* called *botros sambuci vel mulberry* in C-11, 140v. Perhaps actually *Sambucus nigra,* or *S. ebulus.* Cf. art. *Solanum,* below.

[9] Several of these texts on the *Arte della seta* deal with the manufacture and marketing of silk as well as with dyeing and cleaning. For silk see also the general artt. *Textiles,* below.

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[1] See p. 419, n. 8, above.

[2] Grouped here are rules for making a green from leaves of 'nightshade,' *morella*, probably a *Solanum*, possibly *S. nigrum*. Greens made from *folia sambuci* are also included in this section, perhaps wrongly (cf. art. *Sambucus*, above), but the botanical distinction seems less important than the technical method employed. The coloring matter, in any case, is probably impure chlorophyll, primarily. Compare Heraclius, *De coloribus et artibus Romanorum*, II, 17, ed. Mrs M. P. Merrifield, *Original Treatises* (London 1849), I, 200, 201.

[3] Here are included only a selection of chapters on grinding and tempering colors, the preparation of glair, gums, etc. For the temperas usually employed, see under the individual colors.

[4] A drawing of a grinding slab and muller.

[5] Apparently a fourteenth and fifteenth century English device.

[6] See *DAI*, p. 56, n. 127.

[7] Like bole, *q.v., art. supra*, terre verte was a commonplace of the late mediaeval palette. References to its use might be multiplied indefinitely without adding anything to the value of the examples cited here. See *DAI*, pp. 26, 27, n. 12.

[8] See also art. *Silk*, above.

[9] The general purpose of these recipes is implied in the introduction to an exceptional method, O-26, 129v, *Ad opus habendum uti rechamatur auri vel argenti* (cf. CH, pp. 107, 108; also p. 115, n. 9). Cloth of gold, rather than gilded cloth, is probably intended by L-45, 180v, *De panno auri clarificando*, and rules for the recovery of the gold, as in L-40, 35v, *Ad tollendum aurum de quacumque re*, and O-34, *Ffor to take out þe golde or silver of ann olde ryban.*

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[1] Turnsole here has no clear definition. Numerous vegetable colors, chiefly blue and green, but occasionally red or yellow, are called 'turnsole,' *tornа-ad-solem, solsequium,* etc. *Solsequium* appears in C-12; 'Sunsikell water' in L-29. L-20, 205v, glosses *Solsequia* as 'cicorea'; L-34, 28r, mentions *Calendulum, i.e., solsequium vel morella.* Turnsole in the sense of *Crozophora* (see *DAI,* pp. 41–43, n. 60) is perhaps to be seen in L-40, 114v, *Semen unius herbe que vocatur novella vel diana,* and less probably in O-26, 36r,v, *suco bacarum solatris maioris.* F-21, 79v–80r, gives a full and clear description of *Crozophora tinctoria.*

[2] See *DAI,* pp. 38, 39, n. 56, and *MCM,* p. 458. Cf. also seventeenth-century F-24, 69v–70r.

[3] See also art. *Blues, to test,* above.

[4] The purpose of this operation is suggested by R-10, 101r: 'Se li peçi sono grandi, meteli tra li carboni.' Lapis lazuli is hard to break up in a mortar.

Rules to extract the 'gold' (actually, of course, pyrites) from the lapis are found in F-5, 69v; F-16, 46r; F-21, 75v, 79r; R-5, 201r.

[5] See also art. *Oils,* above.

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[1] See *DAI*, pp. 29, 30, n. 26. Copper greens of several sorts are grouped together here, e.g. *Viride salsum*, essentially equivalent to verdigris.

[2] See also artt. *Parsley, Rue, Rhamnus, Saffron*, etc., above.

[3] See *CH*, pp. 61–63, n. 3. Rules for green glazed tin (cf. *ibid.*, p. 61) are found in F-12, 43v; R-10, 99r; red glazed, in F-6, 82r (with *lacca di zimatura di grana*); R-10, 99r (with *lacha di goma*); and blue glazed, in L-40, 137r.

[4] See *AV*. Fourteenth-century F-4, 24r, contains drawings of an *olla*, an *ampulla*, and an *a. lutata*.

[5] See *AV*, pp. 67, 68, n. 25. Thirteenth-century C-2, 138v, directs: 'Pernez le vermillun e le blanc de plum; si le metez ensemble si ert un blanc azur.'

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[1] Rules for the manufacture of 'Rouen green' are common to the *DCM* family (see, e.g., the *Liber de coloribus*, §VI, *art. cit.* p. 421, n. 5, *supra*, p. 294) and the MSS. of the *Secretum philosophorum*.

[2] This 'rynde of walle note tree' is used to improve the color of vermilion. Cf. the *succus . . . magnarum nucum corticis* mentioned in fourteenth-century O-14, 28v, *Ad faciendum colorem . . . pro picturis pannorum vel coriorum*.

[3] Including sealing-wax. Cf. *CH*, p. 13.

[4] Including *album de Apuleya*, except in E-1, where that name is clearly applied to white lead.

[5] For walls. Cf. *CH*, p. 34.

[6] See *DAI*, p. 33, n. 39. For ceruse made from tin plates (cf. *MCM*, p. 467, §XVII, and *ibid.*, n. 44), see also L-20, 179r, 229r; L-35, 170v; L-36, 92v.

[7] See *DAI*, pp. 28, 29, n. 24. Cf. also art. *Giallorino*, and p. 419, n. 7, above.

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