

# Lichen purple—an annotated bibliography

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This bibliography lists and contains comments on publications describing the textile dyeing applications and organic chemistry of purple dyes derived from lichens. Elsewhere in this issue such colorants are termed orcein; the usage “lichen purple” reflects the historical emphasis of the work described. Note that commentary by CJC is placed after the bibliographic information in italics.

**Beecken H, Gottschalk E-M, Gizycki Uv, Krämer H, Maassen D, Matthies H-G, Musso H, Rathjen C, Záhorszky UI** (1961) Orcein und Lackmus. *Angew. Chem.* 73: 665–688.

*A summary of investigations into the structure of 14 components of orcein and the (polymeric) structure of litmus; 59 references. An English translation of this paper is provided in the present issue of Biotechnic & Histochemistry.*

**Berthollet CL, Berthollet AB** (1841) *Elements of the Art of Dyeing and Bleaching*. Thomas Tegg, London. pp. 365–369.

*A chapter on archil describes the manufacture from lichen Roccella (Canaries) or lichen Parellus (also called Perelle from Auvergne) using urine and lime to give a product with an odor of violets. A solution of the dye in ethanol was used for filling spirit of wine thermometers, but the color faded with time. “The contact of air renews the colour, which is destroyed anew in vacuo in process of time”. The same lichen is used for turnsole (litmus), “this preparation is made in Holland.”*

**Bolton EM** (1960) *Lichens for Vegetable Dyeing*. Studio Books, Longacre Press, London. Reprinted in 1972, it was published jointly by Studio Vista Publishers, London, and Robin and Russ Handweavers, McMinnville, Oregon.

*A 60 page book describing lichens and dyes, including practical recipes, with five of the author’s water colors and a picture of 21 samples of dyed fleece. Described here for the first time is the production of a blue dye from*

*Xanthoria parientia, in which the color is developed in sunlight.*

**Brightman FH, Laundon JR** (1985) *Alternatives to Lichen Dyes*. British Lichen Society, London.

*A two page leaflet from the British Lichen Society (London) describes lichens used to produce the dyes orchil and cudbear which contain orcein and the indicator, litmus. Illustrations of the orchil lichen are reproduced from Dillenius’s Historia Muscorum tab. XVII Fig. 39 (1742).*

**Brough S** (1988) Navajo lichen dyes. *Lichenologist* 20: 279–290.

**Brown TM, Cooksey CJ, Dronsfield AT**, (2001) Orchil and litmus – the first synthetic dyes? *Educ. Chem.* 38: 151–153.

*Probably so, they argue: after all, lichens contain a raw material for the preparation of colorants, not the colors themselves.*

**Brunello F** (1973) *The Art of Dyeing in the History of Mankind*. N. Pozza, Vicenza.

*Below, the numbers in parentheses are page numbers. Archil (Roccella tinctoria) was in common use in classical times (26), especially in the Greek islands of Amorgos (93) and is mentioned by Dioscoridis, Pliny and Celsus (96). The histories of the Papyrus Leydensis and Papyrus Holmiensis are related (97) and dyeing using woad then archil to obtain a violet tone on a blue base is discussed (99). The first recipe (no. 32) in Papyrus Holmiensis for an imitation purple using safflower (sic) and archil is reproduced (plate 57). There is speculation that the Roman garments vestes fucatae could have used archil (Greek: phikos, Latin: fucus; 108). The dye was forgotten during Medieval*

times and reintroduced about 1300 to artisans in Florence by Federigo from the Levant (132). Tornaxel (archil) is mentioned in *Plictho de l'arte de Tentori*, G. Rosetti, Venice, 1540 (191) and a chapter in *Nuovo Plico d'ogni de tincture* by G. Tallier, Venice, 1704, has the title "To make an archil dye which dyes everything brown" (207). Hellot, *L'Art de la teinture des laines*, 1750, quotes Rosetti's *Plictho*, reproducing the formula, and quotes from "a fine description of this process" in *Novum Plantarum Genera*, PA Micheli, Florence, 1729, where it is called "raspa" (230). In the dictionary section of the book there is a description of dyeing lichens (350) and their location and an entry under *Rocella tinctoria* (383), with drawings of *Lecanora tartarea* and *Lecidea geografica* (plate 54).

**Calvert FC** (1876) *Dyeing and Calico Printing*. Simpkin, Marshall & Co., London.

A recipe for the preparation of French purple, a fast orchil dye, is given (cited in Kok 1966, p. 262)

**Cardon D** (2003) *Le monde des teintures naturelles*. Belin, Paris. pp. 371–417.

A summary of the history and chemistry of lichen purple dyes

**Cardon D, du Chatenet G** (1990) *Guide des teintures naturelles*. Delachaux and Niestlé, Paris. pp. 303–335.

A summary of the history and chemistry of orcein (*l'orseille*) and litmus (*le tournesol*) with 34 references and illustrations of *Rocella tinctoria*, *R. phycopsis*, *R. fuciformis*, *Ochrolechia tartarea*, *O. parella*, *Pertusaria dealbescens*, *Parmelia glabratula* sbsp. *fuliginosa* and *Lasallia pustulata*.

**Casselmann KL** (1993) *Craft of the Dyer: Colour from Plants and Lichens*. Dover Publications, New York. pp. 164–173.

First published by University of Toronto Press, 1980, this book is mainly about dyeing in Canada and the Northeastern states of the USA, with recipes for using *Parmelia* and *Umbilicaria* ("orchil") lichens and a mixture of *Actinogyra muehlenbergii*, *Lasallia papulosa* and *Umbilicaria* ('*orsallia*') lichens by 4–12 weeks fermentation with ammonia followed by dyeing for 2 days–several months. There are illustrations of *Umbilicaria* lichens, with dyeing results, and an extensive bibliography.

**Casselmann KL** (1994) Lichens: orseille de l'herbe. *Herbarist* 60: 42–49.

The history, uses and folklore of lichens, including those used as purple and brown dyes. Several documentary sources quoted.

**Casselmann KL** (1996) *Lichen Dyes. A Source Book*. Studio Vista, Cheverie, N.S. 57 pages. ISBN 0968102107.m.

**Casselmann KL** (2002) The etymology and botany of some European lichen dyes. *Dyes Hist. Archaeol.* 18: 31–36.

A survey of purple dye lichen names with 31 references.

**de Claubry G** (1861) Sur la preparation de l'orseille. *Compt. Rend. Acad. Sci.* 52: 1252–1254.

A procedure is described for extracting precursors from the lichen with calcium hydroxide followed by acidification and treatment with ammonia to give the dye.

**Clow A, Clow NL** (1952) *The Chemical Revolution. A Contribution to Social Technology*. The Batchworth Press, London. pp. 209–214.

A very detailed history of cudbear manufacture.

**Cocq M** (1812) Memoire sur la Fabrication et l'Emploi de l'Orseille. *Ann. Chim.* 81: 258–278.

Preparation of *La pabelle d'Auvergne* from *Ochrolechia pabelle*, *O. tartarea*, *Diploschistes scruposus*, *Pertusaria* sp. (see Kok 1966, Cardon and du Chatenet 1990), illustrations of the tools used for lichen collection (Tievant 1979)

**Dallon M** (1997) Orchil of Auvergne. *Dyes Hist. Archaeol.* 15: 97–102.

A survey with 16 references of the history of orchil in that region, with harvesting and preparation examples, especially in the Saint Flour area.

**Dambourney LA** (1794) *Recueil de Procédés et d'Expériences sur les Teintures Solides: que nos Végétaux Indigènes Communiquent aux Laines & aux Lainages*.

18th century details of improving fastness using silver birch bark (see Cardon and du Chatenet 1990, p. 317).

**Dambourney LA** (1794) *Histoire des Plantes qui Servent a la Teinture*. Paris. p. 167.

After dyeing woollen cloth with orchil, the fastness was improved by treatment in a bath of vinegar or of cold water and oil of vitriol.

**Diderot** (1788) *La Grande Encyclopedie*. pp. c. 484–666.

"*Lichen de Grece*" (*lichen Graceus*, *lichen Polypoides*, *lichen Tinctorius*), found on Mediterranean coasts and used for dyeing is described; orchil of the sea and orchil of the earth are described. The use of a solution of tin "par l'esprit de nitre regalise" to make the color faster, in

the same way as for cochineal, is mentioned, but the color is affected. The use of orchil for dyeing marble red and blue is mentioned.

**Dorvault** (1889) *L'Officine, ou Repertoire General de Pharmacie Pratique*. p. 623.

A single paragraph describes use of lichens to obtain brown, yellow, purple and blue colours. Rocella and Variolaria species are mentioned and the color precursors, lecanorine, erythrine and orceine. The blue lacmus is obtained from Lecanora tartarea.

**Dubois M l'Abbe** (1833) *Essai sur les Plantes Tinctoriales de l'Auvergne*. *Ann. Sci. l'Auvergne, Clermont-Ferrand*.

A large number of species of lichen were tested and examples are given of the different ways of dyeing using different species, soda, lime, urine. There is much detail about lichen Tartareux, the orchil of Auvergne, and the economy linked with this lichen.

**Dumas J** (1838) *Neue Beobachtungen über das Orcin*. *Ann. Chem. Pharm.* 27: 140–147.

*Organic chemistry of orcein.*

**Dumas JB** (1844) *Traite de Chimie Appliquee aux Arts*, Paris 8: 40–56.

*Organic chemistry of orcein and litmus.*

**Edge A** (1914) British dye lichens. *J. Soc. Dyers Colourists* 30: 186–188.

**Engle RL, Dempsey EW** (1954) The separation of orcein into four fractions by chromatography and the staining qualities of each fraction. *J. Histochem. Cytochem.* 2: 9–20.

*Separations were achieved using paper chromatography as well as alumina columns. Visible spectra are reported. Each of the four fractions had very different staining characteristics on tissue sections, and only the blue-purple fraction stained elastic fibers.*

**Gettens JR, Stout GL** (1966) *Painting Materials. A Short Encyclopaedia*. Dover Publications, New York. p. 125.

*Litmus is obtained from Lecanora tartarea or Rocella tinctoria, and archil is similar although obtained from other species.*

**Gonfreville D** (1848) *Art de la Teinture des Laines: en Toison, en Fil et en Tissu*. E. Lacroix, Paris pp. 535–537.

*Mention is made of Rocella, Variolaria, lichen Corallinus (Pertusaria corallina), lichen Tartareus and a*

*recipe for obtaining orcein; the color precursors, lecanorine, orceine and orcein are described. The use of mordants with orchil to obtain different colors is described, as is the use of lichen dyes in a first dyeing bath ('bottoming').*

**Goodwin J** (1982) *A Dyer's Manual*. Pelham Books, London. pp. 87–92.

*A chapter on lichen dyes gives brief descriptions of the habitat and use of Ochrolechia (Leconora) tartarea, Parmelia saxatilis and Rocella tinctoria.*

**Gordon G, Gordon C** (1758) *Manufacture of Dye Colours*. British patent 727.

*The production of cudbear is described from a mixture of Archelia or Spanish weed, Muscus rupibus admiscens or coroloides and Muscus pyxidatus, spirit of urine, spirit of soot and quick lime. "Digest them together for fourteen days, and they will produce the cudbear fitt for dyers' use."*

**Grierson S** (1986) *The Colour Cauldron: the History and Use of Natural Dyes in Scotland*. Mill Books, Perth. ISBN 0 9510132 11.

*Includes a description of the history of harvesting and processing cudbear, and a survey of orchil lichen species with recipes.*

**Guinon, Marnas, Bonnet** (1856?) *Expose Historique des Travaux Relatif aux Materieres Colourantes des Lichens*. Paris.

*A commercial method for making solid orseille called "Pourpre Francaise" (see Cardon and du Chatenet 1990, pp. 317).*

**Hale ME** (1974) *The Biology of Lichens*. Edward Arnold, London. pp. 161–162.

*A very short summary of the use of orchil lichens, referring to Bolton (1960,1972) and Solberg; plus a little organic chemistry.*

**Halleux R** (1981) *Les Alchimistes Grecs*. Les Belles Lettres, Paris.

*The Greek text of these 3rd century papyri found in a Theban tomb in 1828 is given, together with a French translation, with many footnotes. Of the 70 dye recipes, many are for imitation mollusc purple, and one includes a woad plus lichen-purple recipe.*

**Harley RD** (1982) *Artists' Pigments*. ca 1600–1835. 2<sup>nd</sup> edition. Butterworth Scientific, London. p. 63.

*A one page summary on orchil, cork and litmus with 4 references (1612–1674).*

**Hellot JP** (1901) *The Art of Dyeing Wool and Silk and Cotton*. Scott, Greenwood & Co., London. This is a reprint of the edition published by R Baldwin, 1789, in London. (See Hellot JP 1750).

**Hellot JP** (1750) *L'Art de la Teinture des Laines et des Etoffes de Laine en Grand et Petit Teint*. La veuve Pissot, Paris. Chapter 3, 541–563. A recipe for the preparation of orchil from “Orselle of the Levant” (see Kok 1966, p. 261). The use of tin as a mordant to give a red “demi-ecarlare” (see Cardon and du Chatenet 1990, p. 317).

**Hofenk-de Graaff JH** (1969) *Natural Dyestuffs – Origin, Chemical Constitution, Identification*. International Council of Museums, Amsterdam. Plenary meeting 15–19 September 1969, Amsterdam. A brief history from ancient Rome, where the main use may have been as a ground color before dyeing with Tyrian purple, and the later use in Holland, France and Scotland. Although not usually mordanted, silk can be dyed red using alum +gallnuts followed by warm wine vinegar. Infrared spectra and TLC details (Figs. 32, 33) are given for orchil and orcein.

**Hopf H** (1992) Über Hans Musso (1925–1988) und sein wissenschaftliches Werk. *Chem. Ber.* 125: I–XXIV. A summary of the 221 papers published by Hans Musso, including about 25 on orcein.

**Hoiland K** (1983) Laven korkje, ochrolechia tartarea, som fargeprodusent. Med spesiell omtale av bruken på Lista og i Farsund. *Blyttia* 41: 17–21. The lichen cork (korkje), Ochrolechia tartarea, as dye-stuff producer, with a special mention of the use on Lista and in Farsund. Details are given of the history of use in Norway since 1316, the chemistry of the color production, and the trade in the 18th century centered around Flekkefjord. Illustrations are given of wool dyed with cork, lichen-picks and the lichen; 11 references.

**Hunt R** (1875) *Ure's Dictionary of Arts, Manufactures, and Mines*. Longmans, Green & Co., London. Volume 1, pp. 203–207. Article: archil, its history, production and use.

**Hunt R** (1875) *Ure's Dictionary of Arts, Manufactures, and Mines*. Longmans, Green & Co., London. Volume 1, p. 1013. Article: cudbear, whose name derives from Dr. Cuthbert Gordon and “it was originally manufactured on a great scale by Mr. G Mackintosh, at Glasgow, nearly 80 years ago.”

**Hunt R** (1875) *Ure's Dictionary of Arts, Manufactures, and Mines*. Longmans, Green & Co, London. Volume 3, p. 135. Article: Litmus, with a brief description of the manufacture in Holland.

**Hunzinger C, Hunzinger, Tievant P** (1976) De toutes les couleurs. *Stock* pp. 181–197. A general chapter about lichen dyeing with specific reference to Lecanora tartarea, Lecanora parella and Evernia prunastri.

**Kane R** (1841) Beiträge zur hemischen Geschichte der Orseille und des Lacmus. *Ann. Chem. Pharm.* 39: 25–76. The organic chemistry of orcein.

**Kane R** (1840) Contributions to the chemical history of archil and litmus. *Philos. Trans. Royal Soc.* 130: 273–324.

**Karmous T, Ayed N, Nowik W** (1997) Caractérisation par Chromatographie des Lichens Tinctoriaux de Tunisie. *Analisis* 25: 321–329. Using TLC and HPLC, 20 depside-type precursors and 6 other pigments have been identified in 26 species of lichen in Tunisia.

**Knecht E, Rawson C, Loewenthal R** (1910) *A Manual of Dyeing: for the Use of Practical Dyers, Manufacturers, Students, and all those Interested in the Art of Dyeing*. 2nd ed. Charles Griffin, London. Volume 1, pp. 363–365. First published in 1893, 9th edition 1945. A section on orchil and cudbear describes the manufacture of orchil from Roccella tinctoria (Valparaiso weed), R. fuciformia (Lima weed), Variolaria orcina (from Auvergne) or Lecanora tinctoria (from Sweden) by fermentation with urine and subsequent addition of slaked lime or by fermentation with dilute ammonia at 35–45° C for 5–6 days. Cudbear is usually made from L. tartarea. Wool is dyed without a mordant and is frequently used for “bottoming” indigo.

**Kok A** (1966) A short history of the orchil dyes. *Lichenologist* 3: 248–272. A complete historical review with 68 references, plus a further 11 of more general interest. In a section on the history of lichen purple, the early use in combination with and as a substitute for shellfish purple was mentioned by Theophrastus, Pliny the Elder and in the Stockholm Papyrus, and was a possible constituent of Gaetulian purple. The domestic use probably continued until the re-establishment of commercial trade by Federigo, ca. 1300. The expansion of the use continued

in the 16th and 17th centuries with mention by Roseto (1540), Guicciardini (1560), Imperato (1599), Ray (1686) and Pitton de Tournefort (1717). In the 18th century, some amounts and prices are given for lichen from the Cape Verde Islands and the Canaries. Much detail is given on the perelle industry in France and the cudbear industry in Scotland. In the 19th century, more sources were located in Ceylon, Mozambique, Peru, Madagascar and Zanzibar, and in the second half of the 20th century, the major sources were the Cape Verde Islands and Madagascar. In a section on the preparation of dyes, recipes are quoted for orchil, French purple, Parelle, cudbear and Litmus. In a final section, the dyeing of silk and wool with orchil alone and with other dyes is given in detail.

**Le Pilleur D'Appligny** (1770) *Essai sur la Teinture*. pp. 129–135.

The fugitive nature of orchil dyes is described, with experiments directed toward greater light fastness.

**Leggett WF** (1944) *Ancient and Medieval Dyes*. Chemical Publishing, Brooklyn. pp. 56–60.

A brief history of orseille, with mention of Theophrastus and Dioscorides, Pliny (use as a ground for Tyrian purple), and Federigo (1300). Florence was the main source prior to that of the Canary Islands (1703). Norway and the Mediterranean islands are a source of *Rocella fuciformis* and *Variolaria orcina*. Attempts have been made to develop an industry in Lower California.

**Leuchs JC** (1829) *Traité Complet des Propriétés, de la Préparation et de l'Emploi des Matières Tinctoriales et des Couleurs*. De Malher, Paris. pp. 399–415.

A survey of 73 species of lichen and their ability to yield a red color. The recipe of P Vestring of Stockholm using lime and ammonia to obtain red or violet colours is described, with other processes using salt, salpeter, ammonia, urine, copper sulfate. The orchil lichens described are lichen tartareus, *Variolaria orcina*, lichen Calcareus, Rocella, lichen Farineux, lichen Lacteus.

**Lindsay WL** (1854) Experiments on the dyeing properties of lichens. *Edinburgh Philosoph. J.* 57: 228–49, 385–401.

See Mairet (1931) and Tievant (1979).

**Lindsay WL** (1855) The dyeing properties of lichens. *Edinburgh Philosoph. J., New Series* 2: 385.

See Mairet(1931), Tievant (1979).

**Lindsay WL** (1856) *A Popular History of British Lichens: Comprising an Account of their Structure,*

*Reproduction, Uses, Distribution and Classification*. Lovell Reeve, London.

**Llano GA** (1956) *Economic Uses of Lichens*. Washington. pp. 32–37.

The current use of lichens for dyeing in western and northern Europe is mentioned. There is a short history of the use of lichens for purple dyeing from the 13th century onwards, with a chart showing the geographical origin of commercially used lichens, classified into two groups: orchil of the earth and orchil of the sea. Recipes are given for orchil paste, orchil cake, orchil liquor and the recipe of Cocq (1813).

**de Luynes V** (1861–1870) Sur les Principes Contenus dans les Lichens a Orseille. *Lecons de Chimie Professees de 1860 a 1869 Inclus Societe Chimique de Paris* 5: 431–456.

Item for the 26<sup>th</sup> May 1865: The isolation of erythrine, lecanoric acid and orcinol from lichens, and their reactions.

**de Luynes V** (1863) Sur la Preparation Industrielle de l'Orcine. *Bull. Soc. Encouragement* pp. 270–275.

**Mairet EM** (1931) *Vegetable Dyes, Being a Book of Recipes and Other Information Useful to the Dyer* (5th ed.). St Dominic's Press, Ditchling, Hassocks, Sussex.

This little book was first published in 1916, with a 5th ed. in 1931, and another in 1939. In a chapter on lichen dyes, the processing of *Lecanora tartarea* in Scotland is described: "... is steeped in stale urine for about 3 weeks, wrapped in dock leaves and hung up to dry in peat smoke." A general method of processing lichens is quoted from "Experiments on Lichens for Dyeing Wools and Silks" by Dr Westring of Sweden. The use of stale urine and slaked lime for orchil and cudbear (from *L. tartarea* or *Urceolaria calcarea* in Scotland) is mentioned and purple colors obtainable from *Evernia prunastri*, *U. pustulata* and *Parmelia perlata*. A recipe is given for red-purple dyeing of wool using equal amounts of cudbear and logwood. A list of lichens "used by the peasantry of different countries for wool dyeing" is reproduced from "The Dyeing Properties of Lichens" by Dr. Lauder Lindsay, *Lecanora pallescens*, *Umbellicaria vellea*, *Edinburgh Philosoph. J., July–October, 1855*.

**McGrath JW** (1977) *Dyes from Lichens & Plants*. Van Nostrand Reinhold, Toronto.

Based on 6 years' experience of craft dyeing at Spence Bay in the Canadian Arctic, this book describes 63 plant

species (including 22 lichens) with botanical details, including Inuit name and recipes for dyeing. Purple/blue producers are *Alectoria ochrileuca*, *Cetraria delisei*, *Haematomma lapponicum*, *Umbilicaria vellea* and *Xanthoria elegans*, the last of which only gives a blue color on exposure to sunlight. The lichens are illustrated in color with examples of dyeing results, some with unusual substrates like wolf fur and polar bear fur

**McOmie JF, White IM** (1955) Experiments concerning the structure of a constituent of orcein. *J. Chem. Soc. (London)* pp. 2619–2623.

The structure of purple compounds isolated from the reaction of air and ammonia on orcinol suggested by Liebermann (*Ber.*1875, 8: 1649) or Henrich (*Sitzungsber. Physik.-Med. Soz. Erlangen* 1939, 71: 199) are shown to be more likely of the oxazine type than the suggested indophenol type.

**Musso H** (1955) Zur Kenntniss der Orseille-Farbstoffe. *Naturwissenschaften* 42: 513.

Ring paper chromatography of orcein, eluting with 0.5 M phosphate buffer at pH 11.0 in butanol; or column chromatography using cellulose–butanol–0.5M phosphate buffer at pH 11.75 separates 13 colored components.

**Musso H** (1956) Die Trennung des Orceins in seine Komponenten (II. Mitteil über Orceinfarbstoffe). *Chem. Ber.* 89: 1659–1673.

Following a brief history of orcein from 1835 (*H Robiquet*) onwards, paper chromatography and cellulose powder chromatography are used to separate 14 components, of which 5 are obtained as crystalline compounds. Spectral data obtained in methanol, 0.2 N HCl, 0.2 N NH<sub>3</sub>, and 0.2 N KOH is given.

**Musso H** (1960) Orcein and litmus pigments: constitutional elucidation and constitutional proof by synthesis. *Planta Med.* 8: 431–446.

A summary of previously published material by Musso.

**Musso H, Beecken H** (1957) Über Orceinfarbstoffe. IV. Craig-Verteilung und Verteilungschromatographie. *Chem. Ber.* 90: 1808–1814.

The major components of orcein were separated using cellulose powder chromatography with formamide–chloroform–pyridine for  $\alpha$ -amino-orcein and butanol–phosphate buffer for other amino and hydroxy-orceins.

**Musso H, Beecken H** (1957) Über Orceinfarbstoffe. VI. Die Konstitution von  $\alpha$ -,  $\beta$ - and  $\gamma$ -Amino-orcein. *Chem. Ber.* 90: 2190–2194.

Electronic spectra of the title compounds and their acetates measured in methanol, 0.2 N HCl/methanol and 0.2 N HCl/methanol are given.

**Musso H, Beecken H** (1961) Über Orceinfarbstoffe. XII. Synthesen des Alpha-oxy-orceins. *Chem. Ber.* 94: 585–600.

The synthesis was achieved with about 1% yield.

**Musso H, Krämer H** (1958) Über Orceinfarbstoffe. VIII. Die Konstitution der Oxy-orceine und ihrer Oxydationsprodukte. *Chem. Ber.* 91: 2001–2016.

The preparation and characterization of acetates and leucoacetates is described, and their IR and visible spectral data are given.

**Musso H, Mannsfeld S-P** (1961) Über Orceinfarbstoffe. XIII. Synthese und Acetylierungsgeschwindigkeit des Iso- $\alpha$ -amino-orceins. *Chem. Ber.* 94: 2585–2589.

The synthesis is used to support the proposed structure of  $\alpha$ -amino-orcein.

**Musso H, Matthies H-G** (1957) Über Orceinfarbstoffe. V. IR- und UV-spektren. Hydroxy und Amino-substituierter Phenoxazone. *Chem. Ber.* 90: 1814–1827.

IR and UV data are given for  $\alpha$ -,  $\beta$ - and  $\gamma$ -hydroxy- and amino-orcein, and for  $\gamma$ -amino-orceimine.

**Musso H, Rajtjen C** (1959) Über Orceinfarbstoffe. X. Lichtabsorption und Chromophor des Lackmus. *Chem. Ber.* 92: 751–753.

Visible region spectral data are given for  $\alpha$ -,  $\beta$ - and  $\gamma$ -hydroxy-orceins and for litmus.

**Musso H, Matthies H-G, Beecken H, Krämer H** (1957) Zur Konstitution der Orceinfarbstoffe (part III of Über Orceinfarbstoffe). *Angew. Chem.* 69: 178.

The R<sub>f</sub> values and structures of 12 of the components of orcein separated by cellulose powder chromatography using butanol–phosphate buffer, pH 11.75, are given.

**Musso H, Matthies H-G, Krämer H, Hocks P** (1960) Über Orceinfarbstoffe. XI. Die Konstitution der Amino-orceinimine. *Chem. Ber.* 93: 1782–1788.

pK and redox potentials were determined for orcein components and phenoxazone models.

**Partridge W** (1823) *A Practical Treatise on Dying of Woolen, Cotton, and Skein Silk with the Manufacture of Broadcloth and Cassimere, Including the Most Improved Methods in the West of England*, 1st ed. H. Wallis, New York. Facsimile reprint, published in 1973 by Pasold Research Fund, Eddington. pp. 164–205;

with an introduction by J. de L. Mann, and technical notes by K. G. Ponting. *A brief recipe for dyeing silk with cudbear to give a mazarine blue.*

**Perez-Llano GA** (1944) Lichens, their biological and economic significance. *Bot. Rev.* 10: 1–65.

*Orchil was known to Theophrastus and Pliny, but the art of making dyes from Roccellae, although rediscovered by Federigo about 1300, fell into disuse until the 17th and 18th centuries. Various sources of Rocella tinctoria are mentioned (no dates), starting with the Cape Verde Islands and the Canaries and ending with Valparaiso, Lima and the West Coast of North America. A few prices and amounts are mentioned. A recipe for orchil is taken from Knecht, Rawson & Loewenthal (1919) and for perelle as observed at Clermont, France, from Cocq (1812), quoted in Brewer's Edinburgh Encyclopaedia (1832). Mention is made of the use of Ochrolechia tinctoria in Scotland, Iceland, Westmoreland and Cumberland, and the use of orchil with other dyes, magenta, indigo and the dye from lungwort for a permanent black (JM Matthews: Application of Dye-stuffs 1920) and as a ground for madder reds, and in the manufacture of litmus in Holland. A table describes 75 species of lichen (18 producing blue or purple) with region found and uses. A total of 233 references.*

**Perkins P** (1986) Ecology, beauty, profits: trade in lichen-based dyestuffs through Western history. *J. Soc. Dyers Colourists* 102: 221–227.

*Drawing heavily on Kok's review (1966), the author covers the use in antiquity, in combination with mollusc purples, originally centered at Tyre ca. 1500 BC and spreading to the Canaries and Azores. Other sources were the Amorgos Islands, and Thera and Itanos in Crete, mentioned by Theophrastus (Enquiry into Plants, IV.IV.5, about 320 BC). The contributions of Pliny are summarized, including Gaetolian purple, an industry established by King Juba of Mauritania about 40 BC, mysteriously dieing out about the 4th century AD. After the Dark Ages documentation reappears in the 13th century in Florence, with trade spreading to Genoa and Venice. Lichen supplies about this time were from Majorca (1380) and the Red Sea (1400), and later (1500–1560) from the Canaries. During the 1600's new sources were found in South America, Morocco, Madiera, the Azores, Sardinia, Angola and Madagascar. In the 1700's, supplies from the Cape Verde Islands became important and local sources, of perelle in France and cudbear in Scotland, documented. About 1837, the importance of the Cape Verde Islands declined following discoveries in Angola and Mozambique, and 30 years*

*later, Ceylon, Peru, Baja California, Zanzibar, Corsica, Sardinia and the Greek islands were added to the list. There are 5 citations about the brief exports from Baja California, 1872–1900. Data are presented on the price and amount of lichen produced at different times. The review emphasizes the repeated "discovery–use–depletion" cycle. 40 references.*

**Ploss EE** (1962) *Ein Buch von alten Farben*. Impuls Verlag Heinz Moos, Heidelberg and Berlin. Technologie der Textilfarben im Mittelalter mit einem Ausblick auf die festen Farben.

*Recipe 32 from Papyrus Graecus Holmiensis using safflower and orseille is described (pp 25) and the original MS reproduced (pp 36).*

**Pritchard F** (1984) Late Saxon textiles from the City of London. *Medieval Archaeol.* 28: 46–76.

*In late Saxon textiles from the City of London, an unidentified lichen purple was observed but not confirmed.*

**Rajtjen C** (1959) Chromatography of litmus. Undergraduate thesis. University of Gottingen.

**Robiquet H** (1835) Neue Beobachtungen über das Orcin. *Ann. Chem. Pharm.* 15: 289–300. *Organic chemistry of orcein.*

**Robiquet H** (1830) Essai Analytique des Lichens de l'Orseille. *Ann. Sci. Auvergne.* pp. 337–341.

*Following a survey of the species of orchil lichens and methods of collecting them, details of the isolation of orcine from Variolaria dealbata are given.*

**Robiquet H** (1829) Essai Analytique des Lichens de l'Orseille. *Ann. Chim. Phys.* 42: 236–257.

*The first report of the isolation of orcinol from Variolaria dealbata (Pertusaria dealbescens).*

**Robiquet H** (1835) Nouvelles Observations sur l'Orcine. *Ann. Chim. Phys.* 58: 320–335.

**Roret** (1898) *Origine des Materieres Tinctoriales.* pp. 252–255.

*In one chapter about orseille the author describes how to recognize the orchil lichen and different ways to obtain the dye. The recipe from Cocq (1812) for preparing orchil is given.*

**Rutty J** (1772) *An Essay towards a Natural History of the County of Dublin.* Dublin. pp. 138–140.

*One chapter of the book is devoted to "Indigenous Vegetables Useful in Dying and Painting." This work was reprinted and published by the Department of*

*Continuing Education, University of Bristol, 1990, and describes cork, corker or arcel. "in the Co. of Kerry they steep it in stale urine, and make it up into balls with lime".*

**Schunck E** (1842) On some of the substances contained in the lichens employed for the preparations of archil and cudbear. *Chem. Soc. Mem.* 1: 71–77.

**Schunck E** (1842) Vorläufige Notiz über einige farbstoffgebende Substanzen der Flechten. *Ann. Chem. Pharm.* 41: 157–162.

**Schunck E** (1845) Ueber die Bestandtheile der Lecanora Parella. *Ann. Chem. Pharm.* 54: 257–284.

**Schunck E** (1847) Ueber die in *Rocella tinctoria* enthaltenen Stoffe. *Ann. Chem. Pharm.* 61: 64–80.

**Schützenberger P** (1867) *Traité des Matières Colorantes, Comprenant Leurs Applications à la Teinture et à l'Impression, et des Notices sur les Fibres Textiles, et l'Épaississants, les Mordants.* Paris. Volume 2, pp. 366–401.

*A chapter about lichen dyes.*

**Schweppe H** (1993) *Handbuch der Naturfarbstoffe Vorkommen–Verwendung–Nachweis.* Ecomed, Landsberg/Lech. pp. 517–534.

*A comprehensive coverage of lichen purple including (page numbers in parentheses) an historical summary (530), reference to Papyrus Holmiensis (25, 53, 56, 310), Pliny's Historia naturalis (52, 56), Theophrastus's Geschichte der Pflanzen, IV. Buch, Kapitel 6, 5 (53), the finds at Vindolanda (58, 67), Plictho (82, 84) and Colbert (89). In the 18th century, orseille (orchil) from Rocella tinctoria was obtained from Crete and the Greek islands and persio (cudbear) from Lecanora species was obtained from Scotland and Scandanavia. Orseille used on silk to obtain a violet color (140), and on parchment (318). The constitution and structures of dyes and precursors is covered (517), recipes for persio (cudbear), Franzosischer Purpur (pourpre francais) and lackmus (litmus) are given (528). Different colors are obtained with mordants, Al, Cu, Fe, Mg, Zn (530); and 3 pictures of examples of aluminium mordanted wool dyeing are given (569). Qualitative analysis is by dithionite reduction and oxidation to regenerate the color (no regeneration with azo dyes and shellfish purple under UV irradiation becomes blue) (530).*

**Simmons J** (1985) *A Shetland Dye Book.* Shetland Times, Lerwick.

*Brief descriptions, local names, and recipes are given for 28 plant dyes in Shetland including Ochrolechia tartarea (korkalit). A typical recipe involved three weeks fermentation with urine followed by making into cakes with lime and drying in peat smoke (this was done on Foula). Parmelia parientina gives a lilac dye by urine fermentation, purple when used with chrome mordanted wool.*

**Tassart CL** (1890) *Les Matieres Colorantes.*

*In a chapter about orseille, the different species are described, the chemical studies of Robiquet (1829) and others (Frezon, Stenhouse), and the recipe for French purple of Guinon, Marnas and Bonnet given.*

**Taylor GW** (1990) Ancient textile dyes. *Chem. Brit.* pp. 1155–1158.

*Visible spectra (in methanol) were determined of lichen purple samples from the Vindolanda site, 19th century orchil, and 20th century Ochrolechia tartarea.*

**Taylor GW, Walton P** (1983) Modern dyeings from Lichen Purples. *Dyes Hist. Archaeol. Textiles* 2: 14.

**Tievant P** (1979) *Historique, Usages des Teintures aux Lichens.* Université de Paris I, UER D'art plastique, Thèse de Doctorat de 3ème cycle.

*A description of the history, the lichens and dyeing methods for orchil, cudbear, persio, tournesol, litmus and pabelle. 88 references.*

**Wallert A** (1986) Fluorescent assay of quinone, lichen and redwood dyestuffs. *Studies Conserv.* 31: 145–155.

*A brief section describes lichen dyes, mainly orcein, with 3 references.*

**Westring DM** (1792) *Essais sur la Propriété Tinctoriale de Plusieurs Espèces de Lichen qui Croissent Naturellement en Suède, et sur les Couleurs qu'ils Communiquent aux Lainages et à la Soie.* *Ann. Chim. Paris* 15: 267–297.

*See Mairet (1931).*

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