

1912

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### Recommended Citation

Kellogg, Harriette S. (1912) "Native Dye-Plants and Tan-Plants of Iowa, with Notes on a Few Other Species," *Proceedings of the Iowa Academy of Science*, 19(1), 113-128.

Available at: <https://scholarworks.uni.edu/pias/vol19/iss1/19>

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## NATIVE DYE-PLANTS AND TAN-PLANTS OF IOWA, WITH NOTES ON A FEW OTHER SPECIES.

HARRIETTE S. KELLOGG.

In early days, dyers depended almost entirely upon the vegetable kingdom as the source of their supply of coloring materials, the most important exceptions being sepia from a species of cuttle fish and Tyrian purple from the Murex. Feral plants were the chief reliance but the uncertainty of obtaining a sufficient amount of the raw material, as well as the inferior quality of much of that brought to the market, together with the development of the science of organic chemistry led to the replacing of natural dyes with synthetic or artificial dyes.

In 1910, Prof. Meldola, in a presidential address before the Society of Dyers and Colorists, said, "Such a revolution in an industry of venerable antiquity as has been effected in about half a century has, perhaps, never been witnessed in the history of applied science. . . . An ancient industry, at the touch of science has been transformed." As a result of this change, today in our large manufactories, research chemists are employed as members of the regular staff.

Another result is that aniline dyes derived from coal-tar products replaced the greater number of vegetable dyes, but two, logwood and fustic, not having, as yet, been supplanted. The substitutions have not been wholly satisfactory, many of the aniline dyes not being of sufficient permanency, and experiments have been continued until, at present, coloring principles are manufactured which are identical with the natural vegetable or animal principles formerly employed in dyeing, and moreover have these advantages over the natural products that they may be manufactured in unlimited quantity and be of as great purity or strength as the manufacturers chose to make them.

Today, however, in the newer agricultural districts, encouragement is being offered to farmers to experiment with plants containing dye principles with the hope that careful methods of cultivation employed in growing these may again create a market for such plants, although it is not at all probable that collecting plants in their wild state will ever again possess commercial importance.

Tannin is of much more usual occurrence in vegetation than are dye-principles; however, in many plants, it occurs in such negligible quantity or is so associated with some coloring principle as to be without value to the manufacturer. However this may be, it is true that most plants contain tannin.

In early days in Iowa, especially before the advent of the railway, tanners in Iowa used native barks in their work. Mr. D. S. Morrison, senior member of a firm which has been manufacturing gloves in this state since 1854, says that at first the black oak was used in tanning, but the coloring matter which the oak contained made its use rather unsatisfactory so that eventually dependence was placed upon the sumac, although experiments were made with other plants, notably smartweed. This was probably the Tanweed, *Polygonum Muhlenbergii*, which contains about four per cent of tannin.

Appended are lists of tan and dye plants, native to Iowa, which are as complete as the resources at command will allow. It is of course impossible to

collect all the facts in regard to folk-use of such plants even in our own state but it is hoped that the lists as given may possess something, at least of interest in the history of native economic plants of Iowa.

The literature relating exclusively to dye-plants is meager, consisting almost entirely of isolated references, here and there, in floras. The fact that many specific names of plants are forms of the Latin adjective *tinctorius* is evidence that dye-principles of certain plants were known to early botanists. Linnaeus mentions four such plants only; but in the fifth volume of his *Amenitates Academicae*, he published an article of thirty pages by Engelbert Jorlin, on *Plantae tinctoriae*, in which Swedish dye-plants were named. In the fourth edition of William Withering's *Botanical Arrangement of British Plants*, published in 1801, (first edition 1776) fifty species are named which contain dye-principles. The author referred to Lightfoot's *Flora Scotica* published originally in 1777. Plowright mentions Pennant's *Tours in Scotland* (1782) and Ruttly's *Natural History of the County of Dublin* (1772) as containing references to native dye plants.

Mention should be made of the work of Pierre Joseph Buchoz, who, during the fifty years subsequent to 1758, wrote more than five hundred treatises upon Botanical subjects. These are largely compiled from other sources and cover many phases of plant life.

His Manuel tinctorial, published in 1800, while interesting, cannot be accepted as strictly reliable.

The better known commercial dye plants have been treated more at length in various publications, as Simmonds' *Tropical Agriculture*, in which eight of the most valuable, economically, are discussed. There are many articles in German that consider the subject from a chemical point of view but such are not logically within the scope of this article. In 1901, Dr. Plowright read an interesting paper, before the Royal Horticultural Society of England, upon *British Dye Plants*, in which he stated that in the Highlands and remote parts of Ireland native dye plants are still employed by the women in their homes. He names sixty such plants and in this paper records the results of a series of experiments with them covering a period of two years. The paper was farther illustrated by 150 skeins of wool which had been dyed in preparations from these plants. Rev. Wilks, Editor of the *Horticultural Reports*, said that "the effect of the various dyes was very distinct and beautiful in the direction of what may best be described as high art shades."

The bibliography here listed is of the more easily accessible titles, including also a few of the older works. No attempt has been made to list any considerable number of publications on tan-plants, the majority of those consulted being technical from the point of view of the manufacturer.

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## LICHENES.

*Pertusaria communis* D. C. A cosmopolitan species and commercial source of litmus.

*Urceolaria scruposa* L. is used in England as the source of a red dye. Other dye plants among the lichens which are, however, not found in the Iowa Flora, are: *Bazzania trilobata* (L.) S. F. Gray, growing on pines in the Rocky Mountains and used by the Montana Indians, *Evernia vulpina* (L.) Ach. (Tree Moss, Shwa-wi-san, Oi-ga-ti, or Yellow Moss) used by the California Indians, and *Xanthoria parietina* (L.) Th. Fr. (Wall Lichen), all utilized in dyeing yellow; *Umbilicaria polyrhiza* L. and *Rinodina oreina* (Ach.) Walnio, furnishing red dyes; and the following yielding litmus: *Cladonia* sp., *Dendrographa leucophaea* (Tuck.) Darbish. (California Seaweed), *Lecanora tartarea* Achr. (Cudbear, Tartarean Moss, Korkablatt, Canary-weed), *Parmelia* sp. *Roccella tinctoria* DC. (Dyer's Moss, Canary Moss) and other species of *Roccella*.

## PINACEAE.

*Juniperus communis* L. (Dwarf Juniper), as well as species of yew are used, especially in Australia, in tanning.

There are many tan barks among the Conifers. Among them are the First-Ba, or White Fir (*Abies concolor* Lindl.), Lowland Fir (*A. grandis* Lindl.) and Silver Fir (*A. pectinata* DC.); the Larch (*Larix europaea* DC.); the Spruces—White Spruce (*Picea alba* L.), Sitka Spruce, (*P. sitchensis* Frank) and Norway Spruce (*P. excelsa* Link.); the Pines—California Swamp Pine (*Pinus muricata* D. Don.) the Monterey Pine (*P. insignis* Dougl.) and Aleppo Pine (*P. halepensis* Mill.); the Hemlock Spruce (*T. canadensis* Carr and *T. heterophylla* Sarg.) and the Redwoods (*Sequoia gigantea* Lindl. and Gord. and *S. sempervirens* Endl.)

Dye plants among the Conifers are not numerous. In the Himalaya Mountains, the natives use the cones of the King, or Dye-Pine (*Abies Webbiana* Lindl.) in making a violet dye; the Maoris of New Zealand utilize the bark of the Celery Pine, Pitch Pine, or Tanekaka (*Phyllocladus trichomanoides* D. Don.) in dyeing black and red. The White Fir, mentioned previously as a source of tanning material, is used by the Indians of Northwest America in dyeing a light brown.

## GRAMINEAE.

*Phragmites communis* Trin. (Reed) The flowering tops of this plant used with copperas as a mordant, furnish a green dye which, according to Plowright, is utilized in Great Britain.

The Dhurra (*Sorghum vulgare* Pers.) often escaped from cultivation, is the source of a crimson dye. The use of caramel, derived from sugar, in coloring foods is well known. The *Aeluropus laevis* Trin. is one of the food plants of a Kermes insect from which a purple dye is made.

## SABALACEAE.

The Dragon's-blood (*Daemonorops Draco* Blume) is the source of a red resin much used and also contains tannin. Tannin is present in the roots of the Coco Palm (*Cocos nucifera* L.) and in the Dwarf Palmetto (*Sabal Adansoni* Guerns.)

## LILIACEAE.

The cultivated Onion (*Allium Cepa* L.) furnishes a yellow-brown dye.

Many of the Aloes, as the Cape Aloe (*Aloe arborescens* Mill.) of South Africa, *A. Succotrina* Lam., and *A. spicata* L., have a commercial importance as sources of yellow dye. Socotra (*Dracaena Cimabari* Balf.) is a commercial source of red resin. The roots of *Zanthorrhiza apiifolia* L'Herit. (Shrub Yellow-wort, Parsley-leaved Yellow-wort) are said by von Mueller and Lyons to contain a yellow dye.

## IRIDACEAE.

The cultivated Crocus (*Crocus sativus* L.) also known as Saffron or Azafran, is grown in Afghanistan for the yellow coloring matter which is contained in the stigmas.

## ZINGIBERACEAE.

The Galangal (*Alpina officinarum* Hance) of China and *A. Galanga* Willd. of Java supply the Galangal yellow of commerce. Several species of *Curcuma*

are important as commercial sources of turmeric. *C. longa* L. (Turmeric Plant, Huldee, or Indian Saffron) is undoubtedly the species most utilized, although commercial saffron is also derived from the rhizome of the Anjo, Ukon, or Kyo-o (*C. Zedoaria* Rosc.) of Japan, Samoa, and the Himalaya Mountains and from *C. viridiflora* Roxb. of Sumatra.

## CANNACEAE.

The cultivated *Canna* (*Canna indica* L.) known also as Indian Shot, Mango-halono-tano, or Aliipoe, produces a purple dye which is, however, not permanent.

## MARANTACEAE.

Another source of turmeric is *Kaempferia pandurata* Roxb.

## CASUARINACEAE.

A red dye is obtained from the Swamp Oak (*Casuarina equisetifolia* L.) known also as Beefwood, Ironwood, Agoho, or Toa, of the Pacific Islands and Malay. In the Island of Guam, it is used as a source of tannin.

## SALICACEAE.

*Salix alba* L. (Silky Willow or Huntington Willow) contains a yellow dye-principle and is a commercial source of tannin.

*S. fragilis* L. (Snap, Brittle, or Red Willow) contains tannin. Practically all of the Willows and Poplars contain tannin. In England the Saugh, Sallow, or Hedge Willow (*S. Caprae* L.) is important.

The buds of some species of Poplar (*Populus*) used in dyeing yellow.

## MYRICACEAE.

The Sweet Fern, Fern-gale or Fern-bush (*Myrica asplenifolia* L.) is a commercial source of tannin. The Devonshire or Moss Myrtle, Moss Wythan, Bay-bush, or Sweet Gale, as it is variously known, (*M. Gale* L.) is used in Great Britain in dyeing pale yellow; from the Chinese species *M. Nagi* Thunb. (the Yangmoe of China and Kaiphal of India) a brown-orange dye is obtained.

## JUGLANDACEAE.

*Juglans cinerea* L. (Bitternut or White Walnut) A decoction from the leaves, bark, and unripe fruit was used in dyeing the famous "butter-nut brown" of Civil War times. With an acid this becomes purple.

The wood contains tannin.

*J. nigra* L. (Black Walnut) Supt. O. H. Greene of the Indian Agency at Toledo says that the Tama Indians still use the husks from the nuts as a dye material. It is one of the few dyes requiring no mordant.

The bark and wood both contain tannin.

*Carya olivaeformis* Nutt. (Pecan) furnishes a yellow dye-principle.

*C. porcina* Nutt. (Pig-nut Hickory) contains a yellow, and the White-heart Hickory or Mocker-nut (*C. tomentosa* Nutt.) a green dye-principle.

## BETULACEAE.

The bark of the Alder (*Alnus glutinosa* Medic.) furnishes a yellow dye and contains tannin. From the Munbar (*A. firma* Sieb and Zucc.) of Japan is derived a black dye. According to Coville, the Oregon Indians make an

orange dye from the Wiplam (*A. tenuifolia* Nutt.); while Chesnut states that in California the Indians use Umse, Ga-sheti, or Kus (*A. rhombifolia* Nutt.) for a similar purpose. In England there is a folk-use of *A. nepalensis* D. Don.) for dyeing brown. *A. maritima* Nutt. and *A. nitida* Endl. are also dye-plants. Many of these barks, notably *A. glutinosa* Medic. contain tannin. The bark of the Lady Birch, White Birch, Makepeace or Ribbon-tree (*Betula alba* L.) is used in Great Britain in dyeing brown and contains tannin.

## FAGACEAE.

*Quercus alba* L. (White Oak) contains tannin.

*Q. macrocarpa* Michx. (Bur Oak, Mossy-back Oak) contains tannin.

*Q. nigra* L. contains a dye material and, although it was used in Iowa in early days in tanning, the presence of this coloring principle made its use rather unsatisfactory.

*Q. rubra* L. (Red Oak) contains tannin.

*Q. velutina* Lindl. (Dyer's Oak, Black Oak, Yellow-bark Oak) furnishes a yellow dye. Practically all oaks contain tannin; some being especially valuable as commercial sources of tan-bark. Among the latter is the Valonia (*Q. Aegilops* L.) the unripe cups and acorns of which, according to several authors, are used in dyeing and making ink, the annual export from Smyrna alone amounting to thousands of tons. Others are California Black Oak (*Q. californica* Coop.), the Turkey Oak (*Q. Cerris* L.), the Canyon Live-Oak (*Q. chrysolepis* Liebm.), the Tan-bark Oak (*Q. densiflora* Hook and Arn.), Black Oak (*Q. discolor* Ait.) which not only tans but dyes the leather a brilliant yellow, the Pacific Post-oak (*Q. Garryana* Hook), the Evergreen Oak (*Q. Ilex* L.), the Ki-yam (*Q. lobata* Nee) from which, according to Chesnut, the California Indians also make an ink, the California White Oak (*Q. lusitanica* Lam.) also a source of ink galls, the Chestnut Oak (*Q. Prinos* L.) the African Oak (*Q. Pseudo-suber* Santi.) and the English Oak (*Q. Robur* L.) also used in dyeing brown. Several serve as food sources for the Kermes insects and from the galls thus formed is obtained the brilliant cochineal dye of commerce. The most important of these is the Cochineal Oak (*Q. coccifera* L.) also known as the Kermes Oak.

The Chestnut (*Castanea dentata* Borkh.) furnished both dye and tan materials.

## MORACEAE.

*Humulus Lupulus* L. (Hop-vine), according to Plowright, is used in Great Britain in dyeing yellow.

*Maclura aurantiaca* Nutt. (Osage Orange, North American Bow-wood, Yellow Wood or Osage Apple) contains a yellow dye-principle in its roots.

Fustic, Yellow Brazilwood, Holland Yellow-wood, or Cuba-wood (*Chlorophora tinctoria* Gaud.) is a commercial source of fustic which has not yet been replaced by an artificial product. The root of *Cudrania Javenensis* Trec.) of Australia contains a yellow dye-principle.

## PROTEACEAE.

The Heath Honeysuckle (*Banksia serrata*) contains tannin in its bark, and the same substance is also found in a related species *B. integrifolia*, in *Grevillea striata* R. Br, *Exocarpus cupressiformis* Labill., the Silver Tree (*Leucadendrum*

*argenteum* R. Br.), Kruppelboom or Knotted Tree (*Leucospermum conocarum* R. Br.) the Waagenboom (*Protea grandiflora* Thunb.), Sugarbush (*P. mellifera* Thunb.), *Lomatia ilicifolia* R. Br and *L. longifolia* R. Br.

## SANTALACEAE.

The Cape Sumac or Pruin Bast (*Colpoon compressus* Berg.) furnishes a yellow dye and its leaves and twigs contain tannin. The Quandong (*Fusanus acuminatus* R. Br.) contains dark-colored tannin.

## POLYGONACEAE.

*Polygonum amphibium* L. (Water Persicaria) contains tannin.

*P. aviculare* L. (Crabweed, Mantil, Ninety-knot, or Pinkweed) contains tannin.

*P. Hydropiper* Mx. (Water Smartweed, Lake-weed, Red-shanks, Redweed, or Biting Knotweed) contains tannin. Plowright in "British Dye Plants" reports a folk-use of this plant in dyeing pale-yellow.

*P. Muhlenbergii* (Meisn.) Wats. has been employed in Iowa in tanning leather and is still known as tanweed or leather weed.

*P. Persicaria* L. (Persicaria, Lady's Thumb) contains tannin.

Other tan-plants among the Smartweeds are *P. barbatum* L., *P. Bistorta* L., *P. chinense* L., and *P. perfoliatum* L. The Japanese Indigo Plant (*P. tinctorium* Ait.) is a commercial source of indigo. The Sea-side Grape or Lobe-berry (*Coccoloba uvifera* L.) is one of the commercial redwoods containing dye-principles. The cultivated Rhubarb (*Rheum officinale* Baill.) is used in Thibet as a dye-plant. The Docks probably all contain some tannin, Canaigre (*Rumex hymenosepalus* Torr.) probably being the most important, although *R. maritimus* L. is also used.

## CHENOPODIACEAE.

The cultivated Spinach (*Spinacea oleracea* L.) contains a yellow dye-principle.

## PHYTOLACCACEAE.

*Phytolacca decandra* L. (Pokeweed, Kermes-berries, Portugal-berries, Pigeon-berries, Red-Nightshade, Red-ink Plant) furnishes a red dye.

The Blood-plant (*Rivina humilis* L.) contains a red juice which the ladies of South America use as a rouge.

## RANUNCULACEAE.

*Caltha palustris* L. (Marsh Marigold, Cowslip). A yellow dye known to folk use is obtained from this plant.

*Hydrastis canadensis* L. (Golden Seal, Canada Yellow-root, Indian Dye, Orange-root, Yellow Puccoon). From the rhizome and rootlets a yellow dye, of commercial importance is obtained.

The Asbarg or gandhaki (*Delphinium Zalil*) is named by W. G. Berry (Cir. 25, Bur. Chem. U. S. D. A.) as being used in Afghanistan as the source of a yellow dye which is derived from the blossoms. The same author mentions the Buttercup (*Ranunculus bulbosus* L.) as furnishing a yellow dye. In Great Britain, a yellow dye is obtained from *Thalictrum flavum* L. (Fen Rue, Poor-man's Rhubarb). According to John Smith, a yellow dye is obtained from the roots of Yellow-root (*Zanthoriza apiifolia* L'Herit).

NYMPHAEACEAE.

*Nymphaea odorata* Ait. (Water-lily). Plowright states that in the Hebrides a dye is used, derived from this plant.

BERBERIDACEAE.

*Berberis vulgaris* L. (Barberry). From this is made a yellow basic dye known commercially. From the Oregon Grape (*B. aquifolium* Pursh) a similar dye is obtained.

MENISPERMACEAE.

The False Colomaba-root (*Coscinium fenestratum* Colebr.) furnishes a yellow dye used in the East Indies.

LAURACEAE.

The *Persea Lingue* Nees. of Chili contains tannin.

PAPAVERACEAE.

*Sanguinaria canadensis* L. (Blood-root, Red Indian-Paint, Red-root, Blood-wort). Its roots yield a red pigment which the Indians formerly used to color their bodies. The Tama Indians use this as a dye.

The Garden Celandine (*Chelidonium sineuse* DC.) is a commercial source of a yellow dye, and the Corn or Field Poppy (*Papaver Rhoeas* L.) cultivated in our gardens, furnishes through its petals a coloring matter used in red ink.

CRUCIFERAE.

The cultivated red Cabbage (*Brassica oleracea* L.) furnishes the red coloring material known as caulin. The Wallflower (*Cheiranthus Cheiri* L.) is the source of a commercial yellow dye. The Dyer's Woad, Dyer's Weed, Pastel, or Ash-of-Jerusalem (*Isatis tinctoria* L.) as well as *I. indigotica* Fort. and *I. lusitanica* Brot. of China yield indigo. The beautiful Kendal green was made by "topping" the blue from *I. tinctoria* with a yellow dye from Weld (*Reseda Luteola*).

ANONACEAE.

The Yellow-dye Tree (*Xylopia polycarpa* Oliver) of Soudan contains a yellow dye-principle.

MONIMIACEAE.

The bark of the Boldo (*Peumus Boldus* Molina) contains a dye.

CAPPARIDACEAE.

The Capers (*Capparis spinosa* L.) furnish a yellow dye.

DROSERACEAE.

From the Sundew (*Drosera Whittakerii* Planch) is obtained a dye used in coloring red to brown.

RESEDACEAE.

The Yellow Weed, Dyer's Rocket, Weld, or Dyer's Weed (*Reseda Luteola* L.) is the source of the commercial "Dutch Pink" and is said by Plowright to furnish the best yellow dye in Great Britain. It makes a yellow, blue, or green dye according to the mordant used and, according to Smith, is used largely in coloring paper-hangings. In coloring to produce Kendal green, the

material is first dyed a blue with woad and then put in the yellow dye from weld, thus producing the famous shade.

## SAXIFRAGACEAE.

The Curtidor Bark (*Weinmannia pinnata* L., *W. racemosa* L., and *W. tinctoria* Sm.), the Alum-root (*Heuchera americana* L.) and many other representatives of the family contain tannin.

## ROSACEAE.

The berries of the Whitethorn, Maybush, or Wickens (*Crataegus Oxycantha* L.) are used in making a yellow dye. According to Coville, the Klamath Indians of Oregon express a purple dye from the outer coat of the berries of the Chaklo or Buckbush (*Purshia tridentata* DC.) with which they stain their bodies. According to Plowright, there is a folk-use in England of the Tormentilla, Septfoil, or Shepherd's-knapperty (*Potentilla Tormentilla* Neck.) in making a dull-red dye. The plant also contains tannin which also is present in the bark of the Apricot (*Prunus Armeniaca* L.) and of the Mountain Ash (*Pyrus Aucuparia* Ehrh.) In Great Britain, the green inner bark of the Apple (*Pyrus Malus* L.) is used in dyeing green.

## LEGUMINOSAE.

*Amorpha fruticosa* L. (False Indigo, River Locust, or Bastard Indigo) was formerly a commercial source of indigo.

*Baptisia tinctoria* R. Br.) (Wild Indigo, Indigo Broom, American Indigo, Yellow Indigo) contains indigo.

Many of the Legumes contain indigo and are commercial sources of this product, the more important being the various species of *Indigofera* and *Tephrosia*, the West Indian Indigo-plant or Devil's-eye (*I. Anil* L.) and the *I. tinctoria* L. being the species most cultivated of the former and *T. Apollinea* Link and *T. toxicaria* Pers. of the latter. To obtain the indigo, the whole plant is immersed in water and undergoes fermentation and maceration through heating. The water is then drawn off, the blue powder settles at the bottom of the pans where it is allowed to dry and is then made into cakes. There are many dye-plants among the Acacias. The Black Thorn (*A. farnesiana* Willd.) furnishes a red dye which is used in Guam; the Black Wattle (*A. decurrens* Willd.) yields a red, brown, black, or violet dye according to the salt used. *A. Catechu* Willd. (Ourouparia Gambier, Cashou, or Katechu) yields a dull-brown dye but is chiefly valuable as the source of gambier so much in demand by tanners. Practically all Acacias contain tannin, the principle commercial species being the Red Cebil, (*A. Cebil* Griseb.), *Espinillo*, (*A. farnesiana* Willd.), the Black Wattles, *A. binervata*, DC., *A. dealbata* Link., and *A. decurrens* Willd.), Pilang (*A. leucophaea* Willd.) Hickory Bark (*A. penninervis* Sieb.), Golden Wattle (*A. pycnantha* Benth.) the Doornbosch (*A. horrida* Willd.) and *A. Suma* Kurz. The heartwood of the Red Sandalwood or Kulalis (*Adenanthera pavonina* L.) supplies a red dye which the Brahmins of India used in marking their foreheads. The Ipil or Ifit (*Afzelia bijuga* Gray.) contains a brown dye. Goa powder comes from the Araiba or Araroba Tree (*Andira Araroba* Ag.). The Kidney-vetch, Cat's-claws or Crawl ( *Anthyllis Vulneraria* L.) is of folk-use in Great Britain in dyeing yellow. The Barwood, Camwood, Kambe-wood or Baban-wood (*Baphia nitida* Lodd.)

of Tropical Africa and Jamaica is a commercial redwood. The flowers of the Dhak-tree, Pulas or Palas-tree, or Bastard-teak (*Butea frondosa* Roxb.) are employed in making a red dye. Tannin occurs in *B. superba* Roxb. The Caesalpinias are the sources of various dyes and many of the species contain tannin. Fernambuc, Red Brazilwood, Japanwood, Red Sandalwood (*Caesalpinia cchinata* Lam.) is a commercial redwood. The bark of Sappanwood, Sampfenwood or Bukkum (*C. Sappan* L.) of India furnishes a red dye. A yellow dye is obtained from *C. Crista* L., a red dye from *C. sepriaria* Roxb. and *C. vesicaria* L. while tannin is obtain from many species as *C. brevifolia* Baill., *C. Brasilensis* L., *C. Cacalaco* H. and B., *C. coriaria* Willd., *C. digyna* Rottl. and the species named above. In Siberia the leaves of the Pea-tree (*Caragana arborescens* Lam.) furnish a blue dye. A saffron dye is obtained from the wood of the Yellow Wood, known also as Kentucky Yellow Wood, Yellow Locust, Gopherwood or American Fustic (*Cladrastis tinctoria* Raf.). The Purple Heart (*Copaifera publiflora* Benth.) yields a yellow dye which however needs alum to be permanent. The Broom, Hag-weed or Golden Willow (*Cytisus scoparius* Link.) contains both a yellow coloring principle and tannin. A red dye is obtained from Waras (*Flemingia congesta* Roxb.). One source of the famous Kendal green was *Genista tinctoria* L. which has many local names as: Dyer's Furze, Dyer's Whin, Dyer's Green Woad, Dye-weed, Widow-wisse, and Alleluia. A yellow dye is obtained from this plant, the flowers alone being used in Germany, but the whole upper part of the plant in certain other localities.

Liquorice (*Glycyrrhiza glabra* L.) contains a brown dye-principle.

The most important of the leguminous dye-plants is undoubtedly Logwood (*Heamatoxylon campechianum* L.). As previously stated, it has not yet been replaced by an artificial product. It grows chiefly in South America where it is also known as Campechy Wood or Blauholz and is the source of a yellow dye. A yellow dye is obtained also from the Guamachi (*Pithecolobium dulce* Benth.) of Guam and Tropical America. The *Pterocarpus cabrae* De Wild. (Molompi, African Rosewood, Red Sandalwood), *P. santalinus* L. (Santalwood) and *P. Marsupium* Roxb. (Kino-tree, Biji, Bastard Teak) all yield a red dye, the last named containing considerable tannin. The Pagoda Tree of China and Japan (*Sophora japonica* L.) and the Spanish Broom (*Spartium junceum* L.) yield yellow dyes. From the Tamarind (*Tamarindus indica* L.) is secured a red dye which is especially important in that it is its own mordant. The roots of *Elaphantorrhiza Burchelli* Benth., the leaves and pods of the Cashaw or Mesquite-tree (*Prosopis dulcis* Gill.) and the bark of the Turwar, (*Cassia auriculata* L. and *C. Fistula* L.) contain tannin.

#### MALPIGHIACEAE.

The Barbados Cherry, Mancite or Mangrutta (*Malpighia puniceifolia* L.) contains a light-colored tannin.

#### ZYGOPHYLLACEAE.

The Guayacan (*Guajacum sanctum* L.) produces the famous resin, Guajacum which in turn is the source of Guayac Blue and of Guayac Yellow. The juice of the Syrian Rue (*Peganum Harmala* L.) contains a red dye-principle.

## RUTACEAE.

A yellow dye is obtained from the Herb-of-Grace, An-grac, or Herb-of-Repentance (*Ruta graveolens* L.).

## BURSERACEAE.

The Braziletto-wood or Jamaica Redwood (*Commiphora* sp.) is a commercial redwood.

## MELLIACEAE.

Both tannin and a purple dye-principle are present in the Toon Tree or East Indian Mahogany (*Cedrela Toona* Roxb.) and in the Australian species *C. australis* v. Muell. Both are utilized in the manufacture of a beautiful purple leather.

## POLYGALACEAE.

The Rhatany (*Krameria triandra* Ruiz. and Pav.) contains a coloring principle used in wines. The Chacate (*K. canescens* Gray) contains a red dye-principle which the Mexicans employ in coloring leather. The Milkwort (*Polygala javana* DC.) contains indigo.

## EUPHORBIACEAE.

A number of the Euphorbias contain either a dye principle or tannin but all are foreign to Iowa. Among these are the Candlenut-tree or Tahiti Walnut (*Aleurites triloba* Forst.) from the fruits of which a dye is obtained; the *Baloghia lucida* Endl., the sap of whose wounded trunk furnishes a red dye; the Blood-tree (*Croton gossypifolius* Vahl.) from which is expressed a juice which the Aztecs used to dye cotton cloth a dark-red; *Euphorbia tinctoria* Boiss. and Huet. the source of a deep-purple Turnsole dye; the Kamala, Kameela, Monkey-face-tree, or Spoonwood (*Mallotus philippinensis* Muell.) from which a red powder is derived which is of commercial value; the Tallow-tree (*Sapium Sebiferum* Roxb.) the leaves of which are used in making a black dye; and the Kodari (*Cleistanthus collinus* Benth. and Hook.) and *Phyllanthus Emblica* L. containing tannin.

## EMPETRACEAE.

The Heathberry, Curley, Crake-berry, or Black Crowberry (*Empetrum nigrum* L.) produces berries containing a dye-principle.

## CORIACEAE.

The Tanner's or French Sumach (*Coriaria myrtifolia* L.) and the Tutu (*C. ruscifolia* L.) both contain a black dye-principle and the latter also contains tannin.

## ANACARDIACEAE.

*Rhus aromatica* Ait. (Squaw-berry, Sweet-scented or Trefoil Sumach) contains tannin.

*R. glabra* L. (Smooth Sumach, Vinegar-tree, Mountain Sumach) was much relied upon in Iowa in early days as a source of tannin.

*R. typhina*, L. (Staghorn Sumach) contains tannin.

There are several other species of *Rhus* that are important sources of tannin. Among these are the Tanner's Sumach (*R. Coriaria* L.), the leaves and bark both being utilized, L., *R. lucea* L., and the Purple Fringe or Feather-Tree, also known as Aaron's Beard (*R. cotinus* L.)

Many of these also contain dye-principles. *R. Coriaria* L. with an alum lake produces a brown dye; *R. cotinus* L. the yellow dye, fustic, which has not been replaced by artificial preparations; the juice of the berries of the Squaw-bush (*R. trilobata* Nutt.) mixed with Pinon gum are used by the Hopi Indians in making a red paint which is the Cup-na-la, a ceremonial pigment. Other tannin plants are the Kliphout (*Anaphrenium argenteum* E. Mey.), the Mango (*Mangifera indica* L.), the Quebracho (*Quebrachia Lorentzii* Griseb.), the Mastic or Balsam-tree (*Pistachia Lentiscus* L.), the Turpentine-tree (*P. Terebinthus* L.) the tannin being contained in galls produced on the bark by an aphid, and species of Schinus (*S. dependens* Orteg., *S. terebinthifolius* Raddi. and the Pepper-tree *S. Mollee* L.). Of other dye-plants in this family, there are the Quebracho, already mentioned, which affords a yellow dye, and the Oriental Cashew-nut or Marking-fruit (*Semecarpus Anacardium* L. fil.) the juice of which produces an indelible black stain.

## AQUIFOLIACEAE.

The Mate or Paraguay Tea (*Ilex paraguensis* A. St. Hil.) contains about 15% tannin which is also present in other species of the family.

## ACERACEAE.

*Acer saccharum* Marsh (Sugar Maple, Rock Maple.) The bark of this species is important in the manufacture of several American dyes.

## HIPPOCASTANACEAE.

The bark of the Horse Chestnut, Buckeye, Bongay, or Konker-tree (*Aesculus Hippocastanum* L.) contains tannin.

## RHAMNACEAE.

The seeds of Christ's Thorn (*Paliurus aculeatus* Lam.) contain a dye. The various species of *Rhamnus* yield dyes, the color depending upon the mordant used. Thus the purple juice of the fresh, ripe berries of the Buckthorn, Rhineberry, or Hartsthorn (*R. cathartica* L.) treated with an alkali is the source of the "sap-green" or "bladder-green" of commerce. In England, according to Plowright, a folk-use of the berries of this species and of the Black Dogwood or Berry Alder (*R. Frangula* L.) in making a yellow dye is known. Chinese green indigo is obtained from *R. dahurica* Pal. and *R. tinctoria* Waldst. and Kit. The French-berries (*R. Alaternus* L.) yield a dye. The Spanish-berries (*R. saxatilis* Jacq.) with alum produce a bright-yellow dye, but with iron, it becomes a dark-olive. *R. oleoides* yields a green dye. The root-bark of the Kanwait or Ventilago (*Ventilago madraspatana* Gaertn.) contains a brown coloring stuff, the berries a blue.

## BIXACEAE.

The pods of the Anatto or Orlean (*Bixa Orellana* L.) contain a yellow dye-principle used in coloring butter and oils. The Indians prepare a paint from the same species.

## VIOLACEAE.

The Pansy, Heart's-ease, Lady's-delight, Herb-trinity, Love-in-idleness, or Three-faces-in-a-hood (*Viola tricolor* L.) a cultivated plant often escaped from cultivation, contains a yellow dye-principle.

## DATISCAEAE.

A yellow dye is obtained from the Bastard Hemp (*Datisca cannabina* L.)

## CACTACEAE.

Various species of *Opuntia* as *O. vulgaris* Mill. and of *Nopalea*, as *N. coccinellifera* Salm-Dyck. furnish food for a cochineal insect which is the source of a commercial cochineal dye.

## LYTHRACEAE.

The powdered leaves of the Egyptian Privet, Camphire, or Alkanna (*Lawsonia alba* Lam.) are chewed by women of eastern countries to color their teeth. They are sometimes made into a paste and used as a cosmetic under the name of Henna. The Al-root, Soorangee, or Nino (*Morinda citrifolia* L. and *M. tinctoria* Roxb.) with an alumina lake produces a yellow dye; the bark and leaves of the *Lafoesnia Pacari* St. Hil. of Brazil, a yellow dye, and the flowers of *Woodfordia floribunda* Salisb. a red dye.

The root of the Purple Loosestrife (*Lythrum Salicaria* L.) contains tannin.

## PUNICACEAE.

The fruit and bark of the Pomegranate (*Punica granatum* L.) contain a yellow dye and tannin.

## RHIZOPHORACEAE.

The Many-petaled Mangrove (*Benguiera gymnorhiza* Lam.) is used in India as the source of a black dye and in Japan in coloring a reddish-brown.

The Red Mangrove (*Rhizophora Mangle* L.) is the most important commercially of the dye-plants of this family, the bark containing both a reddish-brown dye-principle and tannin.

## COMBRETACEAE.

The Umbrella-tree or Indian Almond (*Terminalia Catappa* L.) is used in the Tropics both in making a black dye and for ink; from *T. cycloptera* R. Br. is made a yellow dye; from the nuts and fruit of the Ink-nut or Hara-nut (*T. Chebula* Retz.) is obtained a black dye and the bark also contains tannin; a black-olive dye comes from the Bedda-nut (*T. Bellerica* Roxb.) and tannin is also present in this and other species. The White Mangrove (*Laguncularia racemosa* Gaertn.) contains tannin.

## MYRTACEAE.

The Apple-tree (*Angophora intermedia* DC.) contains tannin. Practically all Eucalypts contain tannin and dyes; thus a red dye is obtained from the Iron-bark-tree (*Eucalyptus leucosyylon* F. Muell.); an orange to red kino from *E. macrorhyncha* F. Muell. The bark of the Java Plum (*Eugenia Jambolana* Lamarck.) is used in dyeing. *E. Smithii* Poir and *E. Chequen* contain tannin. The Myrtle-berry (*Myrtus communis* L.) produces a bluish-red dye.

## MELASTOMATACEAE.

According to Kraemer, a black dye is obtained from the Tamonea (*Melastoma malabathricum* L.), from *Tibouchina Maximiliana* Baill.) and from *Tococa guianensis* Aubl. and a yellow dye from *Memecylon*. Tannin occurs in the barks.

## HALORHAGIDACEAE.

The roots of *Gunnera chilensis* Lam. contain both a dye-principle and tannin.

ABALIACEAE.

From the leaves of the Ivy-Bindweed or English Ivy (*Hedera Helix* L.) a black dye is obtained.

UMBELLIFERAE.

*Daucus Carota* L. (Carrot) The juice has a commercial importance as a butter-color. The celery (*Apium graveolens* L.) furnishes a yellow-green dye and the Parsley (*A. petroselinum* L.) a yellow dye.

THYMELAEACEAE.

A yellow dye is obtained from *Thymelaea tinctoria* Endl.

CORNACEAE.

The Cornelian Cherry, Kizzeljek, or Redwood of Turkey (*Cornus Mas* L.) furnishes a red dye. Some species contain a small amount of tannin.

ERICACEAE.

The Bearberry or Manzanita (*Arctostaphylos Uva-ursi* Spreng and *A. pungens* H. B. K.) contain tannin. In England, Plowright reports the use of Ling or Dog Heather, Crow Ling, Besom or Broom (*Calluna vulgaris* (L) Salisb.) in making a yellow-brown dye. From the Bilberry or Whortleberry (*Vaccinium myrtilloides* and *V. Myrtillus* L.) a blue to purple dye is obtained and from the Cranberry or Red Bilberry (*V. Vitis-Idaea* L.) a red dye.

PLUMBAGINACEAE.

Tannin is present in the Marsh Rosemary or Sea Lavender (*Statice Limonium* L.)

EBENACEAE.

Tannin is present in the unripe fruit of both the native Persimmon (*Diospyros virginiana* L.) and the Japanese species (*D. Kaki* L.) and is probably present in other species.

SYMPLOCACEAE.

From the leaves of the Sweet-leaf, Horse-sugar, Florida Laurel or Yellow-wood (*Symplocos tinctoria* L'Herit.) a yellow dye is obtained.

OLEACEAE.

*Fraxinus quadrangulata* Mx. (Blue Ash) contains a blue dye-principle. From the berries of the Privet, Skedge, Prim, or Print (*Ligustrum vulgare* L.) a bluish-red dye is made. From the same plant a green dye is known to folk-use in England.

GENTIANACEAE.

A yellow dye is obtained from the Yellowwort (*Chlora perfoliata* L.) and from the Bitter-root or Bitterwort (*Gentiana lutea* L.).

APOCYNACEAE.

The leaves of the Ivory-Tree (*Wrightia tinctoria* R. Br.) contain indigo. *Aspidosperma Quebracho-blanco* Schl. contains tannin.

ASCLEPIADACEAE.

The leaves of Stephanotis (*Marsdenia tinctoria* R. Br.) yield indigo.

BORAGINACEAE.

*Echium vulgare* L. (Blue Thistle, Viper's Bugloss, Blue-weed, Blue-stem) contains a violet dye-principle in its roots.

*Lithospermum arvense* L. (Corn Gromwell, Printing Plant, Salfern, Bastard Alkanet) contains a red dye-principle in its roots.

*L. canescens* Lehm (Indian Paint, American Anchusa, Hoary Puccoon) has properties similar to those of *L. arvense*.

*L. officinale* L. (Gromwell, Stony-hard, Lichwale) has properties like those of *L. arvense*.

Many species of *Lithospermum* possess dye-principles. The North American Indians make a violet dye from the Blue Flax (*L. angustifolium* Mx.); a red dye is obtained from the North American Alkanna (*L. hirtum* Lehm); according to Norton, dye-principles are present also in *L. multiflora*, S. Wats. (*L. strictum* Lehm., and *L. spathulatum* Mart. and Gray.

The Borage family is rich in dye plants. Among those foreign to Iowa are the Alkanet (*Alkanna tinctoria* (L) Tausch.), the root of which yields an important commercial dye varying from red to crimson. The Alkanna green is also obtained from the root. Species of *Arnebia* yield a violet dye. The petals of the Forget-me-not (*Myosotis palustris* Lam.) contain a dye-principle. The roots of Golden-drop (*Onosma Emodi* Wall. and *O. echioides* L.) yield a red dye. Gray mentions a violet dye obtained from *Plagiobothrys tenellus* Gray. According to Chesnut, the crimson juice of the Kockh (*P. campestris* Greene) is used by Indian women and children to stain their cheeks. Chesnut also speaks of the purple juice of *P. ursinus* A. Gray. The depth and yield of color will depend somewhat upon the age of the plant. Other species of *Plagiobothrys*, according to Norton, also undoubtedly contain dye-principles. A red coloring material comes from *Symphytum officinata* L. (Blackwort, Healing-herb, or Bonaset).

#### VERBENACEAE.

From the Puriri (*Vitex littoralis* Decne.) yellow dye is obtained which needs the addition of alum lake to become permanent.

#### LABIATAE.

*Stachys palustris* L. (Hedge Nettle, Cock-head, Marsh Moundwort). According to Plowright, a pale yellow dye from this plant is known to domestic use in England. *S. sylvatica* L. is used in the Himalaya Mountains in making a red dye.

A red dye is obtained from the Chua (*Perilla arguta* Benth.) and a yellow dye from the Salvia (*S. officinalis* L.).

#### SOLANACEAE.

According to Baron von Mueller, a violet dye is obtained from the berries of *Solanum guianense* Don. and *S. indigoferum* A. St. Hil.

#### SCROPHULARIACEAE.

From *Lyperia atropurpurea* Benth. of South Africa, the natives obtain an orange dye.

#### BIGNONIACEAE.

From *Bignonia Chica* H. and B. is obtained the Chica red, a commercial dye. The Lapach or Taigu-wood (*Tecoma Lapacho* (K) Sch.) yields a yellow dye.

#### ACANTHACEAE.

Indigo is obtained from species of *Ruellia*.

## RUBIACEAE.

*Galium Mollugo* L. (Greater Wild Madder, Whip-tongue, White Hedge) contains a red dye-principle.

*G. trifidum* L. (Smaller Wild Madder (Dyer's Cleaves) contains the same principle. In England there is a folk-use of *G. verum* L. in making a red dye.

No family is richer in dye-plants than is the Rubiaceae. Among these are many of commercial importance and many known only to folk-use.

Of the former, there are the Gardenia (*G. grandiflora* Lour.) the source of Chinese yellow; the Indigo-berry or Ink-berry (*Randia aculeata* L.) yielding a blue dye; the Madder plants (*Rubia tinctorium* L., *R. cordifolia* L., *R. peregrina* L., and other species) which are sources of Turkey-red; the Lobe-root (*Toddalea aculeata* Pers.) yielding a yellow dye; and the Gambier (*Uncaria Gambier* Roxb.) which produces the yellow gambier. In China the natives chew it with the Betel-nut. It also contains tannin. Other plants known especially to folk-use are the Indian Mulberry, Al-tree or Yaw-weed (*Morinda tinctoria* Roxb.) yielding a red dye; the Clay-root, Che-root or Indian Madder-plant (*Oldenlandia umbellata* L.) yielding a red dye and having also some commercial importance; and *O. umbellata* L.

## CAPRIFOLIACEAE.

*Sambucus canadensis* L. (Elderberry) yields a red dye. Other species as *S. nigra* L., *S. Ebulus* L. and *S. racemosa* L. contain the same dye-principle and are of commercial importance.

## COMPOSITAE.

*Helianthus annuus* L. (Sunflower, Comb-flower, Larrabell). From its blossoms is obtained a yellow dye.

An orange-yellow dye which according to Plowright is fast without a mordant is obtained from the Chamomile (*Anthemis tinctoria* L.).

Plowright is also authority for the use of the Water-Hemp (*Bidens tripartita* L.) as a dye-plant. From the flowers of the Safflower, Dyer's Saffron, or American Saffron (*Carthamus tinctorius* L.) is obtained a yellow dye which with the addition of French chalk is sometimes made into a rouge. The Corn-Marigold (*Chrysanthemum sagetum* L.) produces an orange-yellow dye-principle which however requires a mordant to become permanent. Millsbaugh states that the Fire-weed (*Erechtites*) contains a dye-principle. The flowers of *Heterothalamus brunioides* Less. produce the dye known as yellow Romerillo dye. From the Chamomile or Matricaria (*M. Chamomilla* L.) comes a yellow dye. Plowright says that in the Highlands, the Weeby, Stinking Willey, Cushag or Staggerwort (*Senecio Jacobaea* L.) is used in making a dye. The Saw-wort (*Serratula tinctoria* L.) produces a yellow dye. Wormwood (*Artemisia Absinthium* L.), an introduced plant which has become established in Iowa, contains a yellow dye-principle which is known to domestic use.