

The lichen genus *Chrysothrix* in the Ozark Ecoregion, including a preliminary treatment for eastern and central North America

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ABSTRACT. – The taxonomy of *Chrysothrix* Mont. is reviewed for eastern and central North America with special emphasis on the Ozark Ecoregion. Six taxa are recognized; three of these occur in the Ozarks. The new combination *Chrysothrix onokoensis* (Wolle) R.C. Harris & Ladd is made and the new species *Chrysothrix insulizans* R.C. Harris & Ladd is described. Eastern North American material previously determined as *Chrysothrix candelaris* is referred to *C. xanthina*. A key, descriptions, illustrations and distribution maps are provided.

INTRODUCTION

Attempting to catalogue all of the lichens of a region, such as the Ozarks, often leads to critical re-evaluation of previously accepted concepts. Inspired by Kalb (2001) to take a close look at our *Chrysothrix* Mont. specimens, we found that our previous determinations were wrong. Laundon's (1981) pioneering treatment proposed very broad species concepts and accordingly we initially assigned collections of *Chrysothrix* on rock to *C. chlorina* (Ach.) J.R. Laundon and collections on bark or wood to *C. candelaris* (L.) J.R. Laundon. It turns out that neither of these species is actually known from the Ozark region. The situation was further confused in that a few saxicolous specimens of *Chrysothrix* had been misdetermined as sterile *Chaenotheca furfuracea* (L.) Tibell. In the Ozarks, corticolous specimens are now assigned to *C. xanthina* (Vainio) Kalb, which also rarely occurs on rocks. Two additional saxicolous species are recognized in the Ozarks (one of them previously undescribed). In the process of resolving our Ozark problems, limited additional material from eastern and central North America was reviewed. Based on these data, it appears that *Chrysothrix chlorina* is apparently a northern species, and *C. xanthina*, thought by Kalb to be a tropical/subtropical species, is common as far north as New England and Minnesota. It is clear that further work is needed to resolve species problems in *Chrysothrix* in eastern North America, especially outside the Ozark region.

This paper was originally begun as a contribution to the volume honoring Klaus Kalb (Fritsch et al. 2007) but Ozark *Chrysothrix* proved too messy to meet the deadline for inclusion. Therefore, it is somewhat belatedly dedicated to Klaus Kalb, who among his many contributions to tropical lichenology, began the deconstruction of *Chrysothrix*.

Because of their prominent yellow coloration, *Chrysothrix* thalli are readily evident in the field. They typically occur in microhabitats with a combination of moderate to high light intensities and limited exposure to direct wetting. Corticolous species tend to inhabit relatively mesic habitats, growing in bark

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crevices and on the protected undersides of leaning boles, in areas that are either protected from direct runoff, or drain and dry quickly after wetting. At least in the Ozarks, calicioid lichens, particularly species of *Mycocalicium*, are a frequent associate on corticolous substrates. With the exception of *Chrysothrix flavovirens*, which always occurs on conifers, most corticolous species inhabit a wide range of hardwoods and conifers.

Saxicolous species of *Chrysothrix* occur on acidic siliceous rocks, often in areas with high light levels that are protected under overhanging bluffs and ledges. In more exposed habitats, thalli tend to occur on vertical or inversely slanted surfaces. Almost all saxicolous populations in the Ozarks occur on massive rock substrates, as opposed to cobbles and fragments.

METHODS

Granules were measured dry with a Zeiss Stemi 200-C with an Olympus DP20 digital camera using Microsuite Special Edition. Microscopic characters were measured in water with an Olympus BX51 microscope with camera and software as above. Chromatography was done variously with Merck glass and aluminum plates mostly with chloroform-acetone 4:1, but some with chloroform-methanol 10:1 or generally following the three solvent system of Culberson and Kristinsson (1970). The identification of leprapinic acid is tentative, based on co-chromatography with a duplicate of *Chrysothrix occidentalis* Elix & Kantvilas (Nepal, Weber L-87604). For complete collection data see <http://sciweb.nybg.org/science2/VirtualHerbarium.asp>.

Character synopsis for <i>Chrysothrix</i> and some similar taxa in eastern and central North America. Taxa documented from the Ozark Ecoregion are in bold . Minor constituents are in parentheses										
Taxon	substrate		granule size, µm	calycin	pinastic	vulpinic	leprapinic?	rhizocarpic	zeorin	parietin
	bark/ wood	rock								
<i>Chrysothrix candelaris</i>	●		50-75	±	±					
<i>Chrysothrix chlorina</i>		●	45-75	+		+			+	
<i>Chrysothrix flavovirens</i>	●		15-25(30)					+		
<i>Chrysothrix insulizans</i>	●	●	20-50	+			+			
<i>Chrysothrix onokoensis</i>		●	20-80				+			
<i>Chrysothrix xanthina</i>	●	●	25-40		+					
<i>Chrysothrix</i> sp.	●		25-45(65)	+	±					
Similar taxa:										
<i>Caloplaca chrysodeta</i>		●	(35) 45-85							+
<i>Chaenotheca furfuracea</i>	●	●	38-65			+				
<i>Psilolechia lucida</i>	●	●	30-55					+		

TAXONOMY

Key to *Chrysothrix* and *Chrysothrix*-like taxa in eastern North America

1. Photobiont chlorococcoid, the cells ± isodiametric; thallus chemistry various 2
 2. On bark or wood 3
 3. Granules small, 15-45 µm across; calycin or leprapinic? acid or pinastric acid or rhizocarpic acid as the major substance; eastern North America 4
 4. Thallus usually bright yellow, UV- (leprapinic? acid or pinastric acid or calycin); granules 25-45µm; on hardwoods or conifers 5
 5. Major substance pinastric acid or leprapinic? acid (K-, KC-); on trees and wood6
 6. Pinastric acid major; widespread in eastern U.S*C. xanthina*
 6. Leprapinic? acid major; specimens on *Quercus* & palm, southern Coastal Plain or on *Abies*, Maine & Michigan *C. insulizans* s. lat
 5. Major substance calycin (often K+ slowly reddish); typically on *Quercus*; Alabama, Florida & Georgia *Chrysothrix* sp.
 4. Thallus dull pale yellow to pale greenish yellow (whitish yellow with age in herbarium), UV + dull to bright orange (rhizocarpic acid); granules small, 15-25(-30) µm across, “loose”, without binding hyphae; exclusively on conifers *C. flavovirens* s. lat.
 3. Granules coarser, 35-80 µm across; calycin and/or pinastric acid; not seen from eastern North America *C. candelaris*
 2. On rock 7
 7. On acidic siliceous rock; thallus K- to K+ slowly reddish (calycin)..... 8
 8. Thallus thick, attached to rock by rhizohyphae (these sometimes not evident); usually easily separated from rock 9
 9. Thallus UV± dull orangish (leprapinic? acid), of loosely aggregated granules with numerous projecting hyphae, bicolor in section, yellow above, whitish to brown below (fig. 8); Ozarks, Pennsylvania & S.E. U.S *C. onokoensis*
 9. Thallus UV- (calycin, vulpinic acid, zeorin), usually of more tightly compacted granules, mostly without obvious projecting hyphae, ± uniform yellow in section; Ontario, Vermont *C. chlorina*
 8. Thallus thin, lacking rhizohyphae, of scattered to contiguous granules or leprose; rarely easily separable from rock 10
 10. Thallus K- (pinastric or rhizocarpic acid), forming a thin, ± continuous, granular crust11
 11. Thallus bright yellow to bright greenish yellow, UV- (pinastric acid); normally on bark, rarely on rock *C. xanthina*
 11. Thallus pale yellow to pale greenish yellow, UV+ dull to bright orange (rhizocarpic acid); normally on rock, often in heavily shaded crevices of fieldstone walls, rarely on bark or wood *Psilolechia lucida*
 10. Thallus K+ slowly reddish (calycin + leprapinic? acid), forming small ± round patches on rock, sometimes forming large continuous, rimose or rimose-areolate patches with rounded soralium-like outliers *C. insulizans*
 7. On calcareous rock; thallus K+ instantly magenta-purple (parietin)*Caloplaca chrysodeta*
1. Photobiont *Stichococcus*, the cells subrectangular to elongate; thallus containing vulpinic acid sterile *Chaenotheca furfuracea*

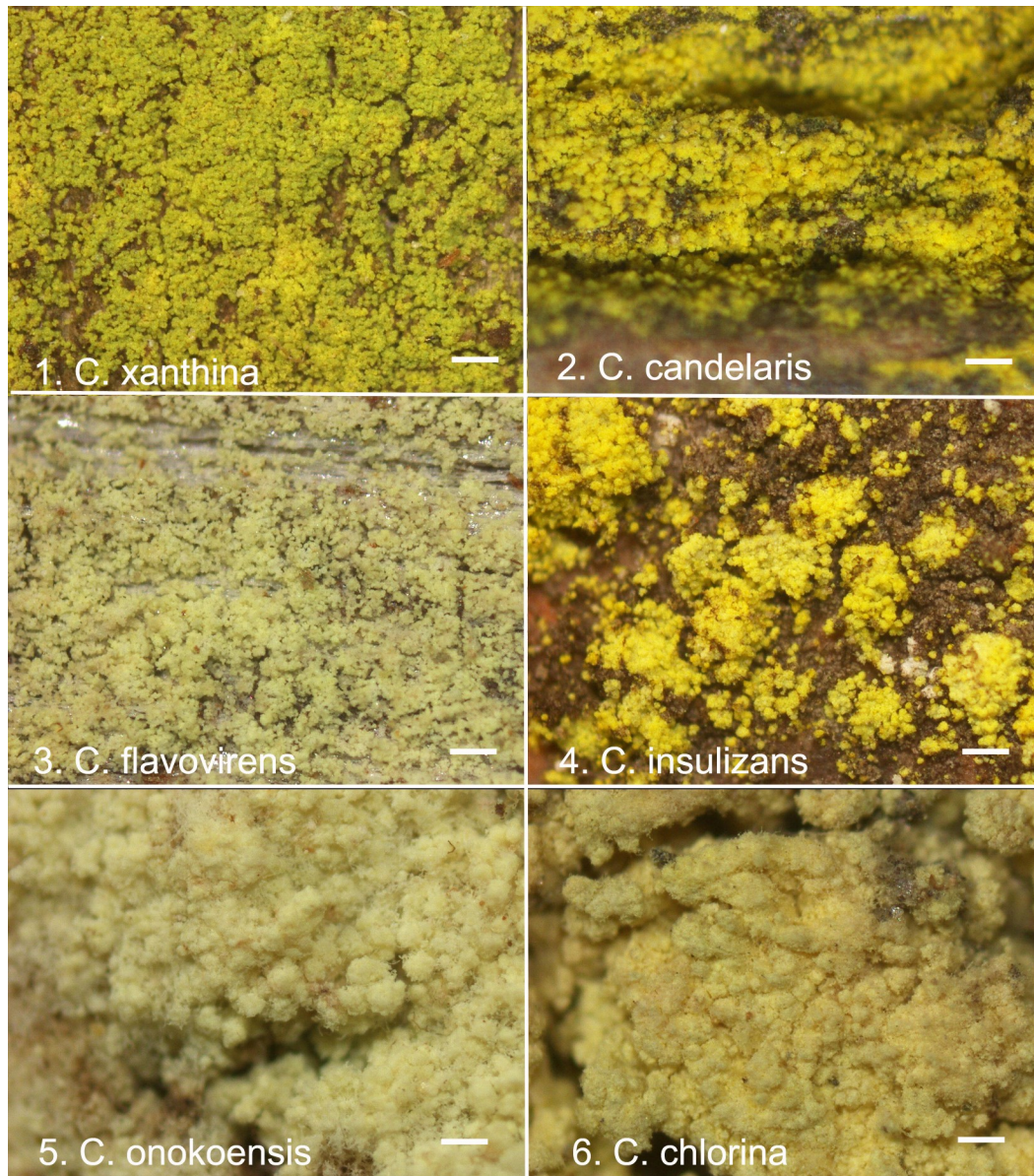


Plate 1. Figure 1. *Chrysothrix xanthina*, Arkansas, Izard Co., *Buck 40233*. **Figure 2.** *C. candelaris*, Germany, *Funck*. **Figure 3.** *C. flavovirens*, New Jersey, Burlington Co., *Harris 43831*. **Figure 4.** *C. insulizans*, Missouri, Shannon Co., *Ladd 18690* (holotype). **Figure 5.** *C. onokoensis*, Arkansas, Franklin Co., *Harris 49242*. **Figure 6.** *C. chlorina*, Norway, Hordaland, *Havaas*. (all NY). Bar = 200 µm.

Chrysothrix candelaris (L.) J.R. Laundon

PLATE 1, FIGURE 2.

DESCRIPTION. - **Thallus** leprose, of thin, scattered granules coalescing into a \pm continuous, non-areolate crust, bright yellow, often with orangish or greenish tinge or rarely greenish yellow, unstratified, without marginal lobes; photobiont chlorococcoid, with \pm spherical cells to 15 (-18) μm across. **Chemistry**: K⁺, KC⁺ reddish or K⁻, C⁻, PD⁻, UV⁻; three chemotypes 1) calycin; 2) calycin + pinastric acid; 3) pinastric acid. **Granules** \pm spherical, 50-75 μm across. **Apothecia** not seen. **Pycnidia** not seen. (partly modified from Laundon, 1981).

DISCUSSION. - All specimens seen by us from eastern and central North America that had been identified as *C. candelaris* are indistinguishable from *C. xanthina* in granule size and chemistry. The granules are 25-40 μm in diameter, (20-50 μm for *C. xanthina*, Kalb, 2001), averaging 29-36.5 μm , and contain pinastric acid as the major substance. According to Kalb (2001) *C. candelaris* has granules 75-200 μm in diameter and contains calycin as the major substance. Based on measurements of eight European collections, we observed granules 50-75 μm (averages 44.5-69 μm), somewhat smaller than given by Kalb (2001), but not overlapping those of *C. xanthina*. Harris has been aware since the early 1970s that eastern North American material assigned to *C. candelaris* contains pinastric acid as the major substance, and, not realizing that size matters, annotated some specimens as *Lepraria citrina* (Schaer.) Rabenh. (type collection pinastric acid major, confirmed by Kalb 2001). However, in an isotype of *Lepraria citrina* Schaer. (Schaer. Lich. Helv. 3, NY) the granules are larger than in *C. xanthina* (56-73 μm in diameter) suggesting that it may be a chemotype of *C. candelaris* or an unrecognized species.

SPECIMENS EXAMINED. - **FRANCE**. Orne et Calvados, *Olivier*, Lich. Exs. 150; sine loc, *Desmazières*, Pl. crypt. ed. 1, 682 (NY). **GERMANY**. Fichtelgebirge, *Funck*, Crypt. Gew. Fichtelberg. 705 (NY). **SCOTLAND**. SOUTH AYRSHIRE. Culzean Castle and County Park, *King L230* (NY). **SWEDEN**. BLEKINGE. Trenssum Par., Hällaryd, *Kärnefelt 2718* (NY).

Chrysothrix chlorina (Ach.) J.R. Laundon

PLATE 1, FIGURE 6; PLATE 3, FIGURE 11 (map).

DESCRIPTION. - **Thallus** thick, continuous to strongly areolate, bright yellow, ecorticate, loosely attached and easily separated from rock, lacking well-defined lobes, forming extensive, irregularly spreading patches, to ca. 1.0 mm thick, \pm densely compact in central parts, consisting of yellow granules which become paler toward base; rhizohyphae not evident to well developed; photobiont chlorococcoid, spherical, to 18 μm across. **Chemistry**: K \pm , KC \pm reddish, C⁻, PD⁻, UV⁻; calycin, vulpinic acid and zeorin (minor) (not usually reported for *C. chlorina* but was found also by Tønsberg 1992). **Granules** variable, spherical or \pm irregular, 40-75 μm across (100-200 μm , Laundon, 1981), occasionally with projecting hyphae; hyphae colorless, 2.0-5.0 μm thick. **Apothecia** not seen. **Pycnidia** not seen.

DISCUSSION. - *Chrysothrix chlorina* is separated from the morphologically similar *C. onokoensis* by chemistry (calycin, vulpinic acid and zeorin vs. leprapinic? acid), and to a lesser extent in more frequently having the granules without projecting hyphae compacted into a denser crust which is not obviously bicolor in section (lacking a distinct layer of rhizohyphae in eastern North American material) although the lower parts may be paler. From the limited material examined, *C. chlorina* seems to have a distinctly northern distribution in eastern North America.

SPECIMENS EXAMINED. - **CANADA. ONTARIO**: THUNDER BAY DIST.: Hwy 593, 10 km S of Silver Mountain, *Barclay 9819* (CANL), small lake 1 mi. NE of Sturgeon Bay, *Garton 8474* (CANL), Spur Bay at SW corner of Ombabika Bay, Lake Nipigon, *Garton 20892* (CANL), N end of Inner Barn Island, Wabinoosh Bay, Lake Nipigon, *Garton 20992* (CANL, NY) **U.S.A. VERMONT**, WINDHAM CO.: Brattleboro, *Russell* (NY).

Chrysothrix flavovirens Tønsberg *s. lat.*

PLATE 1, FIGURE 3; PLATE 3, FIGURE 9 (map).

DESCRIPTION. - **Thallus** crustose, leprose, thin, on bark of conifers, dull yellow or greenish yellow (becoming whitish yellow in herbarium), unstratified, ± spherical or irregular granules coalescing into small discontinuous patches, more often forming extensive patches, one-few granules thick; rhizohyphae absent; photobiont chlorococcoid, to 8.5 µm across. **Chemistry**: spot tests negative, UV+ dull to bright orange; rhizocarpic acid. **Granules** spherical to ± irregular, 15-25(-30) µm across, “loose” (i.e., fungal hyphae linking granules absent). **Apothecia** not seen. **Pycnidia** not seen.

DISCUSSION. - *Chrysothrix flavovirens* as treated here presents two problems. The first is that all eastern North American material, although indistinguishable in morphology from an isotype (Tønsberg, Lich. Isid. Sored. Crust. 7, NY) and in having the same substrate preference for conifer bark as in Europe, lacks diffractaic acid and, thus, is provisionally included in a broad concept of the species as an acid deficient chemotype. The second is that the granules seem to lack any hyphae binding them into a ± coherent thallus suggesting that there may not be a close relationship between *C. flavovirens* and the rest of *Chrysothrix*.

The combination of dull, often greenish yellow color, very small granules (averages of four specimens 20(-25) µm) and growing exclusively on conifers, usually in humid, shaded habitats, is distinctive for *C. flavovirens*. It appears to be relatively common, perhaps confined to the Coastal Plain, ranging from south-central Florida to Maine. It has not been collected in the Ozarks. Substrates include a wide range of conifers: *Chamaecyparis*, *Pinus*, *Taxodium*, and *Tsuga*.

SPECIMENS EXAMINED. - **U.S.A. ALABAMA.** BALDWIN CO.: Splinter Hill Bog Preserve, *Lendemmer 9062* (NY); JACKSON CO.: Pisgah, Jones Cove, below Pisgah Civitan Park, *Harris 43334* (NY). **CONNECTICUT.** TOLLAND CO.: Town of Mansfield, N of end of White Oak Road, *Harris 46158* (NY). **FLORIDA.** BAKER CO.: Along CR 127 at Moccasin Creek, *Harris 39281* (NY); FLAGLER CO.: Along Co. Rd. 304 at Sweetwater Creek, *Harris 37424* (NY); GILCHRIST CO.: Wacasassa Flats, *Harris 31680* (NY); HAMILTON CO.: Bee Haven Bay, N of Co. Rd. 6, *Harris 32502* (NY); POLK CO.: Walter Heiler Development near Nalcrest, *Wheeler s.n.* (NY); SUMTER CO.: Green Swamp Wildlife Management Area, Cross Creek Swamp, *Harris 41625* (NY). **MAINE.** YORK CO.: Massabesic Experimental Forest, *Harris 46235* (NY). **MARYLAND.** WORCESTER CO.: Hickory Point Cypress Swamp, *Lendemmer 6356* (NY), *Lendemmer 6361* (NY). **NEW JERSEY.** ATLANTIC CO.: Mullica River system, NW of Pleasant Mills Cemetery, *Lendemmer 3293* (NY); N bank of Tuckahoe River, *Lendemmer 7566* (NY); BURLINGTON CO.: Mt. Misery, E of Mt. Misery Road, *Buck 47393* (NY); Shinn’s Branch, Lebanon State Forest, *Anderson s.n.* (NY); Wharton State Forest, Quaker Bridge, *Brodo 29809* (CANL), *Harris 43831* (NY); CUMBERLAND CO.: Edward Bevin Wildlife Management Area, *Lendemmer 1910* (NY); Gloucester Co.: Glassboro/Clayton Wildlife Management Area, *Harris 43831* (NY); SUSSEX CO.: Stokes State Forest, Tillman Ravine, *Harris 27952* (NY). **NEW YORK.** DUTCHESS CO.: Carey Arboretum, *Harris 13397* (NY), *Harris 14069* (NY); SUFFOLK CO.: Cranberry Bog Nature Preserve, *Harris 19415* (NY). **NORTH CAROLINA.** CRAVEN CO.: N of Flanners Beach Road, *Lendemmer 3728* (NY); WAKE CO.: William B. Umstead State Park, *Lendemmer 8048* (NY), *Lendemmer 8393* (NY), *Perlmutter 786* (NY). **PENNSYLVANIA.** MONROE CO.: Delaware Water Gap Natl. Recreation Area, *Harris 49523* (NY), *Lendemmer 4936* (NY) (Lendemmer, Lich. E. N. Amer. 213). **RHODE ISLAND.** WASHINGTON CO.: Marion Eppley Wildlife Sanctuary, *Harris 53128* (NY).

Chrysothrix insulizans R.C. Harris & Ladd, *sp. nov.*

MYCOBANK #511492.

PLATE 1, FIGURE 4; PLATE 3, FIGURE 10 (map).

Chrysothrix saxicola ab aliis speciebus saxicolis thallo tenui dispersoque, primo soraliis simili, demum plus minusve continuo areolatoque, sorediis 25-30 μm in diametro et calycin et acidum leprapinicum? continenti differt.

TYPE. U.S.A. MISSOURI. SHANNON CO.: Ozark National Scenic Riverway, in Prairie Hollow Gorge Natural Area, east of hwy V, W1/2 sec. 15 T29N R3W, on shaded rhyolite face under massive overhang on west-facing slope, 18 May 1995, *Ladd 18690* (NY, holotype).

DESCRIPTION. - **Thallus** crustose, leprose, thin to moderately thick, bright yellow to yellow-green or yellow-orange, unstratified, adnate, forming small, \pm round or irregular soralium-like colonies, one-few granules thick to 200 μm , often remaining discontinuous but also forming or coalescing into larger, continuous, rimose or rimose-areolate patches several cm. across and then to 500 μm thick; rhizohyphae absent; photobiont chlorococcoid, spherical, 9–14 μm across. **Chemistry**: K+ reddish, C–, KC + reddish, PD–, UV–; calycin (major) and leprapinic? acid (\pm major), unknown pulvinic acid derivative (tr.). **Granules** farinose, \pm spherical, 20–50 μm across; hyphae 2-2.5 μm wide. **Apothecia** not seen. **Pycnidia** not seen.

DISCUSSION. - The epithet "insulizans", meaning "island-forming", derives from the thallus which very often consists of separate soralium-like patches. *Chrysothrix insulizans* is separated from the other North American species on rock in containing calycin (K+ reddish) and the thin, often discontinuous thallus. *Chrysothrix insulizans* may prove identical to the Australian and Asian *C. occidentalis* (Elix & Kantvilas 2007) but is maintained as distinct here mainly based on geography and a minor chemical difference (calycin minor in the latter). We have not seen enough material to evaluate possible morphological differences.

We initially believed that *C. insulizans* was strictly saxicolous but a handful of corticolous specimens have been found with identical chemistry. They fall into two groups: a southern Coastal Plain population which is \pm within the geographical range of the saxicolous material (thus more likely to be *C. insulizans*), and a northern population (Maine & Michigan) occurring on *Abies* which is probably a distinct taxon requiring molecular methods for a definitive disposition.

Chrysothrix insulizans typically occurs on non-calcareous rock, often shaded under overhangs but also in exposed situations. It has a S.E. U.S.-Ozark distribution. Most collections are from sandstone, but it also occurs on rhyolite, granite, and cherty dolomites.

SPECIMENS EXAMINED. - U.S.A. ARKANSAS. MONTGOMERY CO.: E of Little Missouri Falls, Ouachita Natl. Forest, *Sharnoff & Sharnoff 1049.14* (CANL); STONE CO.: Ozark Natl. Forest, Blanchard Springs Recreational Area, *Ladd 15355* (HB. LADD). FLORIDA. PUTNAM CO.: Along C.R. 21, 2.7 mi S of Johnson, *Harris 39870* (cort., NY); VOLUSIA CO.: Daytona Beach Peninsula, *Shchepanek 29A* (cort., CANL); WASHINGTON CO.: Rock Hill, ca. 7 mi due SE of Chipley, E of Co. Rd. 273 just S of I-10, *Harris 35596* (NY). GEORGIA. CHARLTON CO.: Okefenokee Natl. Wildlife Refuge, along Suwannee Canal, *Wetmore 65307* (cort., NY); COFFEE CO.: Broxton Rocks Ecological Preserve, 9 mi E of Broxton, 3 mi S of Ocmulgee River, *Harris 32603* (NY); Broxton Rocks Ecological Preserve, Ricketson Tract, *Harris 36120* (NY); JEFF DAVIS CO.: 0.4 mi E of Coffee Co. line on Georgia Hwy 107, *Harris 36190* (NY); ROCKDALE CO.: Panola Mountain State Park, *Lendemer 9003* (NY) (LENDEMER, LICH. E. N. AMER. 274). MISSOURI. CARTER CO.: Bluff on E side of Current river across from Big Spring S of Van Buren, *Harris 25664* (NY); CRAWFORD CO.: Woodson K. Woods Memorial Conservation Area *Lendemer 6081* (NY); IRON CO.: Royal Gorge, along St. Rd. 21/72 1.7 mi S of jct with Co. Rd. CC, *Harris 21794* (NY), *Ladd 6188* (HB. LADD); NEWTON CO.: Wildcat City Park at S edge of Joplin, Silver Creek Glade, *Buck 42971* (NY); REYNOLDS CO.: St. Francis Mountains, Johnson Shut-Ins State Park, *Harris 31226* (NY); STE. GENEVIEVE CO.: Canyon in LaMotte sandstone along upper reaches of Fourche DuClos, 2.1 mi SW of Lawrenceton, *Ladd 20243* (HB. LADD); SHANNON CO.: MOFEP site 4, in Cardareva State Forest, *Chadwell 65* (NY); Ozark Natl. Scenic Riverways, Rocky Falls, *Buck 18082* (NY); Ozark Natl. Scenic Riverways, Prairie Hollow Gorge, *Buck 18177* (NY). WAYNE CO.: Sam A. Baker State Park, Shut-Ins Trail, along Big Creek, *Buck 45365* (NY), *Ladd 17086* (NY, HB. LADD). NORTH

CAROLINA. CARTERET Co.: Cape Lookout National Seashore, Shackleford Banks, *Harris 47176* (cort., NY); JACKSON Co.: Cedar Cliff Mountain, ca. 3.5 mi E of Tuckasegee (NC 107) on NC 281, *Harris 33035* (NY); MACON Co.: Nantahala Natl. Forest, McDowell Mountain, *Harris 33122* (NY). **OHIO.** JACKSON Co.: Along old US 35, just W of Jackson Co. Road 28, *Buck B101* (CANL). **OKLAHOMA.** LATIMER Co.: Robber's State Park, *Keck 1685* (NY). **SOUTH CAROLINA.** ABBEVILLE Co.: Sumter Natl. Forest, Parsons Mountain, *Harris 40293* (NY); GREENVILLE Co.: Along US 276, 0.2 mi downhill of Bald Rock, *Harris 43451* (NY); LANCASTER Co.: Forty Acre Rock Heritage Preserve, just S of Taxahaw, *Harris 43486* (NY).

SPECIMENS EXAMINED FROM ABIES. – **MAINE.** HANCOCK Co.: Acadia Natl. Park, Schoodic Peninsula, *Sullivan 2260* (CANL). **MICHIGAN.** CHEBOYGAN Co.: Iron Bridge at Carp Creek, *Riefner 81-364* (NY); DELTA Co.: ca. 0.3 mi S of Portage Bay Campground, *Harris 11969* (CANL, NY); KEWEENAW Co.: Isle Royale Natl. Park, bog behind Checker Point on S. shore of Siskiwit Bay, *Wetmore 48771* (CANL).

Chrysothrix onokoensis (Wolle) R.C. Harris & Ladd, *comb. nov.*

MYCOBANK #511495.

Bulbotrichia onokoensis Wolle, Bull. Torrey Bot. Club 6: 141. 1877. TYPE: sine loc. [Pennsylvania, Carbon Co.: Glen Onoko], 1875, *Wolle* (PH 1060002 [barcode 6109], lectotype, **designated here**).

PLATE 1, FIGURE 5; PLATE 2; PLATE 3, FIGURE 11 (map).

DESCRIPTION. - **Thallus** crustose, leprose-byssoid, thick, bright yellow to bright yellow-green, ecorticate, loosely attached and easily separated from rock, lacking well-defined lobes, forming extensive, irregularly spreading patches to 10 cm wide, to ca. 1.0 m thick, consisting of an upper layer of yellow granules and a lower layer of whitish to brownish rhizohyphae, to 0.6 mm thick (fig. 8); rhizohyphae brown (initially colorless), 3.5-6.5 μm thick; photobiont chlorococcoid, spherical, (7-)10-15(-20) μm across. **Chemistry:** spot tests negative, UV \pm dull orange; leprapinic? acid. **Granules** variable, spherical or \pm irregular, 20–80 μm across, usually with projecting hyphae; hyphae colorless, 2.5-4.5 μm thick, with rough, colorless sheath, to 1.0 μm thick. **Apothecia** not seen. **Pycnidia** not seen.

DISCUSSION. - Although *Bulbotrichia* (= *Trentepohlia*) *onokoensis* was described as an alga, it was promptly recognized as a lichen by the distinguished botanist (though not a lichenist) Asa Gray (1878) in a letter to the editor of the Torrey Botanical Club Bulletin which may be taken as a model of polite rebuke.

"§ 215. DEAR MR. EDITOR :-Considering that your worthy CLUB bears the name of that venerable man and scrupulously conscientious botanist who disliked most of all hasty and inconsiderate publication of genera, and species, may an old botanist advise some younger ones to make haste more slowly? In particular, the proper determination of low *Algae* and *Fungi* requires not only critical study of many forms with the best appliances, but also a good acquaintance with the literature of the subject at first hand.

It is not my vocation to look after Cryptogamic botany, and I am sincerely desirous to avoid giving offence. Yet I will venture a few remarks upon Mr. Wolle's papers on Fresh Water Algae.

... " *Bulbotrichia onokoensis*" is founded on the young thallus of a Lichen."

Gray's observation then languished for 128 years until James Lendemer, in the process of databasing algal types at the Academy of Natural Sciences of Philadelphia recognized *Bulbotrichia onokoensis* was a *Chrysothrix*. There was some minimal excuse for Wolle's error since *Trentepohlia* often forms orange tufts on moist rock although the color of the *Chrysothrix* is yellow, not orange.

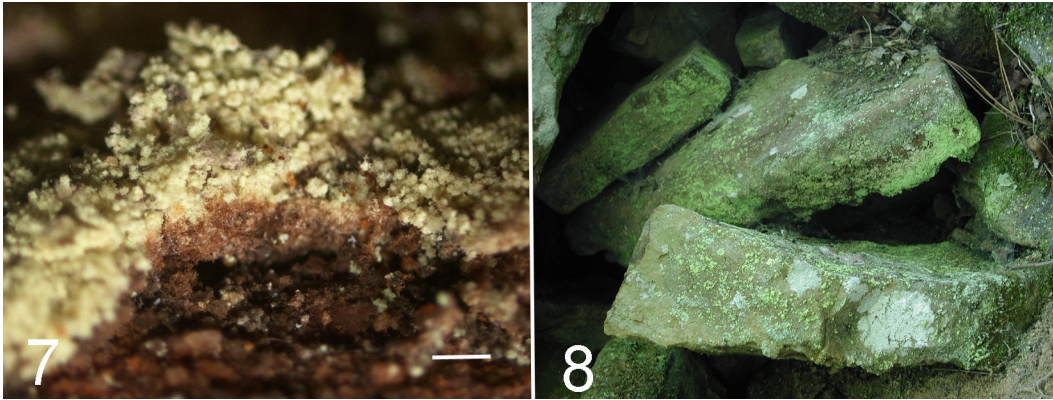


Plate 2. Figure 7. *Chrysothrix onokoensis*, section of thallus, Arkansas, Crawford Co., *Buck 46663* (NY). Bar = 0.5 mm. **Figure 8.** *C. onokoensis*, habit, Arkansas, Franklin Co., *Harris 49242* (NY, photo: Tony Kirchgessner).

Embarrassingly we also had problems (although not of the above magnitude) placing this species since we initially identified some specimens of *C. onokoensis* as sterile *Chaenotheca furfuracea* (L.) Tibell which differs in photobiont (*Stichococcus* vs. chlorococcoid) and chemistry (vulpinic acid vs. rhizocarpic acid). It was also initially identified as *Chrysothrix chlorina* which differs in having more compact thallus cross-section \pm uniformly colored (two layered in *C. onokoensis*) and in containing calycin, vulpinic acid and zeorin. Also, pending further study, *C. onokoensis* and *C. chlorina* do not overlap in distribution (fig. 11). *Chrysothrix insulizans* likewise grows on rock and *C. xanthina* rarely also; *C. insulizans* differs in thinner, more discontinuous thallus lacking rhizohyphae and containing calycin and leprapinic? acid, *C. xanthina* in thin, granular thallus lacking rhizohyphae containing pinastric acid. Australian *C. tchupalensis* Elix & Kantvilas (Elix & Kantvilas 2007) has a similar morphology and contains leprapinic acid but differs in also containing a xanthone (no xanthenes have been detected in *C. onokoensis*).

Chrysothrix onokoensis grows on shaded sandstone with the exception of the specimen from Alabama which is on limestone. The Pennsylvania collection seems out of the main range of the species but Glen Onoko is known to harbor rare vascular plants disjunct from more southern regions (including the Ozarks) (Pretz 1911).

SPECIMENS EXAMINED. - **ALABAMA.** DEKALB AND MARSHALL COS.: Buck's Pocket State Park, *Buck 34704* (NY). **ARKANSAS.** CRAWFORD CO.: Ozark Natl. Forest, along Forest Service Road 1725 (CR 257), 0.2 mi NW of jct with Forest Service Road 1716 *Buck 46663* (NY); FRANKLIN CO.: Ozark Natl. Forest, Boston Mountain Ranger District, Shores Lake, *Buck 46699* (NY), *Buck 49565* (NY), *Harris 49242* (NY), *Ladd 25832* (HB. LADD), *Ladd 27571* (HB. LADD), *Lendemmer 5501* (NY); MADISON CO.: Boston Mountains, Ozark Natl. Forest, White Rock Wildlife Management Area, Beech Hurricane Ravine, *Buck 37357* (NY), *Ladd 22198* (HB. LADD); NEWTON CO.: Boston Mountains, Ozark Natl. Forest, Alum Cove Recreation Area, *Harris 21507* (NY), Ozark Natl. Forest, near SW corner of Upper Buffalo Wilderness, *Lendemmer 6567* (NY); STONE CO.: Ozark Natl. Forest, Blanchard Springs Recreation Area, *Ladd 15347* (HB. LADD). **GEORGIA.** COFFEE CO.: Broxton Rocks Ecological Preserve, *Buck 24970* (NY), *Buck 30501* (NY). **PENNSYLVANIA.** CARBON CO.: Cliffs Lehigh Valley, *Wolle* s.n. (PH, syntype).

Chrysothrix xanthina (Vain.) Kalb

syn. nov. *Bilimbia aurata* Riddle, in Britton & Millspaugh, Bahama Flora 543. 1920. Type. Bahamas, New Providence, Farrington Road, 24 Aug 1904, *E. G. Britton 2221* (NY, isotype, pinastric acid!).

? *Bilimbia stevensonii* Fink ex J. Hedrick, Mycologia 22: 251. 1930. Type. Puerto Rico, near Rio Piedras, *Stevenson 5163* (MICH, holotype, chemistry not studied).

PLATE 1, FIGURE 1; PLATE 3, FIGURE 12 (map).

DESCRIPTION. - **Thallus** crustose, leprose, thin, on bark, wood and rarely rock or bryophytes, bright yellow or greenish yellow, unstratified, of \pm scattered granules usually coalescing into small discontinuous patches, sometimes into more extensive patches, when \pm continuous one-few granules thick to ca. 100 μ m, occasionally remaining as mostly separate granules; rhizohyphae absent; photobiont chlorococcoid, to 15 μ m across. **Chemistry**: spot tests negative, UV-; pinastric acid. **Granules** spherical to \pm irregular, 25-40 μ m across; hyphae 2-4 μ m across. **Apothecia** on a single Florida specimen (*Buck 28935*), arthonioid, yellow pruinose, ca. 0.1-0.2 mm across; spores 3-septate, ca. 10.5-12 x 2.5-3 μ m (\pm immature?). **Pycnidia** not seen.

DISCUSSION. - *Chrysothrix xanthina* is distinctive in its relatively thin thallus, small granules, production of pinastric acid and occurrence on bark or wood. Rare specimens on rock are distinguished from *C. onokoensis* by thin thallus lacking rhizohyphae and from *C. insulizans* by more continuous thallus and producing pinastric acid instead of leprapinic? acid and calycin. Corticolous material assigned to *C. insulizans* is morphologically very similar and only separable with chromatography.

Kalb (2001) resurrected *C. xanthina* from the synonymy of *C. candelaris* based on chemistry and soredial size (see above under *C. candelaris*). Kalb (2001) considered it a subtropical/tropical taxon and cited a single Florida specimen. However, material indistinguishable from his concept of *C. xanthina* is widely distributed in eastern North America from the Canadian border to Florida, and westward to the eastern edge of the mixed grass prairie regions of the Great Plains, occurring on both hardwoods and conifers. A variety of trees with both acidic and circumneutral to slightly basic bark are common substrates, including most of the common genera of trees in the region: *Acer*, *Betula*, *Carpinus*, *Carya*, *Cercis*, *Crataegus*, *Fraxinus*, *Gleditsia*, *Gymnocladus*, *Juglans*, *Juniperus*, *Nyssa*, *Pinus*, *Platanus*, *Prunus*, *Quercus*, *Taxodium* and *Tilia*. This species also occurs on decorticate hardwood and softwood, and rarely on lightly shaded, sheltered sandstone.

The synonyms cited above were not included in Laundon (1981); both have apothecia. Since becoming aware of the critical characters in *Chrysothrix*, we have not re-examined the type material of *Bilimbia stevensonii* so that we have no record of soredial size or chemistry. Its definitive disposition is left for future study.

SPECIMENS EXAMINED (ON BARK OR WOOD UNLESS OTHERWISE NOTED). - **ALABAMA**. BALDWIN CO.: Splinter Hill Bog Preserve, *Harris 53332* (NY); BIBB CO.: Talladega Natl. Forest, Reed Brake Research Natural Area, *Harris 28885* (NY); CLAY CO.: Talladega Natl. Forest, Cheaha Wilderness, Chinnabee Silent Trail, *Harris 28384* (NY); ESCAMBIA CO.: Escambia Creek Wildlife Management Area, *Buck 51671* (NY); Solon Dixon Forestry Education Center, *Lendemmer 9458* (NY); MARSHALL CO.: Lake Guntersville State Park, *Lendemmer 4857* (NY). **ARKANSAS**. BAXTER CO.: Ozark Natl. Forest, Leatherwood Wilderness, *Harris 51199* (NY); BENTON CO.: Hobbs State Park-Conservation Area, *Harris 51709* (NY); CARROLL CO.: Dolomite bluff along White River north of hwy 62 bridge, *Ladd 22628* (HB. LADD); FRANKLIN CO.: Ozark Natl. Forest, Bee Rock, on rock, *Ladd 25883A* (HB. LADD); Ozark Natl. Forest, along Hurricane Creek near Shores Lake, *Morse 12049* (KANU); GREENE CO.: Crowley's Ridge State Park, *Ladd 16009B* (HB. LADD); HOT SPRING CO.: DeGray Lake State Park, *Ladd 15651* (HB. LADD); IZARD CO.: NE corner of Devil's Knob-Devil's Backbone Natural Area, *Buck 40233* (NY); JEFFERSON CO.: Pine Bluff Arsenal along south side of Arkansas River, *Ladd 21777* (NY), *Ladd 21871* (NY), *Ladd 22039* (NY); MADISON CO.: Withrow Springs State Park, along War Eagle Creek, *Ladd 14804* (HB. LADD); PIKE CO.: Wooded novaculite bluffs north of Langley, *Ladd 14944* (HB. LADD); POPE CO.: Ozark Natl. Forest, Kings Bluff, on rock, *Ladd 27469* (NY, HB. LADD); PRAIRIE CO.: Wattensaw Wildlife Mgmt. Area, *Ladd 18530* (HB. LADD); SHARP CO.: Strawberry River Preserve, *Harris 45583* (NY); STONE CO.: Ozark Natl. Forest, Blanchard Springs Recreation Area, *Ladd 15393* (HB. LADD); VAN BUREN CO.: Ozark Natl. Forest, Upper Brock Creek Campground, *Ladd 28190* (HB. LADD). **FLORIDA**.

ALACHUA CO.: Paynes Prairie State Preserve, Bolens Bluff Trail, *Harris 29464* (NY); BAY CO.: N of Fla. Hwy. 20, 1.2 mi E of U.S. Hwy. 231, *Harris 35746* (NY); CALHOUN CO.: W of St. Rd. 71. 6.6 mi N of Gulf County line, *Harris 32173* (NY); CITRUS CO.: Withlacoochee State Forest, *Harris 31827* (NY); CLAY CO.: Gold Head Branch State Park, *Harris 29092* (NY); COLLIER CO.: Big Cypress Natl. Preserve, *Harris 30192* (NY); DADE CO.: Royal Palm Hammock, *Small 7596* (NY); COLUMBIA CO.: along Fla. Hwy. 250, ca. 0.5 mi S of I-10, *Harris 26252* (NY); DIXIE CO.: Steinhatchee Wildlife Management Area, *Harris 31590* (NY); HAMILTON CO.: Bee Haven Bay, N of Co. Rd. 6, E of Jasper, *Harris 32490* (NY); HENDRY CO.: Along CR 78, 0.6 mi W of SR 29 at LaBelle, *Buck 33879* (NY); HIGHLANDS CO.: Archbold Biological Station, *Buck 33684* (NY); HOLMES CO.: E of Co. Rd. 177A, 4 mi NW of St. Rd. 79 in Bonifay, *Harris 32095* (NY); LAFAYETTE CO.: Along Co. Rd. 355A, 1.4 mi SE of Fla. Hwy. 51, *Harris 35804* (NY); LEON CO.: Leon Sinks Geological Area, *Harris 23275* (NY); LEVY CO.: along Fla. Hwy. 24 ca. 6 mi NE of jct. with U.S. Alt 27 at Bronson, *Harris 29308* (NY); MANATEE CO.: Duette Park, *Harris 42079* (NY); MARION CO.: Ocala, *Underwood 1845* (NY); ORANGE CO.: Tosohatchee State Reserve, *Harris 37513* (NY); OSCEOLA CO.: Bull Creek Wildlife Management Area, *Harris 37558* (NY); POLK CO.: Bok Tower Gardens, *Wheeler s.n.* (NY); SEMINOLE CO.: along Econlockhatchee River at Little-Big Econlockhatchee Canoe Launch, *Harris 37721* (NY); SUMTER CO.: Withlacoochee State Forest, Jumper Creek, *Harris 39839* (NY); TAYLOR CO.: Big Bend Wildlife Management Area, *Harris 39532* (NY); UNION CO.: Worthington Springs, *Harris 35947* (NY); VOLUSIA CO.: South Tomoka Wildlife Mgmt. Area, *Buck 28935* (NY). **GEORGIA.** BAKER CO.: Ichuaway Plantation/Jones Ecological Research Center, on rock, *Lendemer 9513* (NY), *Lendemer 9568* (NY), *Lendemer 9583* (NY); CLARKE CO.: East Athens, *Harris 28935A* (NY); COFFEE CO.: Broxton Rocks Ecological Preserve, *Harris 38729* (NY); COLUMBIA CO.: Heggie's Rock Preserve, *Harris 43520* (NY); EARLY CO.: Williams Bluff Preserve, *Lendemer 9343* (NY); GREENE CO.: Oconee Natl. Forest, end of Forest Service Road 1202, *Harris 38872* (NY); ROCKDALE CO.: Panola Mountain State Park, *Lendemer 8954* (NY); TOWNS CO.: Reed Branch Wet Meadow TNC Preserve, *Lendemer 10323-A* (NY); WALKER CO.: Chattahoochee Natl. Forest, Johns Mountain Overlook, *Harris 28205* (NY). **INDIANA.** PUTNAM CO.: Hoosier Highlands, *Zanoni 122-38* (NY). **KANSAS.** CHAUTAUQUA CO.: Along Birch Creek E of Rd. 29, *Morse 15695* (KANU); COWLEY CO.: Chaplin Nature Center in Arkansas City, *Morse 10707* (KANU); DOUGLAS CO.: University of Kansas Breidenthal Biological Reserve, *Adviata 1252* (KANU), *Adviata 1258* (KANU); MIAMI CO.: North La Cygne State Fishing Lake and Wildlife Area, *Morse 11304* (KANU); MONTGOMERY CO.: Elk City Lake, west of Memorial Lookout, *Morse 14591* (KANU); **KENTUCKY.** NELSON CO.: Bernheim Arboretum and Research Forest, *Ladd 23983* (NY); WHITLEY CO.: Cumberland Falls, *Allen 74* (NY). **MARYLAND.** WORCESTER CO.: Hickory Point Cypress Swamp, *Lendemer 6345* (NY). **MASSACHUSETTS.** Cambridge, *Tuckerman s.n.* (NY). **MICHIGAN.** MARQUETTE CO.: Huron Mountain Club, Salmon Trout River, *Manierre L-450* (NY); WASHTENAW CO.: Crooked Lake, Waterloo Recreation Area, *Buck s.n.* (NY). **MINNESOTA.** CASS CO.: Ottertail Peninsula in Leech Lake, *Buck B517* (NY); ST. LOUIS CO.: Voyageurs Natl. Park, S side of Old Dutch Bay, *Wetmore 31263* (NY). **MISSOURI.** BARRY CO.: Mark Twain Natl. Forest, Piney Creek Wilderness, *Lendemer 6485* (NY); Roaring River State Park, *Buck 38848* (NY), *Ladd 13094* (HB. LADD); BOONE CO.: Southeast of Sapp, along tributary of Fox Hollow Branch, *Ladd 12620* (HB. LADD); BUTLER CO.: Allred Lake Natural Area, *Harris 45289* (NY); CARTER CO.: MOFEP site 9, in Peck Ranch Conservation Area, *Ladd 20524* (HB. LADD); CHRISTIAN CO.: Mark Twain Natl. Forest, S of Chadwick Road at jct. of Monarch road, *Buck 44541* (NY); CRAWFORD CO.: Vilander Bluff Natural Area, *Harris 50099* (NY); DALLAS CO.: Bennett Spring State Park, *Ladd 5699* (HB. LADD), *Ladd 6218* (HB. LADD); DENT CO.: Hyer Woods Preserve, *Ladd 12349* (HB. LADD); Montauk State Park, *Ladd 26492* (HB. LADD); DOUGLAS CO.: Hunter Creek Glade, ca. 6.5 miles E/SE of Ava, *Ladd 25991* (HB. LADD); HOWELL CO.: Three miles N of Brandsville, *Summers 3145* (HB. LADD); IRON CO.: Munger Shut-Ins, along East Fork Black River, *Ladd 17664* (HB. LADD); JEFFERSON CO.: LaBarque Hills Preserve, *Ladd 12973* (HB. LADD); LAWRENCE CO.: Fall Hollow Gorge, on rock, *Ladd 27727* (HB. LADD); MADISON CO.: Rhodes Mountain, *Ladd 10529* (HB. LADD); MARIES CO.: Spring Creek Gap Conservation Area, *Harris 46597* (NY); OREGON CO.: Falling Springs Mill, *Summers 2519* (NY); McDONALD CO.: Huckleberry Ridge Conservation Area, *Buck 38404* (NY); OREGON CO.: Low woods along Eleven Point River at Cave Bluff, *Summers 2492* (HB. LADD); OZARK CO.: Caney Mountain Conservation Area, *Buck 36036* (NY); PULASKI CO.: Dolomite bluff along Gasconade River, near terminus of hwy Y, *Ladd 12566* (HB. LADD); RIPLEY CO.: Mark Twain Natl. Forest, Cupola Pond Natural Area, *Ladd 12262* (HB. LADD); SHANNON CO.: Ozark Natl. Scenic Riverways, vicinity of Rocky Falls, *Buck 18153* (NY); Ozark Natl. Scenic Riverways, along Current River 1 mile NW of Owls Bend, *Ladd 17898* (HB. LADD); Ozark Natl. Scenic Riverways, Prairie Hollow Gorge Natural Area, *Nigh 1199* (HB. LADD); MOFEP site 4, in Peck Ranch Conservation Area, *Chadwell 64* (KANU); STONE CO.: Ashe Juniper Natural Area, *Buck 42855*(NY); dolomite bluff along James river 1.5 miles southwest of Janesville,

Ladd 12447 (HB. LADD); TANEY CO.: Mark Twain Natl. Forest, Hercules Glade Wilderness, *Buck 44492* (NY). **MISSISSIPPI.** SCOTT CO.: Bienville Natl. Forest, *Harris 28738* (NY). **NEW YORK.** WASHINGTON CO.: Shushan, *Burnham s.n.* (NY). **NORTH CAROLINA.** BUNCOMBE CO.: 5 mi N of Ashville, *Voth 121* (NY); CLAY CO.: Nantahala Natl. Forest, Buck Creek Barren, *Lendemmer 10768-A* (NY); HAYWOOD CO.: Great Smoky Mtns. Natl. Park, 3 mi SE of Waterville, along Baxter Creek Tail, *Lendemmer 8182* (NY); JACKSON CO.: Cedar Cliff Mountain, *Harris 42775* (NY); PASQUOTANK CO.: 4-5 mi N of Elizabeth City, *Reed 66090* (NY); ORANGE CO.: Mason Farm Biological Preserve, *Perlmutter 866* (NY), *Perlmutter 981* (NY), *Perlmutter 1030* (NY); PENDER CO.: Holly Shelter Game Land, *Brodo 31134* (CANL), *Lendemmer 8428* (NY); WAKE CO.: William B. Umstead State Park, *Lendemmer 8300* (NY), *Lendemmer 8360* (NY). **OHIO.** GALLIA CO.: Wayne Natl. Forest, above Symmes Creek, *Lendemmer 7388* (NY). **OKLAHOMA.** CADDO CO.: Red Rock Canyon State Park, *Morse 14837* (KANU), *Morse 14871* (KANU); CHEROKEE CO.: Cookson Wildlife Management Area, Bolin Hollow, *Harris 49022* (NY); W of Blue Top Road, *Harris 48905* (NY), *Ladd 25645* (HB. LADD); J.T. Nickle Family Preserve, 7 mi. NE Talequah, *Ladd 22390* (HB. LADD); OSAGE CO.: Woolaroc Wildlife Preserve, *Morse 14892* (KANU); SEQUOYAH CO.: Sallisaw-Brushy Lake State Park, *Buck 38669*, on rock, *Ladd 22482B* (HB. LADD); **PENNSYLVANIA.** PIKE CO.: Delaware Water Gap Natl. Recreation Area, Childs Recreation Area, *Lendemmer 3409* (NY). **SOUTH CAROLINA.** ABBEVILLE CO.: Sumter Natl. Forest, Parsons Mountain, *Harris 40331* (NY); LANCASTER CO.: Forty Acre Rock, *Harris 40187* (NY); LEXINGTON CO.: Peachtree Rock Nature Preserve, *Harris 39925* (NY); NEWBERRY CO.: Sumter Natl. Forest, Buncombe Trail, *Harris 40136* (NY); PICKENS CO.: along Eastatoe Creek ca. 2.5 mi SW of town of Rocky Bottom, *Harris 24780* (NY); SUMTER CO.: Manchester State Forest, *Harris 40230* (NY). **TENNESSEE.** PERRY CO.: Jennings Bluff along Tennessee River, *Ladd 14081* (HB. LADD). **TEXAS.** HARDIN CO.: Saratoga, *Fie s.n.* (NY); HOUSTON CO.: Mission State Park, *Wetmore 17671* (NY); KENEDY CO.: 48 mi N of Raymondville, *Pursell 5922* (NY); TRAVIS CO.: Bear Creek, *Ferguson s.n.* (NY); TYLER CO.: Big Thicket Natl. Preserve, 5 mi SE of Warren, *Egan 8042* (NY); UVALDE CO.: Winston Ranch, 6 miles S. of Sabinal, *Morse 9204* (KANU). **VIRGINIA.** SHENANDOAH CO.: along state route 675 at Edinburg Gap, *Guccion 1060* (NY); **WEST VIRGINIA.** PENDLETON CO.: Monongahela Natl. Forest, Fanny Bennett Hemlock Grove, *Ladd 22753* (HB. LADD); POCAHONTAS CO.: Watoga State Park, Riverside Campground Area, *Harris 43937* (NY), *Lendemmer 9820* (NY). **WISCONSIN.** ONEIDA CO.: Patterson Hemlocks State Natural Area, *Buck 41811* (NY).

Chrysothrix sp.

DESCRIPTION. - Morphologically essentially as in *C. xanthina*. **Chemistry:** K± reddish, KC± reddish, C-, PD-, UV-; calycin or calycin (major) + pinastric acid (minor). **Granules** 25-45(-65) µm across (averages 33-37.5 µm). **Apothecia** (Cuba, *Hioram 5771* [NY]) arthonioid, semi-immersed, yellow pruinose, ca. 0.1-0.2 mm across; spores 3-septate, ca. 12.5-15 x 3-4 µm. **Pycnidia** not seen.

DISCUSSION. - Some corticolous specimens from the southeast United States and the Caribbean resemble *C. xanthina* but have small soredia and calycin as the major substance. The ultimate disposition of this material can probably only be determined with molecular data. We are not aware of an available name nor are we prepared at this time to slog through the extensive list of synonyms for *C. candelaris*. A poor specimen (*Worthley L-633*) is included here, even though the granule size (42-65 µm wide) approaches that of *C. candelaris*, since distribution suggests it belongs with this apparently subtropical taxon and *C. candelaris* is otherwise unknown in eastern North America.

Most collections are from *Quercus*, particularly live oaks (*Q. geminata*/*Q. minima*/*Q. virginiana* complex), but this entity occurs less commonly on other hardwood trees and shrubs, as well as a single collection from a dead *Pinus*.

SPECIMENS EXAMINED. - **BAHAMAS.** ANDROS: Barton Creek, *Brace 5297* (as *Bilimbia aurata*) (NY). **CUBA.** Confianza Estate, *Hioram 5771* (NY). **UNITED STATES.** **ALABAMA.** CALHOUN CO.: Fort McClellan, *Worthley L-633* (NY). **FLORIDA.** DUVAL CO.: Jacksonville Beach, *Buck B160* (NY); ESCAMBIA CO.: Gulf Island National Seashore, Santa Rosa Island, *Guarisco 55* (KANU); FRANKLIN CO.: St. George Island State Park, *Ladd 14579* (HB. LADD); HIGHLANDS CO.: Archbold Biological Station, *Harris 41773* (NY); LIBERTY CO.: Torreya State Park, *Ladd 14600* (HB. LADD); POLK CO.: Tiger Creek Preserve, *Wheeler s.n.* (NY); TAYLOR CO.: Along C.R. 361, 1.7 mi N of Keaton Beach, *Buck 31154* (NY); WAKULLA CO.: Ochlockonee River State Park, *Ladd 14442* (HB. LADD). **GEORGIA.** HEARD CO.: Camp Meeting Rock Preserve, *Harris 43313* (NY); JEFF DAVIS CO.: 0.4 mi E of Coffee Co. line on Georgia Hwy 107, *Harris 36189* (NY).

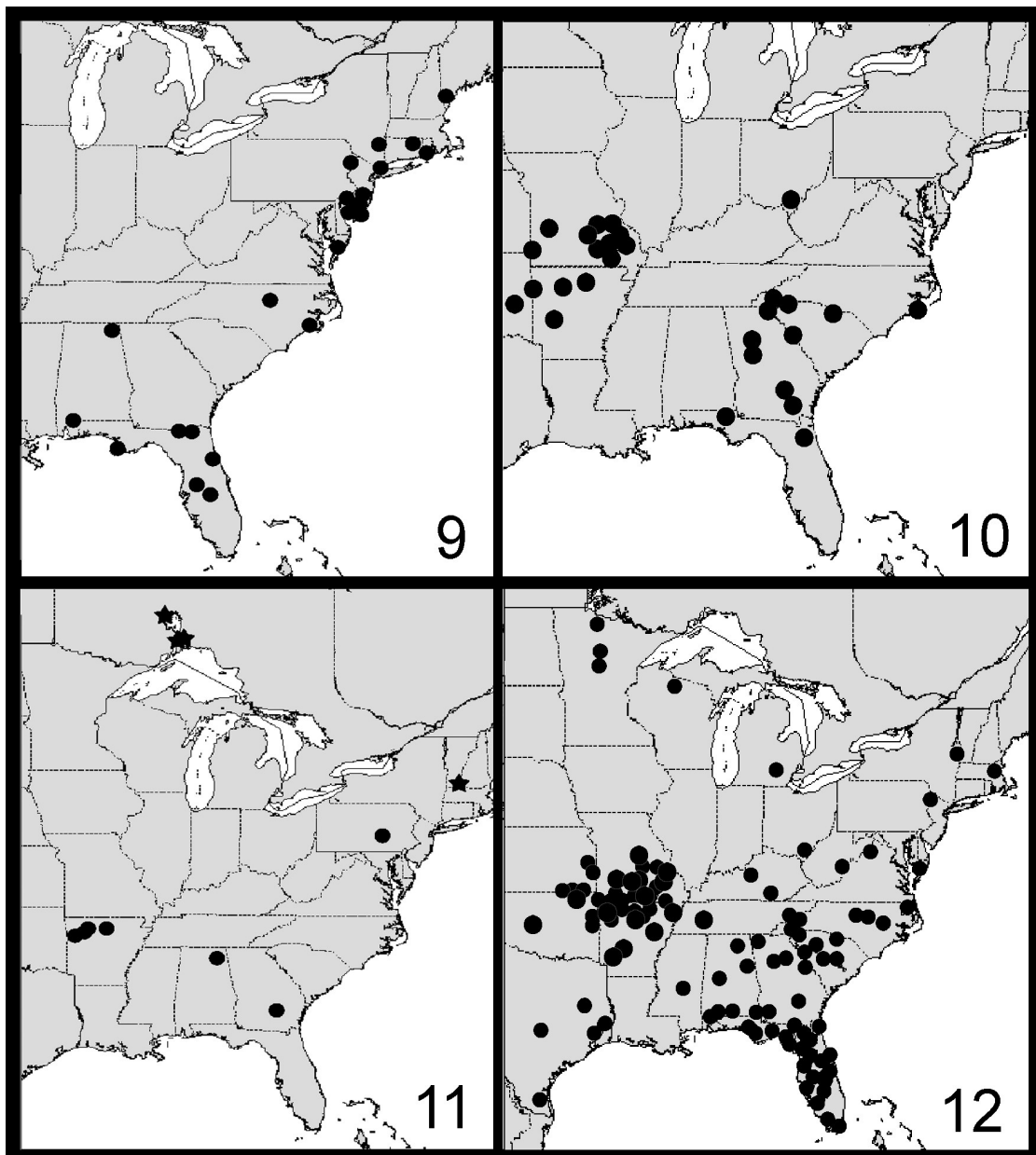


Plate 3. Figure 9. Eastern North American distribution of *C. flavovirens*. **Figure 10.** Eastern North American distribution of *C. insulizans*. **Figure 11.** Eastern North American distribution of *C. chlorina* (stars) and *C. onokoensis* (dots). **Figure 12.** Eastern North American distribution of *C. xanthina*.

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