

Two new species of *Caloplaca* from Tadjikistan, Central Asia

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Two new species of *Caloplaca* are described, *C. pseudocitrina* (in the *C. citrina* group), which is characterized by rather long spores with a thin septum, and a squamulose thallus and *C. akbarica* (*C. saxicola*-group) characterized by rather thick, brightly yellowish pruinose apothecia and a paraplectenchymatous proper exciple. The characters of the new species and their closely allied taxa are compared in tables and illustrated.

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Introduction

The genus *Caloplaca* Th. Fr. comprises an enormous diversity of species, presumably over 800, occurring in many different biota and habitats all over the world. Several more or less distinctive groups of species can be recognized although intermediate forms occur in many cases (Clauzade & Roux 1985, Kärnefelt 1989). There is no world checklist or revision of the entire genus apart from the list of names produced by Cliff Wetmore, <http://www.rc.umn.edu/~wetmore/AllCaltop.htm>. Species are mainly revised in smaller groups from various geographical regions, in which Eurasia and North America are best known (Poelt & Hinteregger 1993, Arup 1995a, Navarro-Rosines & Hladun 1996, Wetmore & Kärnefelt 1998, Wetmore & Kärnefelt 1999, Wetmore 2001). In Central Asia the knowledge of the genus is still scarce.

Material and methods

The results presented here are based mainly on herbarium material kept in KW, LD, C, BM, GZU, TNS, H, B, S. For anatomical observations, fragments of lichens were sectioned with a Kryomat, Leitz freezing microtome and sections put in lactophenol-cotton blue or water. Anatomical structure and hymenial characters were studied with a Zeiss Axioscope light microscope, and photomicrographs made with a Digital DP 11 camera.

Caloplaca pseudocitrina Khodosovtsev & Kudratov sp. nov.

Thallus squamulosus saxicola soralibus marginalibus a *Caloplaca citrina* simili, differt ascosporis longioribus 19.0–21.9 × 6.2–7.6 µm, septo tenuire 1.0–2.1 µm.

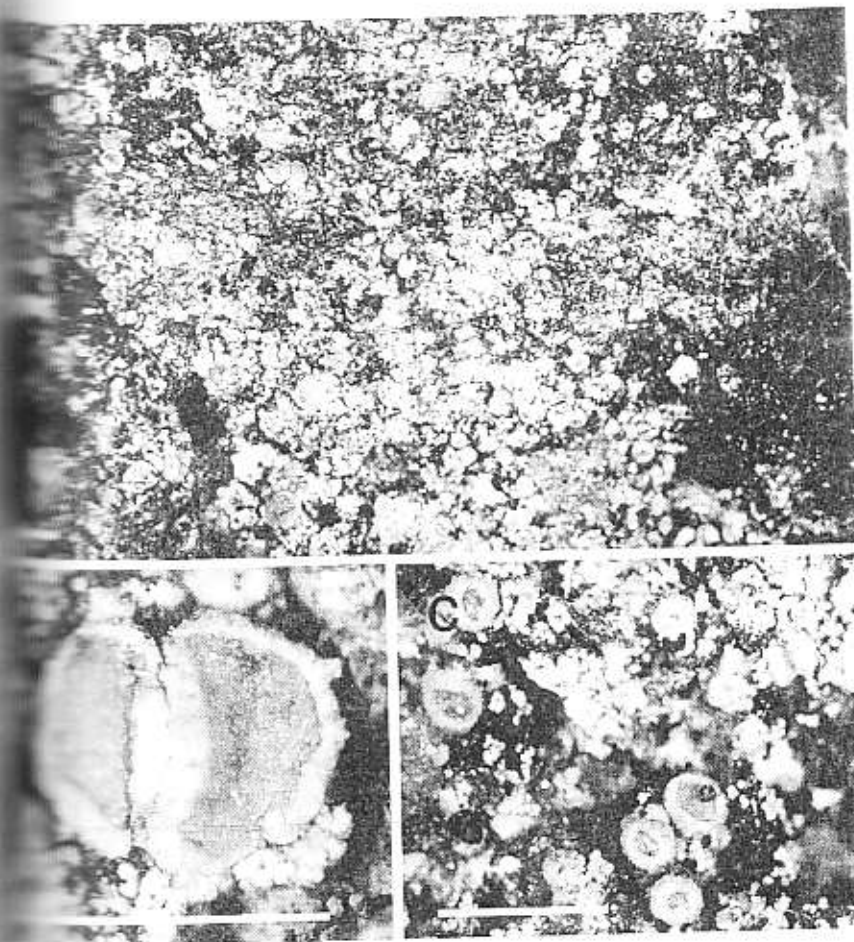


Fig. 1. *Caloplaca pseudocitrina*. a, habit; b, close up of apothecia and sorediate squamules; c, close up of thallus portion with squamules and apothecia. Holotype, bar = 1 mm.

with a fine yellow granulose. *C. flavogranulosa* + *C. stellata* have group, though in its star shaped *Caloplaca limon* had a unique st (1994). *Caloplaca* narrow ascospore squamules (Setu).

Caloplaca pse characterized mainly by the spots (Fig. 1). It has been considered a new species within the genus separated on the basis of its characters (Clauzade & Roux 1992). *C. lactea* complex characterized by its spore characters.

There are 10 species of *Caloplaca* with various ascospores and various authors. *C. citrina* 2.5-6.0 μ m (Arx 1972), *C. citrina* 2.5-6.0 μ m (Hansen et al. 1992), *C. citrina* about 3 μ m (Sochting 1992), *C. citrina* 4 μ m (Poelt & Roux 1992), *C. citrina* septum 1/3 length 15 \times 3-8.5 μ m (Hansen et al. 1992), *C. citrina* neotype material 12-15 \times 5-6 μ m (Nordin 1972).

The new species is characterized by the size of the ascospore and the size of the ascospore septum (Table 1). *Caloplaca citrina* var. *arctica* (Vezda) Lich. sensu lato is probably closely related to *Caloplaca citrina* and *Caloplaca citrina* spore septa. *Caloplaca citrina* characterized by 12 μ m (Poelt & Roux 1992), shorter and much smaller than *Caloplaca citrina* (Hansen, et al. 1992).

Additional specimens. *Caloplaca citrina* locality, 2800-3000 m, (KW, TJK).

developed. Epithecium yellowish about 10 μ m high. Hypothecium hyaline, 30-50 μ m high. Hymenium 40-60 μ m high. Paraphyses unbranched to apically branched, 1.8-2.2 μ m wide, apical cells up to 3.6-4.5 μ m wide. Asci with 8 spores, ascospores 19.0-21.9 \times 6.2-7.6 μ m, septum 1.0-2.1 μ m. Pycnidia not seen. Algae of *Trebouxia*-type, cells 6.0-12.0 μ m diam.

Ecology and distribution. The new species is so far only known growing on metamorphic limestone in the arid regions on rather high altitudes in Tajikistan.

Taxonomic notes. The *Caloplaca citrina* complex is still not taxonomically clear (Wetmore 2001). Many species can nevertheless be recognized on the basis of their unique character states. The specimens with stipitate squamules have been separated as *C. soropelta* by Sochting (1992). The species from sea-shore rocks

Central Tajikistan, Chormagzak pass, "Schirshovskaya", alt. 1850 m, 1968, Kudratov 898 (TJK, holotype, KW, isotypus).

Thallus squamulose, forming extensive spots up to 2-3 mm large. Squamules yellow-orange, plane to slightly convex, 2-2.0 mm large, single or consisting of 3-5 lobes, 0.1-0.4 \times 0.1-0.2 mm, attached to the substrate in the central parts with more or less free margins, sorediate. Cortex paraplectenchymatous, 1-2 μ m thick, cells 4.8-7.2 μ m. Soralia developed in the central parts of the squamules. Soredia granular, yellowish, 30-40 (-50) μ m diam., often single and attached to the substrate.

Asci biatorine to biatorine, 0.2-1.2 mm wide, 1-2 per squamule. Disc concave to convex, yellowish with yellow-orange margin. Proper margin paraplectenchymatous, 15-20 μ m in the central parts, 90-110 μ m laterally. Thalline margin poorly

with a fine yellow prothallus was separated as *C. flavogranulosa* (Arup 1993). The recently described *C. stellata* have some affinities with the *C. citrina* group, though this species seems rather isolated with its star shaped lobes (Wetmore & Kärnefelt 1998). *Caloplaca limonia*, characterized by blastidia also had a unique structure of the exciple (Nimis et al. 1994). *Caloplaca phlogina* was characterized by narrow ascospores and granular areoles without squamules (Serussiaux et al. 1999).

Caloplaca pseudocitrina described as new here, is characterized mainly by the size of the ascospores, and by the squamulose thallus forming extensive spots (Fig. 1). The shape and size of ascospores have been considered important characters for the separation of species which are morphologically very close within the genus. *Caloplaca tenuata* was mainly separated on the basis of septum measurements (Clauzade & Roux 1985). Furthermore *C. aquensis* was characterized by the width of the septum of 2-4 µm, while the morphologically similar *C. ferrari* has a narrower septum, 1-2 µm wide (Navarro-Rossines & Roux 1992). The separation of some species in the *C. lactea* complex have mainly been based on ascospore characters (Navarro-Rossines & Hladun 1996).

There are large differences in the size of ascospores and septa on material of *C. citrina* by various authors, e.g. 8.0-19.2 × 4.0-7.8 µm, septum 2.5-6.0 µm (Arup 1993); 9-18 × 5-8 µm, septum 1-2 µm (Hansen et al. 1987); 10-12 × 7-8 µm, septum about 3 µm (Sochting 1989); 10-15 × 2-6, septum 2-4 µm (Poelt & Hinteregger 1993); 10-15 × 7-8 µm, septum 1-3 length of ascospores (Nordin 1972); 10-15 × 5-8.5 µm, septum 4-4.8 µm (Oxner 1993). The neotype material of *C. citrina* was characterized by 12-15 × 5-6 µm large ascospores, and the septum 4-5 µm (Nordin 1972).

The new species *C. pseudocitrina* is well separated from *C. citrina* s. lat. based on the rather large size of the ascospores combined with the narrow septum (Table 1). A morphologically similar taxon *C. citrina* var. *arctis* is known only in the sterile stage (Vezda: Lich. sel. exc. n. 2470). Two other presumably closely related taxa which grow on soil *C. heterospora* and *C. tominii* also have rather narrow spore septa. *Caloplaca heterospora*, however, is also characterized by semiglobular ascospores 10-20 × 6-12 µm (Poelt & Hinteregger 1993) and *C. tominii* by shorter and much wider ascospores 13-15(-17) × 6-9 µm (Hansen, et al. 1987).

Additional specimens examined: Tajikistan, N slope of Turkenstan ridge, Oktangi valley, 'Kirikkozik' locality, 2800-3000 m alt., 20.07.1988, I. Kudratov (KW, TJK).

Key to species of the *Caloplaca citrina* group with mainly squamulose thallus

1. Thallus sterile 2
1. Thallus fertile 7
2. Thallus with granular cortical areoles without squamules, soon completely sorediate, on bark *Caloplaca phlogina*
2. Thallus squamulose, on various substrate 3
3. Squamules peltate, soralia marginal, soredia 25-35 µm diam. *Caloplaca soropelta*
3. Squamules attached on lower surfaces or central parts 4
4. Thallus blastidiate, pale yellow, weakly pruinose, blastidia 40-80 µm developing from the upper surface of the areoles *Caloplaca limonia*
4. Thallus yellow-orange to orange, not pruinose, sorediate, soralia marginal 5
5. Soredia granular, (30-)40-60(-80) µm diam. on soil and rocks 6
5. Soredia fine (20-)25-35(-50) µm diam., on soil, various rocks, bark and lignum *Caloplaca citrina* s.l.
6. On soil *Caloplaca tominii*
6. On rocks *Caloplaca citrina* var. *arctis*
7. Septum 1-2 µm 8
7. Septum 2-5 µm 10
8. Ascospores widely ellipsoid to semiglobose, 9-20 × 6-12 µm, thallus blastidiate-sorediate, thallus thin squamulose, on soil *Caloplaca heterospora*
8. Ascospores more narrow, sorediate, soralia marginal 9
9. Ascospores narrowly ellipsoid, 19-22 × 5-7 µm, soredia 30-40 µm, on rocks *Caloplaca pseudocitrina*
9. Ascospores ellipsoid, 13-15(-17) × 6-9 µm, soredia 40-60 µm, on soil *Caloplaca tominii*
10. Thallus with granular corticate areoles without squamules, soon completely sorediate, ascospores 12-15 × 4-5 µm, septum 2-4 µm, on bark *Caloplaca phlogina*
10. Thallus areolate to squamulose, ascospores much wider 11

	<i>C. pseudocitrina</i>	<i>C. citrina</i>	<i>C. phlogina</i>	<i>C. citrina</i> var. <i>arets</i>	<i>C. heterospora</i>
Thallus	squamulose	squamulose	granular areolated	squamulose	squamulose
Color	orange-yellow	orange-yellow	yellow-orange	yellow-orange	yellow-orange
Size (mm diam.)	0.2-2.0	0.3-1.0	0.1-0.2	1-2	0
Attachment	lower surface	lower surface	lower surface	lower surface	lower surface
Prothallus	poorly developed	poorly developed	poorly developed	poorly developed	poorly developed
Soredia	marginal	marginal		marginal	
Soredia (μm diam.)	30-50	25-35		40-60	
Prothallus (μm diam.)			25-35		25-50
Prothallus (mm diam.)	0.5-1.2	0.2-0.7	0.3-0.6		0.5-1.0
Ascospores (μm)	18-22 \times 5-7	10-15 \times 7-8	12-15 \times 4-5		9-20 \times 6-12
Septum (μm)	1-2	2-4	2-4		1
Paraphyses					6-9
Paraphyses (μm diam.)	3-5	3.5-5.5	to 5.5		
Substrate	metamorphic limestone rock	different substrata	bark	rocks	soil
References	present paper	Poelt & Hinteregger 1993	Serustiaux et al. 1999	A. Vezda: Lich. sel. exs. n. 2470	Poelt & Hinteregger

Thallus blastidiate, pale yellow, weakly pruinose, soredia 40-80 μm developed from upper surfaces of the areoles and lobes, ascospores 8-16 \times 4-4 μm , septum 3-5 μm *Caloplaca imonia*

Thallus sorediate, soralia marginal, thallus predominantly orange, without pruina 12

Prothallus not developed, soredia 25-35 μm diam. on rock, bark, rarely on soil *Caloplaca citrina* s.l.

Prothallus yellowish, soredia 35-50 μm diam., on seashore rocks *Caloplaca flavogranulosa*

Caloplaca akbarica Kudratov & Khodosovtsev sp. nov.

Thallus rosuliformis flavo-aurantiacus, saxicola. A simili *Caloplaca aurantia* differt apotheciis pruina crassa obtectis. Ascospores ellipsoidae (10.7-)12.0-14.5-(16.8) \times (-5.1) 6.5-8.5(-9.6) μm , septum (1.4)-1.8-2.5 (-2.8) μm .

Type. Southern Tajikistan, E slope of ridge Gozimalik, way from Hodjabeheb to Gaudjina, 1500 m alt., 1990, Kudratov 11916 (TJK, holotypus; KW, isotypus).

Thallus rossett yellow to orange 2.5-3.5 mm in

thick, widene or overlapping lowish pruin small lobes, less convex, Cortex consist enchyematous

Apothecia sessile to con yellow pruin pruinose prim

<i>C. heterospora</i>	<i>C. tominii</i>	<i>C. limonia</i>	<i>C. soropelta</i>	<i>C. flavogranulosa</i>
squamulose	areolate to squamulose	areolate to squamulose	squamulose	areolate to squamulose
yellow-orange	yellow-orange	pale yellow	yellow-orange	yellow-orange
	0.5-1.5	1.0-2.0	up to 1	0.2-0.6
lower surface	lower surface	lower surface	peltate	lower surface
poorly developed	poorly developed	poorly developed	poorly developed	fine, yellowish
	marginal		marginal	marginal
	40-60		20-30	35-50
25-50		40-80		
0.5-1.0	0.5-1.0	0.5-1.0	0.6	0.5-1.1
9-20 × 6-12	16-17 × 8-9	8-16 × 4-8		10-16 × 4-7
1	1-1.5	3-5		3-5
6-9	to 6	to 8		3-5
soil	soil	calcareous rocks, soil	calcareous rocks	seashore rocks
Poeit & Hinteregger 1993	Hansen et al. 1987	Nimis et al. 1994	Söchting 1992	Arup 1993

Thallus rosette-shaped, up to 2-3 cm large, lobate, yellow to orange. Marginal lobes flattened, thin, 1.5-2.5(-3) mm long, 0.5-1.0 mm wide and about 0.2 mm thick, widened towards tips, margins close together or overlapping, without distinct fissures, with yellowish pruina. Central part of thallus consists of small lobes, 0.3-1.0 × 0.2-0.3 mm, plane to more or less convex, orange, with small fissures or cracks, cortex consisting of several layers of paraplectenchymatous cells.

Apothecia geornine, 0.5-1.0 mm wide, numerous, sessile to constricted at the base, with thick brightly yellow pruina, at first developing as distinctly pruinose primordia contrasting to the orange thallus.

Disc concave to plane with thick yellow pruina, with slightly crenulate margin. Cortex of the thalline margin paraplectenchymatous, 20-25 µm thick. True excipie well developed, paraplectenchymatous, consisting of slightly elongated 4-5 × 3-4 µm, large cells. Epithecium yellow, 7-10 µm high. Hymenium hyaline, 70-95 µm high. Hypothecium hyaline, 48-60 µm high. Asci 8 spored, 60-64 × 12-15 µm. Ascospores ellipsoid (10.7-)(12.0-14.5(-16.8) × (5.1-)(6.5-8.5(-9.6) µm, septum (1.4-)(1.8-2.5(-2.8) µm. Pycnidia not seen.

Etymology. The new species is named in the honor of the first teacher of botany of the first author, the

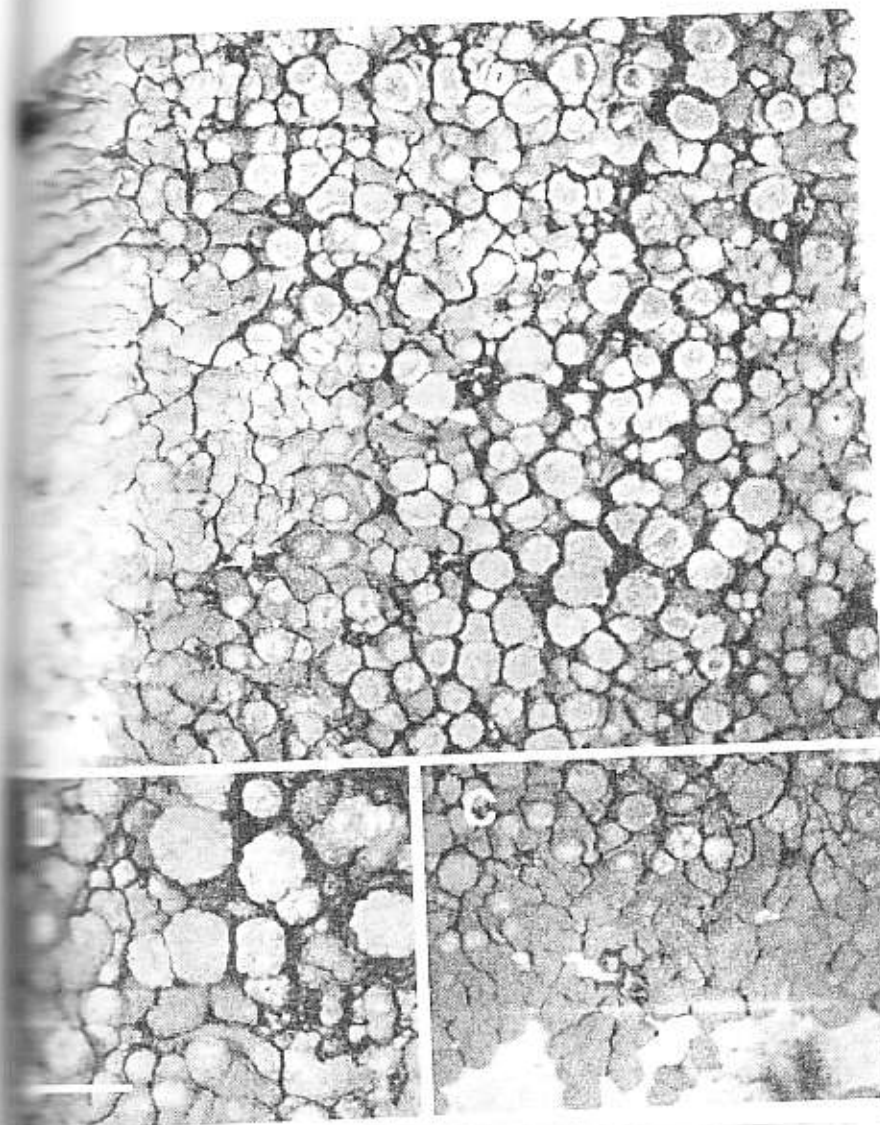


Fig. 2. *Caloplaca akbarica*: a, habit; b, close up of pruinose apothecia; c, close up of flat marginal lobes. Holotype, bar = 1 mm.

Table 2. Character

marginall lobes
color
central part
pruina
cortex
disc
ascospores
septum
ecology
references

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Roux and C
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botanist Akbar Juraev.

and distribution. The new species is so far known growing on exposed limestone in the mountains at high altitudes in Tadjikistan.

Diagnostic notes. *Caloplaca akbarica* is characterized by the distinctly pruinose apothecia first appearing as pruinose primordia, which distinctly contrast to the orange central part of the thallus, the flat marginal lobes, and the paraplectenchymatous cortex (Fig. 2). It is presumably related to the *aurantia* complex although it differs in the more flattened marginal lobes and in the pruinose apothecia. *Caloplaca akbarica* also resembles *C. aurantia*

in the flattened pruinose lobes. However, the ascospores in the *C. aurantia-flavesces* group are more reniform (Table 2). *Caloplaca impolita* which is also characterized by a flattened and yellowish pruinose thallus differs from *C. akbarica* in the much narrower ascospores, and a wider septum (Arup 1995b). Furthermore the thallus in *C. impolita* is more areolated in the central parts, and it is mainly coastal in western North America (Arup 1995, Wetmore & Kärnefelt 1998). It also differs from other central Asiatic species with lobed margin, e.g. from *C. scrobiculata* in the paraplectenchymatous cortical layer (Magnusson 1940). *Caloplaca scrobiculata* is presumably much closer to *C. wachyphylla*, which keeps a quite isolated position in *Caloplaca*.

Reference

- Arup, U. 1995
citrina, Tw
ern North
- 1995a. Lit
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- 1995b. E
North Am

Table 2. Character states in *Caloplaca akbarica* and some allied lobated species.

	<i>C. akbarica</i>	<i>C. aurantia</i>	<i>C. impolita</i>	<i>C. scrobiculata</i>	<i>C. saxicola</i> s.l.
marginal lobes	flat	flat	flat	convex	convex
color	yellow-orange	yellow-orange	yellow-orange	yellow-orange to orange	yellow-orange to orange-red
central part	small lobes	areolated	areolated	areolated	areolated
pruina	yellow on tips	white tips	yellow	-	grayish in central part
cortex	paraplect.	paraplect.	paraplect.	prosoplect. (scleroplect.)	paraplect.
disc	thick, yellow,	dull-orange pruinose	yellow-orange	orange to orange	orange-red
ascospores	12-15 × 6-9 ellipsoid	12-13 × 7-13 citriform	11-15 × 4.5-5.5 ellipsoid	14-20 × 6-8 ellipsoid	9-16 × 4-6 ellipsoid
septum	1.8-2.5	2.5-3.0	3.6-5.6	1-1.5	2-4
ecology	saxicolous in arid regions	calcicolous in arid regions	saxicolous mostly littoral	saxicolous	saxicolous widespread
references	present paper	present paper	Arup 1993	Poelt & Hinteregger 1993	present paper

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