

# The Lichen genus *Physcia* and allied genera from Maharashtra, India

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The paper gives an account of 14 species of the genera *Hyperphyscia* (1 sp.), *Phaeophyscia* (7 spp.) *Physcia* (5 spp.) and *Physconia* (1 sp.) from the Maharashtra state of India. *Phaeophyscia fumosa* Moberg, *Physcia albata* (F. Wilson) Hale and *Physcia undulata* Moberg are recorded for the first time from India.

**Key-words**— Lichen, Physciaceae, Maharashtra, India

## INTRODUCTION

THE present study is a continuation of our survey of the lichen family Physciaceae from Maharashtra state of India. Several species (*Anaptychia* - 5, *Heterodermia* - 36, *Hyperphyscia*- 4 species, *Phaeophyscia* - 14 species, *Physcia* - 21 species and *Physconia*- 6 species) in this family have been recorded from India (Awasthi, 1988, 2000). However, none of the species in the genera *Hyperphyscia*, *Phaeophyscia*, *Physcia* and *Physconia* has been recorded from Maharashtra. In our previous studies (Makhija *et al.*, 2004) we have reported 14 species of the genus *Heterodermia* Trevis. emend. Poelt. In the present paper we are describing 14 species of the genera *Hyperphyscia* (1 sp.), *Phaeophyscia* (7 spp.), *Physcia* (5 spp.) and *Physconia* (1 sp.) from this region. *Phaeophyscia fumosa* Moberg, *Physcia albata* (F. Wilson) Hale and *Physcia undulata* Moberg are recorded for the first time from India.

## MATERIALS AND METHODS

The specimens were examined with a stereomicroscope and a light microscope. Sections of the thalli and apothecia were stained with Lugol's Iodine solution. All sections were examined with lactophenol as mounting medium. TLC was done by the standard method (Culberson & Kristinsson, 1970; White & James, 1985) using solvent systems benzene-dioxane-acetic acid (180:45:5, 230 ml), hexane-ethyl ether-formic acid (130:80:20, 230 ml) and toluene-ethyl acetate-formic acid (139:83:8, 230 ml). The specimens recorded in the text are deposited in the Ajrekar Mycological Herbarium (AMH), Agharkar research Institute, Pune, India.

## KEY TO THE GENERA

- 1a. Upper cortex paraplectenchymatous; hypothecium hyaline or yellowish; ascospores brown to dark brown, 2-celled, thick walled, *Physcia* or *Pachysporaria* type; K + yellow; atranorin present.....*Physcia*
- 1b. Upper cortex paraplectenchymatous; hypothecium hyaline or yellowish; ascospores brown to dark brown,

- 2-celled, thick walled, *Physcia*, *Physconia* or *Pachysporaria* type; K-; atranorin absent.....2
- 2a. Ascospores *Physconia* type Lobes pruinose; upper cortex paraplectenchymatous, lower cortex prosoplectenchymatous.....*Physconia*
- 2b. Thallus gray brown to dark brown; ascospores *Physcia* or *Pachysporaria* type.....3
- 3a. Thallus thicker, loosely appressed; rhizines black dense, often projecting beyond lobes; lower cortex paraplectenchymatous.....*Phaeophyscia*
- 3b. Thallus thin agglutinated to substratum; lower cortex absent; rhizines absent, towards the margin and dark brown to black towards the centre. .... *Hyperphyscia*

## TAXONOMIC DESCRIPTIONS

Genus *Hyperphyscia* Müll. Arg.

*Bull. Herb. Boissier* 2, App. 1: 10 (1894).

Thallus foliose, suborbicular, gray brown to dark brown, closely adnate to substrate, rather thin, heteromerous, underside black in central part, paler towards the margins, rhizinae sparse or absent, upper cortex paraplectenchymatous and lower cortex poorly developed or absent, photobiont a green alga, apothecia laminal lecanorine, hypothecium colourless; ascospores 2-celled, brown, *Pachysporaria* or *Physcia* type spore, pycnoconidia more than 10µm long.

Four species of *Hyperphyscia* are known from India (Awasthi, 2000).

*Hyperphyscia syncolla* (Nyl.) K. Kalb.

(Pl. 1, Fig. 1)

*Neumarkt OPf.* 11 (1983)

= *Physciopsis syncolla* Nyl.

*Acta Soc. Sci. Fenn.* 7: 441 (1863a)

**Thallus** foliose, corticolous, tightly attached to the substratum, light gray to dark gray, 1-2 cm in diameter, smooth, often verrucose in the central part, 112-126 µm thick; lobes

narrow 0.5-1 mm broad, dichotomously branched, adjacent, sometimes with lateral lobes; upper surface, smooth, shiny, non sorediate, non isidiate; upper cortex paraplectenchymatous, 10.5 µm thick; medulla yellow, 63-70 µm thick; algal layer, even, 24.5-35 µm thick; lower surface light brown at periphery and dark brown to black in centre, ecorticate; rhizines sparse. **Apothecia** not seen.

**Chemistry:** Thallus K-, C-, KC-, P-; medulla K + pinkish purple, C-, KC-, P-; UV-; skyrin present.

**Habitat:** The specimen was collected on the road side tree.

**Distribution:** India (Maharashtra), Nepal. Widely distributed in East Africa.

**Remarks:** Four species of *Hyperphyscia* have been reported from India (Awasthi, 2000) and *Hyperphyscia syncolla* is the only species of this genus being reported from Maharashtra.

**Specimen examined:** Maharashtra, **Pune District**, Sinhgad, 16.8.2000, U.V. Makhija & B.C. Behera, 00.24.

Genus *Phaeophyscia* Moberg.

*Symb. Bot. Upsal* **22(1)** : 29 (1977).

**Thallus** foliose, suborbicular, lobes radiating, narrow, grayish brown to brown, heteromerous, corticated on both the surfaces, upper cortex paraplectenchymatous, photobiont green alga, medulla white or orange red in lower part, underside black or dark brown, rarely whitish, lower cortex usually brownish to blackish, paraplectenchymatous, with simple rhizinae, white at the tips, sometimes seen projecting beyond the margins. **Apothecia** lecanorine, laminal, often coronate with rhizines at the base, hypothecium colourless, **Ascospores** brown, 2-celled, *Physcia* or *Pachysporaria* type spore, atranorin absent.

Fourteen species of *Phaeophyscia* are known from India (Awasthi, 2000).

Key to the species of *Phaeophyscia* from Maharashtra

- 1a. Thallus isidiate or sorediate.....2
- 1b. Thallus lacking isidia or soredia.....5
- 2a. Thallus isidiate;
  - Thallus greenish to grayish brown, pruinose; medulla yellowish brown to orange near the isidia; isidia marginal to laminal, marginal isidia developing into squamulose lobules.....*P. kairamoi*
- 2b. Thallus sorediate.....3
- 3a. Medulla with orange to red pigment (Skyrin);
  - Thallus concave; lobes 1-3 (-4) mm broad, lower surface black, rhizines black often projecting; apothecia 1-3 mm in diam.; disc brown, flat to concave; ascospores *Pachysporaria* type, 9-15 x 4.5-6 µm.....*P. pyrrophora*
- 3b. Medulla white lacking orange pigment.....4
- 4a. Thallus broad lobed 2-4 mm; soralia laminal becoming

marginal, concolorous to white; ascospores *Physcia* type, 12-29.4 x 6-9 µm.....*P. hispidula*

4b. Thallus radiating, lobes up to 1 mm broad, convex, soralia laminal and marginal usually white but sometimes yellowish.....*P. orbicularis*

5a. Lobes 1 mm broad, with orange medulla; ascospores *Pachysporaria* type, 18-32 x 6-15 µm; skyrin present, zeorin absent.....*P. fumosa*

5b. Lobes 1 mm or more than 1 mm broad; medulla orange; skyrin and zeorin present.....6

6a. Lobes narrow 0.5-1 mm broad; apothecia with a corona of minute lobules; ascospores *Pachysporaria* type, 25-30 x 9-11 µm, skyrin and zeorin present. *P. endococcinodes*

6b. Lobes 2-3 mm broad; apothecia lacking corona; ascospores *Physcia* type, 25-29 x 16.8 µm. *P. endococcina*

*Phaeophyscia endococcina* (Körb.) Moberg

(Pl. 1, Fig. 2.)

*Symb. Bot. Upsal.* **22(1)** : 35(1977).

= *Parmelia endococcina* Körb.

*Parerga Lichenologica.* **36** (1859).

**Thallus** foliose, suborbicular, grayish orange, 2-4 cm in diameter, adpressed, centrally almost subcrustaceous and peripherally minutely laciniate, 105-147 µm thick; lacinae 2-3 mm broad and somewhat imbricate; non sorediate, non isidiate; upper surface reddish orange, smooth, upper cortex paraplectenchymatous, 25-29 µm thick, cells thin walled, lumina roundish to subangular honeycomb type; medulla reddish orange near the lower cortex; lower side black, but growing ends orange, lower cortex brownish black, paraplectenchymatous, 21-33.6 µm; rhizines black, simple to branched. **Apothecia** superficial, sessile, round upto 0.5-2 mm in diameter; disc brownish black, smooth; margin thin, entire; hymenium light brownish, 84-105 µm high; hypothecium hyaline to yellowish, 84-105 µm high; paraphyses conglutinate; asci cylindrical to subcylindrical, 8 sporate, 70-85 x 8-16 µm. **Ascospores** 2-celled, brown, *Physcia* type, ellipsoid, thick walled, 25-29 x 16.8 µm.

**Chemistry:** Thallus and medulla K + purple, C-, KC-, P+ orange; UV -; skyrin and zeorin present.

**Habitat:** Collected on trees and rocks mostly in dry climate.

**Distribution:** India (Maharashtra), Fennoscandia, Nepal.

**Remarks:** *Phaeophyscia endococcina* is closely related to *P. endococcinodes* (Poelt) Essl. but it differs from *P. endococcinodes* in ascospore type. They are *Pachysporaria* type in *P. endococcinodes* and *Physcia* type in *P. endococcina*.

**Specimens Examined:** Maharashtra, **Kolhapur District**, Panhala, 13.10.1974, P.G. Patwardhan & C.R. Kulkarni, 74.1205, 74.1225. **Nasik District**, Saptashringi Gad, 3.8.1974, A.V. Prabhu & M.B. Nagarkar, 74.206; Trimbakeshwar, 5.8.1974, M.B. Nagarkar & A.V. Prabhu, 74.302, 74.309. **Pune District**, Sinhgad, 19.5.1974, C.R. Kulkarni, 74.100, 74.103.

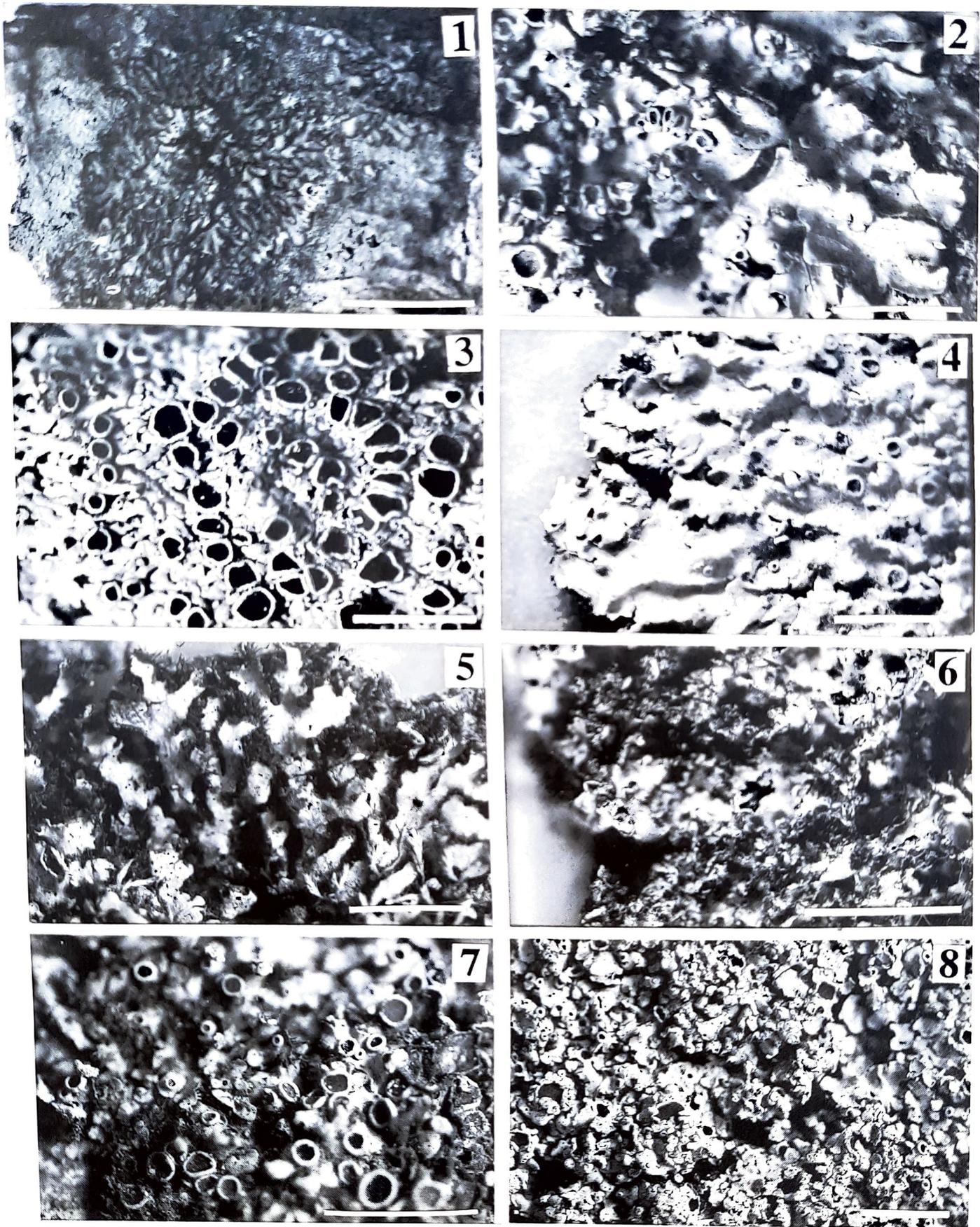


PLATE-1

Figs- 1-8, Habit

1. *Hyperphyscia syncolla*-00.24 AMH, 2. *Phaeophyscia endococcina*-74.302 AMH, 3. *Phaeophyscia endococcinodes*-00.125 AMH, 4. *Phaeophyscia fumosa*-03.2 AMH, 5. *Phaeophyscia hispidula*-81.280 AMH, 6. *Phaeophyscia kairamoi*-02.288 AMH, 7. *Phaeophyscia orbicularis*-02.11 AMH, 8. *Phaeophyscia pyrrophora*-88.86 AMH (Scale: bar = 5 mm)

***Phaeophyscia endococcinodes* (Poelt) Essl.**

(Pl. 1, Fig. 3.)

*Mycotaxon* 7: 301 (1978).= *Physcia endococcinodes* Poelt*Kumbhu Himal* 6: 77 (1974).

**Thallus** foliose, gray to brownish gray, closely adnate to the substratum, occurring in circular patches, 2-3 cm in diameter; 100-120  $\mu\text{m}$  thick; lobes radiating, subdichotomously branched, centrally imbricate, discrete at periphery, 0.5-1.0 mm broad, apices minutely notched; non sorediate; non isidiate; upper surface smooth, flat to convex; upper cortex paraplectenchymatous, 24-27  $\mu\text{m}$  thick; medulla reddish orange near the lower cortex, 45-55  $\mu\text{m}$  thick; lower cortex brownish black, paraplectenchymatous, 21-33  $\mu\text{m}$  thick; rhizines long, black. **Apothecia** sessile, round, 0.5-2 mm in diameter; margin concolorous, entire to crenulate, corona of minute lobules present; disc brownish black, smooth, epruinose; epithecium brownish, 16-20  $\mu\text{m}$  thick; hymenium hyaline, 84-105  $\mu\text{m}$  high; hypothecium hyaline, 20-25  $\mu\text{m}$  high; asci clavate, 8 spore, 72-90 x 9-18  $\mu\text{m}$ . **Ascospores** brown, 2-celled, *Pachysporaria* type, ellipsoid, thick walled, 25-30 x 9-11  $\mu\text{m}$ . Pycnidia present.

**Chemistry:** Thallus K-; medulla K + purple-violet, C-, KC-, P-; UV -; skyrin and zeorin present.

**Habitat:** Common on trees in moist open places along the roadside.

**Distribution:** India (Himalaya, Maharashtra, Manipur, Nagaland and Uttar Pradesh), Asia, Australia, Canada, East Africa, New Zealand, North America. This species has a south temperate tropical montane distribution.

**Remarks:** *Phaeophyscia endococcinodes*, reported for the first time from Maharashtra, differs from the other species in ascospore size and chemistry. However, the most closely related species is evidently *Phaeophyscia endococcina* (Körb.) Moberg from which it may be almost impossible to distinguish except for the ascospore type as in *P. endococcinodes* the spore type is *Pachysporaria* and *Physcia* type in *P. endococcina*.

**Specimens Examined:** Maharashtra, **Pune District**, Dongarwadi, 19.9.2000, U.V. Makhija & V.A. Mantri, 00.125; Durgwadi, 2.9.2003, U.V. Makhija & A.V. Dube, 03.297; G.S. Chitale & A.V. Dube, 03.321, 03.331. **Satara District**, Mahabaleshwar, Lingmala, 15.7.2003, A.V. Dube & G.S. Chitale, 03.152; B.C. Behera & N. Verma, 03.145; Panchgani, Tata Holiday Home, 29.9.2003, G.S. Chitale & A.V. Dube, 03.357, 03.360, 03.362.

***Phaeophyscia fumosa* Moberg**

(Pl. 1, Fig. 4.)

*Nord. J. Bot.* 3: 514 (1983).

**Thallus** foliose, grayish green, closely adnate to the substratum, occurring in circular patches, orbicular, 4-5 cm in diameter; 96-120  $\mu\text{m}$  thick; lobes radiating, imbricate, 0.5-2.5 mm broad, rarely narrow, flat to concave, margins slightly

crenate; non isidiate; non sorediate; upper surface smooth, slightly glossy; upper cortex paraplectenchymatous, 15-18  $\mu\text{m}$  thick; algal layer uniform, 18-30  $\mu\text{m}$  thick; medulla reddish orange near the lower cortex, 30-48  $\mu\text{m}$  thick; underside black, except for the pale extreme lobe tips, lower cortex brownish black, paraplectenchymatous 9-27  $\mu\text{m}$  thick; numerous black rhizines, slightly projecting beyond the lobe margins. **Apothecia** abundant, round, 0.5-1.5 mm in diameter; with crenulate or lobulate, concolorous margin; disc brownish black, smooth, epruinose; epithecium brownish, 9-18  $\mu\text{m}$  thick; hymenium, hyaline, 54-69  $\mu\text{m}$  high; hypothecium, hyaline, 15-30  $\mu\text{m}$  high; paraphyses simple; asci cylindrico-clavate, 60-66 x 9-15  $\mu\text{m}$ . **Ascospores** 2-celled, brown, *Pachysporaria* type, ellipsoid, thick walled, 18-32 x 6-15  $\mu\text{m}$ . Pycnidia present.

**Chemistry:** Thallus K-; medulla K + purple-violet, C-, KC-, P-; UV -; skyrin present.

**Habitat:** Collected on bark of tree in dry deciduous forest.

**Distribution:** India (Maharashtra), the species is known from South Africa.

**Remarks:** *Phaeophyscia fumosa* is reported for the first time from India which can be easily separated from closely related species *Phaeophyscia endococcinodes* (Poelt) Essl. in having larger ascospores and absence of zeorin and larger, broader lobes. This is a rare species in India. It has been collected only once from Maharashtra.

**Specimen Examined:** Maharashtra, **Pune District**, Sinhadag, 4.7.2003, A.V. Dube & G.S. Chitale, 03.2.

***Phaeophyscia hispidula* (Ach.) Moberg**

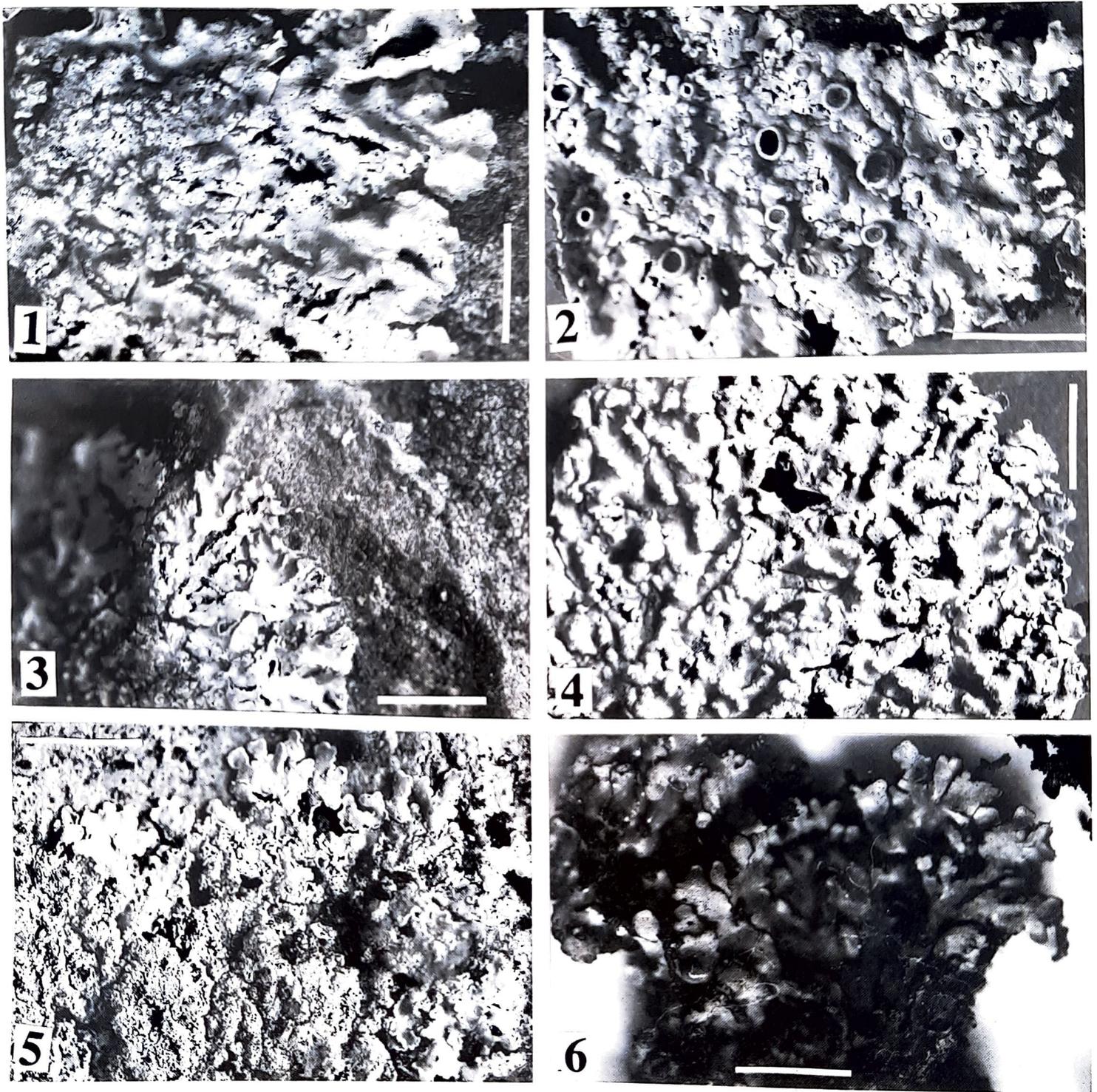
(Pl. 1, Fig. 5)

*Bot. Notiser* 131: 260 (1978).= *Parmelia hispidula* Ach.*Lich. Univ.* 468 (1810).

**Thallus** foliose, spreading irregularly to orbicular, loosely attached to the substratum, blackish gray or brown, 4-10 cm in diameter, 90-120  $\mu\text{m}$  thick; lobes 2-4 mm broad with slightly dichotomous branching, somewhat concave with ascending apices and margins; soredia laminal to sometimes marginal, farinose to granular, sometimes black to white; upper surface dull, epruinose, upper cortex paraplectenchymatous, 18-24  $\mu\text{m}$  thick; medulla white; under side brownish black, lower cortex paraplectenchymatous, 12-21  $\mu\text{m}$  thick; rhizines black, often white tipped, projecting beyond lobe margins and apices. **Apothecia** rare, constricted at base, with black hairs, 1.5-2 mm in diameter, thalline margin with rhizines on the margins; disc mud brown; epithecium brown, 9-15  $\mu\text{m}$  thick; hymenium hyaline to yellowish, 15-30  $\mu\text{m}$  high; paraphyses simple, thick at the apices; asci clavate, 45-66 x 9-12  $\mu\text{m}$ . **Ascospores** 8/ ascus, 2-celled, brown, *Physcia* type, 12-29.4 x 6-9  $\mu\text{m}$ .

**Chemistry:** Thallus and medulla K-, KC-, C-, P-; UV -; no lichen substances present.

**Habitat:** Abundant on tree trunks, but occasionally occurs on mossy rocks, in both dry and moist places.



## PLATE-2

Figs-1-6, Habit

1. *Physcia albata*-03.25 AMH, 2. *Physcia integrata*-00.463 AMH, 3. *Physcia tribacia*-03.72 AMH, 4. *Physcia tribacoides*-00.42 AMH, 5. *Physcia undulata*-90.30 AMH, 6. *Physconia enteroxantha*-74.1139 AMH (Scale: bar = 5 mm)

**Distribution:** India (Maharashtra, Manipur, Nagaland, South India and Uttar Pradesh), Australia, Canada, North America, Nepal and New Zealand. Widely spread in East Africa and in other tropical and subtropical regions of the world.

**Remarks:** *Phaeophyscia hispidula* shows great amount of variation in the size of thallus, lobes width and nature of soredia. Some specimens may be small without projecting rhizinae and having soralia mainly marginal and sometimes the soralia may be eroded making it difficult to identify. This species is the most abundantly occurring species of this genus in India but first time reported from Maharashtra.

**Specimens Examined:** Maharashtra, **Ahmadnagar District**, Bhandardara, 25.5.2002, A.V. Bhosale & G.S. Chitale, 02.132, 02.133, 02.137, 02.138; Kalsubai, 25.5.2002, U.V. Makhija & G.S. Chitale, 02.170. **Kolhapur District**, Panhala, 13.10.1974, P.G. Patwardhan & C.R. Kulkarni, 74.1147, 74.1170, 74.1183, 74.1190, 74.1216, 74.1217, 74.1222. **Nasik District**, Saptashringi Gad, 24.5.2002, U.V. Makhija & A.V. Bhosale, 02.196. **Pune District**, Malshej Ghat, Neemgiri, 9.9.2002, U.V. Makhija & G.S. Chitale, 02.2, 02.4, 02.5, 02.7; Purandar Fort; 27.10.1993, P.G. Patwardhan, 93.25, 13.9.2002, B.C. Behera & G.S. Chitale, 02.65, 02.67, 02.68, 02.74; Sinhagad, 4.7.2003, A.V. Dube & G.S. Chitale, 03.8; U.V. Makhija & N. Verma, 03.13, 03.17, 03.18, 03.23, 03.24, 03.59, 03.63. **Raigad District**, Karnala, 16.9.2002, U.V. Makhija & B.C. Behera, 02.101. **Satara District**, Mahabaleshwar, 24.9.1997, B.A. Adawadkar, 97.48, 25.5.2001, U.V. Makhija & B.A. Adawadkar, 01.30, 01.41, 01.42, 01.43, 01.46, 01.50, 01.51, 01.52; Lingmala, 15.7.2003, B.C. Behera & A.V. Dube, 03.137, 03.156, 29.9.2003, A.V. Dube & N. Verma, 03.483; Panchgani 1973, M.E. Hale, 40006; 4.8.1981, M.B. Nagarkar, 81.280; Gureghar, 15.7.2003, B.C. Behera & N. Verma, 03.149, 29.9.2003, G.S. Chitale & A.V. Dube, 03.354; Tata Holiday Home, 29.9.2003, G.S. Chitale & A.V. Dube, 03.356. **Sindhudurg District**, Amboli, 22.9.1980, P.G. Patwardhan, 80.489, 80.490.

*Phaeophyscia kairamoi* (Vain.) Moberg

(Pl. 1, Fig. 6)

*Symb. Bot. Upsal.* **22**(1): 40 (1977).

= *Physcia kairamoi* Vain.

*Acta. Soc. Fl. Fenn.* **46**: 3 (1921).

**Thallus** subfoliose, corticolous spreading irregularly to orbicular, loosely attached to the substratum, greenish to grayish brown, sometimes small lobes yellowish orange to light brown, upto 4 cm in diameter, loosely attached to the substratum, 73.5-175  $\mu\text{m}$  thick; lobes irregularly branched, moderately broad, 1-2 mm broad, no hyaline hairs seen on lobes, sometimes upper surface glistening, white pruina present; isidia marginal to laminal, further turning into lobules; soredia absent; upper cortex paraplectenchymatous, 14-17.5  $\mu\text{m}$  thick, cilia not seen; medulla white in the lobe region but yellowish brown to orange near the isidia, 24.5-70  $\mu\text{m}$  thick; algal layer 17.5-24.5  $\mu\text{m}$  thick; underside black, lower cortex paraplectenchymatous with abundant jet black rhizines simple to sometimes branched, white tipped, projecting beyond the thallus. **Apothecia** not seen; pycnidia seen sometimes.

**Chemistry:** Thallus and medulla K-, KC-, C-, P-; UV-; no lichen substances present.

**Habitat:** Growing in shady, rather moist places.

**Distribution:** India (Maharashtra, W. Himalaya). Widely distributed in North America.

**Remarks:** *Phaeophyscia kairamoi* has been reported to be closely related to *Phaeophyscia sciastra* (Ach.) Moberg with apothecia without marginal rhizinae (Moberg, 1969). Another species probably closely related to *P. kairamoi* is *P. hispidula* (Ach.) Moberg but the latter has somewhat larger lobes and has laminal soredia instead of marginal isidia.

**Specimen Examined:** Maharashtra, **Kolhapur District**, Panhala, 11.12.2002, G.S. Chitale, 02.288.

*Phaeophyscia orbicularis* (Neck.) Moberg

(Pl. 1, Fig. 7)

*Symb. Bot. Upsal.* **22**(1): 44 (1977).

= *Lichen orbicularis* (Neck.)

*Deliciae Gallo-Belgicae* **509** (1768).

**Thallus** foliose, corticolous, orbicular to suborbicular, loosely attached to the substratum, grayish black, upto 3 cm in diameter, 99-141  $\mu\text{m}$  thick; lobes short, narrow, dichotomously branched, with small lateral lobes, 0.5-1 mm broad, sometimes upper surface glistening, white pruinose; isidia marginal to laminal, further turning into lobules; soralia absent; upper cortex paraplectenchymatous, 18-21  $\mu\text{m}$  thick, cilia not seen; medulla white in the lobe region but yellowish brown to orange near the isidia, 48-66  $\mu\text{m}$  thick; algal layer 27-30  $\mu\text{m}$  thick; underside black, lower cortex paraplectenchymatous; with abundant jet black rhizines, simple to sometimes branched, white tipped, projecting beyond the thallus. **Apothecia** not seen; pycnidia sometimes seen.

**Chemistry:** Thallus and medulla K + purple, KC-, C-, P-; UV -; skyrin present.

**Habitat:** Only one specimen at hand which was found in dry deciduous forest on road side.

**Distribution:** India (Jammu and Kashmir, Maharashtra, Manipur, South India and Uttar Pradesh). Australia, Britain, Canada, Fennoscandia region, New Zealand, North America, and tropical regions of the world.

**Remarks:** It has been reported from various parts of India but seems to be a rare species in Maharashtra.

**Specimen Examined:** Maharashtra, **Pune District**, Malshej ghat, Neemgiri, 9.9.2002, U.V. Makhija & G.S. Chitale, 02.11.

*Phaeophyscia pyrrophora* (Poelt) Awasthi & Joshi

(Pl. 1, Fig. 8)

*Ind. Mycol. Res.* **16**(2): 278 (1978).

= *Physcia pyrrophora* Poelt

*Khumbu Himal.* **6**: 84 (1974).

**Thallus** foliose, orbicular to sub-orbicular, greenish gray to dark gray, closely attached to the substratum, 3.5 cm in

diameter, 120-135  $\mu\text{m}$  thick; lobes sublinear to round, imbricate, irregular, branched, 1-3 (-4) mm broad, epruinose; isidia and soredia absent; upper surface concave, smooth, upper cortex paraplectenchymatous, 18-21  $\mu\text{m}$ ; medulla orange, 60-72  $\mu\text{m}$  thick; algal layer 27-30  $\mu\text{m}$  thick; lower cortex blackish brown, paraplectenchymatous, 12-18  $\mu\text{m}$  thick; rhizines black. **Apothecia** numerous, 1-3 mm in diam.; margin entire to irregular, lobulate at age; disc dark brown, flat to concave, epruinose; thalline exciple concolorous; epithecium brown, 12-15  $\mu\text{m}$  thick; hymenium hyaline, 45-54  $\mu\text{m}$  high; hypothecium 15-36  $\mu\text{m}$  high; paraphyses simple, septate; ascicylindrico-clavate, 80-91 x 9-16  $\mu\text{m}$ . **Ascospores** 8/ascus, *Pachysporaria* type, 9-15 x 4.5-6  $\mu\text{m}$ .

**Chemistry:** Medulla K + red-violet, C-, KC-, P-; UV -; skyrin present.

**Habitat:** Common on trees in open moist places.

**Distribution:** India (Manipur, Maharashtra and Uttar Pradesh), Japan and Nepal.

**Remarks:** *Phaeophyscia pyrrophora* is one of the most commonly occurring species of this genus in India and is characterized by broad concave, imbricate lobes and *Pachysporaria* type of ascospores. It resembles *P. endococcinodes* (Poelt) Essl. in having orange medulla due to the presence of skyrin, but latter species has narrow flat to convex lobes.

**Specimens Examined:** Maharashtra, **Ahmadnagar District**, Bhandardara, 25.9.2002, A.V. Bhosale & G.S. Chitale, 02.135, 02.136, 02.139, 02.140. **Kolhapur District**, Panhala, 9.9.1988, P.G. Patwardhan & M.B. Nagarkar, 88.82, 88.83, 88.84, 88.85, 88.86, 88.87, 88.88, 88.89; 4.9.1990, P.G. Patwardhan & B.A. Adawadkar, 90.19, 90.27, 90.31, 90.35; 13.10.2000, U.V. Makhija & V.A. Mantri, 00.414. **Nasik District**, Trimbakeshwar, 26.9.2002, U.V. Makhija & B.C. Behera, 02.205, 02.206, Brahmagiri, 02.208. **Satara District**, Panchgani, 25.9.2001, B.A. Adawadkar, 01.55, 01.59.

Genus *Physcia* (Schreb.) Michx

*Flora boreali-americana*. Tom. 2: 326 (1803).

**Thallus** foliose, suborbicular, appressed to subsessile at margin, white to gray, usually narrow lobed, heteromerous, corticated on both surfaces, upper cortex paraplectenchymatous, photobiont a green alga, lower cortex paraplectenchymatous, rhizinate, apothecia lecanorine, hypothecium hyaline; ascospores brown, 2-celled, *Physcia* type or *Pachysporaria* type, atranorin always present.

Twenty-one species of *Physcia* are known from India and Nepal (Awasthi, 2000).

#### Key to the species of *Physcia* from Maharashtra

- 1a. Without soralia, usually with abundant apothecia.  
Underside black, pruina seen on the disc of young apothecia; medulla K + yellow; ascospores 21-25 x 8-12  $\mu\text{m}$ ; atranorin and zeorin present.....*P. integrata*
- 1b. With soralia, with or without apothecia.....2

- 2a. Medulla K-, zeorin absent.  
Soralia at or under lobe tips, marginal.....*P. tribacia*
- 2b. Medulla K+; atranorin and zeorin present.....3
- 3a. Soralia laminal.  
Lobes mostly broad upto 5 mm, soralia starting as small pustules and form confluent patches; ascospores 21-25 x 10-12  $\mu\text{m}$ .....*P. albata*
- 3b. Soralia marginal.....4
- 4a. Soralia marginal-linear, giving undulating appearance, lobes shiny, pruinose; atranorin and zeorin present.....*P. undulata*
- 4b. Soralia marginal-capitate, callus like, lobe tips lacinate; ascospores 17.5-28 x 7-12  $\mu\text{m}$ ; atranorin, zeorin and traces of triterpenoids present.....*P. tribacoides*

*Physcia albata* (F. Wilson) Hale

(Pl. 2, Fig. 1)

*Bryologist* 66: 72 (1963).

=*Parmelia albata* F. Wilson

*Victorian Nat.* 6: 69 (1889).

**Thallus** foliose, grayish white, loosely adnate to the substratum, orbicular to irregular, variable in size from 1-7 (-10) cm in diameter, epruinose, 159-189  $\mu\text{m}$  thick; lobes mostly broad at the growing end, 1-4 (-5) mm, tips rounded and incised; soralia laminal to marginal, starting as small pustules or cracks, becoming large and confluent, granular, capitate and rounded; upper cortex paraplectenchymatous, 12.6-21  $\mu\text{m}$ ; lower cortex paraplectenchymatous, 21-25  $\mu\text{m}$ ; under side white to light brownish; with few pale to blackish brown, simple, rhizines. **Apothecia** rare but when present 0.5-1.2 mm in diam., subsessile; thalline margin entire; epithecium brown, 12.6-21  $\mu\text{m}$  thick; hymenium hyaline, 63-92  $\mu\text{m}$  high; hypothecium hyaline, 21-42  $\mu\text{m}$  high; paraphyses simple, thick at apices; asci clavate, 54-80 x 4-9  $\mu\text{m}$ . **Ascospores** *Physcia* to *Pachysporaria* type, 21-25 x 10-12  $\mu\text{m}$ .

**Chemistry:** Thallus and medulla K+ yellow, C-, KC-, P-; UV-; atranorin, zeorin, and unknown triterpenoid below zeorin is present.

**Habitat** It seems to have a wide range of habitats but is very rarely found growing on rocks. Its typical habitat is tree trunks, with moss often associated with *Leptogium*.

**Distribution:** India (Maharashtra), Australia, New Zealand, South Africa. It is widespread in East Africa.

**Remarks:** This is the first record of *Physcia albata* from India. *Physcia albata* seems somewhat similar to *P. tribacoides* Nyl. in its external morphology and chemistry but they differ in colour of the thallus and the size of lobes. Colour of the thallus is whitish gray and lobes are about 1-5 mm in former species and in *Physcia tribacoides* the colour of the thallus is bluish to greenish gray and size of the lobes are 1-3 mm broad.

**Specimens Examined:** Maharashtra, Ahmadnagar

**District**, Bhandardara, 25.9.2002, U.V. Makhija & A.V. Bhosale, 02.134, 02.141; Kalsubai, 25.9.2002, U.V. Makhija & G.S. Chitale, 02.168, 02.169. **Nasik District**, Anjaneri, 26.9.2002, U.V. Makhija & A.V. Bhosale, 02.225; Saptashringi Gad, 24.9.2002, B.C. Behera & A.V. Bhosale, 02.173, 02.175, 02.197, 02.198. **Pune District**, Bhimashankar, 17.9.1997, U.V. Makhija, 97.24; Junnar, Durgwadi, 2.9.2003, G.S. Chitale & A.V. Dube, 03.334; Malshej Ghat, Neemgiri, 9.9.2002, U.V. Makhija & G.S. Chitale, 02.8, 02.9; Sinhadgad, 4.7.2003, U.V. Makhija & G.S. Chitale, 03.16, 03.25, 03.47, 03.72. **Raigad District**, Karnala, 16.9.2002, U.V. Makhija & B.C. Behera, 02.99.

*Physcia integrata* Nyl.

(Pl. 2, Fig. 2)

*Syn. Method. Lich.* **1**(2): 424 (1860).

**Thallus** foliose, orbicular to irregular, grayish white, warty, upto 4 cm in diameter, more or less adnate to the substratum, 123-130 µm thick; lobes imbricate, 0.5-1 mm broad, tips rounded, margins dissected into lobes, sometimes shows dichotomy; non sorediate and non isidiate; upper side pale grayish white, usually glossy, upper cortex paraplectenchymatous, 17.5-24.5 µm thick; algal layer 16-28 µm thick; medulla white, 38.5-70 µm thick; under side black, cortex paraplectenchymatous with thick, black cell wall, 14-17 µm thick; rhizines few black simple to branched. **Apothecia** usually abundant, 0.5-1.5 mm in diameter, subsessile, margins entire; disc dark brown to black, presence of white pruina abundant in young apothecia; epithecium brown; hymenium pale yellow, 70-87.5 µm high; hypothecium pale yellow, 28-35 µm high; paraphyses simple, thick at apices; asci clavate 54-60 x 9-12 µm. **Ascospores** *Pachysporaria* type, 21-25 x 8-12 µm.

**Chemistry**: Thallus and medulla K+ yellow, C-, KC-, P-; UV-; atranorin, zeorin and unidentified triterpenoids present.

**Habitat**: Growing on both tree trunks and rocks in open sites.

**Distribution**: India (Maharashtra, Tamil Nadu), Africa, Australia and Mexico.

**Remarks**: *Physcia integrata* can easily be separated by the black, distinctly paraplectenchymatous lower cortex, shiny upper side and by the presence of pruina in young apothecia.

**Specimens examined**: Maharashtra, **Kolhapur District**, Panhala, 13.10.1974, P.G. Patwardhan & C.R. Kulkarni, 74.1202; 9.9.1988, P.G. Patwardhan & M.B. Nagarkar, 88.90, 88.91, 88.92, 88.93, 88.94. **Nasik District**, Anjaneri, 26.9.2002, B.C. Behera & B.A. Adawadkar, 02.224. **Pune District**, Bhimashankar, 17.9.1997, B.A. Adawadkar, 97.25, 97.30; Junnar, Durgawadi, 2.9.2003, U.V. Makhija & A.V. Dube, 03.291. **Satara District**, Panchgani, 4.8.1981, U.V. Makhija, 81.281, 81.282; 25.9.2001, U.V. Makhija, 01.36, 01.48, 01.58, 01.61; Tata Holiday Home Campus, 29.9.2003, G.S. Chitale & A.V. Dube, 03.361, 03.411, 03.485.

*Physcia tribacia* (Ach.) Nyl.

(Pl. 2, Fig. 3)

*Flora* **57**: 307 (1874).

= *Lecanora tribacia* Ach.

*Lich. univ.* **415** (1810).

**Thallus** saxicolous, foliose, whitish gray to dark gray, 2-3 cm in diameter, more or less adnate to the substratum, 90-105 µm thick; lobes imbricate, sometimes narrow, upto 0.5-1 µm broad, lobes margin crenulate; upper side pale grayish to dark grayish, usually glossy, without pruina; soralia marginal to terminal, starting on the underside of the extreme lobe tips, granular; upper cortex paraplectenchymatous, 15-30 µm thick; algal layer uniform about 21-24 µm thick; medulla white, 21-30 µm; under side light brown, lower cortex paraplectenchymatous, 12-18 µm thick; rhizines few small, simple, brown to black. **Apothecia** absent.

**Chemistry**: Thallus K+ yellow and medulla K-, C-, KC-, P-; UV-; atranorin present.

**Habitat**: Collected on rock in an open place.

**Distribution**: India (Maharashtra, Tamil Nadu), Nepal, East Africa.

**Remarks**: *Physcia tribacia* is being reported for the first time from Maharashtra and seems closely related to *P. tribacoides* Nyl. and *P. albata* (F. Wilson.) Hale but differs in lobe size as it is 0.5-1 mm in *Physcia tribacia* and they are broader in latter two species.

Lobes are 0.5-3 mm in *P. tribacoides* and 1-5 mm in *P. albata*. Besides this in *Physcia tribacia* only atranorin is present and in *P. tribacoides* and *P. albata* zeorin and unknown triterpenoids are present in addition to atranorin.

**Specimen examined**: Maharashtra, **Pune District**, Sinhadgad, 4.7.2003, G.S. Chitale & A.V. Dube, 03.72.

*Physcia tribacoides* Nyl.

(Pl. 2, Fig. 4)

*Flora* **57**: 307 (1874).

**Thallus** corticolous, foliose, bluish to greenish gray, 2-5 cm in diameter, more or less adnate to the substratum, 192-238 µm thick; lobes imbricate, 0.5-3 mm broad, crenulate to lobulate; upper side pale grayish white, usually glossy, without pruina; soralia marginal to laminal, small patches, capitate, granular, spreading all over thallus; upper codex paraplectenchymatous, 17.5-24.5 µm thick; algal layer uniform about 35 µm thick; medulla white, 105-129.5 µm thick; under side pale to light brown, lower cortex paraplectenchymatous with thick brown cell walls, 24.5-42 µm thick; rhizines few small and simple white to black. **Apothecia** rarely present, 0.1-1 mm in diameter; disc brown, sometimes pruina seen; epithecium reddish brown, 14-42 µm thick; hymenium hyaline, 52.5-105 µm high; hypothecium hyaline, 35-70 µm high; paraphyses filiform, branched and thick at apices; asci clavate, 52.5-80.5 x 7-10.5 µm. **Ascospores** *S/ ascus*, brown, *Pachysporaria* type, 17.5-28 x 7-12 µm.

**Chemistry**: Thallus and medulla K+ yellow, C-, KC-, P-; UV; atranorin, zeorin and two unknown triterpenoids present.

**Habitat**: On trees in open places usually at lower elevations.

**Distribution:** India (Manipur, Maharashtra and Tamil Nadu), Australia, Britain, East Africa, Europe, New Zealand, North America and tropical and temperate regions of Japan.

**Remarks:** *Physcia tribacoides* is first time reported from Maharashtra and is easily recognized by its callus like soralia, crenulate lobes and the paraplectenchymatous lower cortex with thick walled cells. This species differs from *P. albata* in lobe size as they are 0.5-3 mm and bluish to greenish gray in *P. tribacoides* and 1-5 mm and grayish white in *P. albata*.

**Specimens examined:** Maharashtra, **Chandrapur District**, Chandrapur, 24.8.2000, K.R. Ranadive & V.A. Mantri, 00.72. **Kolhapur District**, Panhala, 13.10.2000, U.V. Makhija & K.R. Ranadive, 00.395, 00.400a, 00.406. **Pune District**, Lonawala, 00.97; Malshej ghat, Neemgiri, 9.9.2002, U.V. Makhija & G.S. Chitale, 02.6a; Sinhadag, 16.8.2000, U.V. Makhija & B.C. Behera, 00.3a, 00.21, 00.22, 00.32, 00.36, 00.42, 00.43, 00.44. **Satara District**, Panchgani, Tata Holiday Home, 29.9.2003, U.V. Makhija & G.S. Chitale, 03.355, 03.413.

*Physcia undulata* Moberg

(Pl. 2, Fig. 5)

*Nord. J. Bot.* **6**: 861 (1986).

**Thallus** corticolous, foliose, brownish white to pale yellow, 6-7 cm in diameter, undulating surface, pruinose to shiny, dull, closely adnate to the substratum, 192-269  $\mu\text{m}$  thick; lobes narrow, linear, orbicular to suborbicular, confluent at the centre but lobes separating at periphery, margins white or paler than thallus, crenate, irregular, 0.3-2 mm broad; soralia marginal to laminal, linear, granular crowded at the centre, giving margins an undulating appearance; upper cortex paraplectenchymatous, 28-45.5  $\mu\text{m}$  thick; algal layer uniform, 31.5-45.5  $\mu\text{m}$  thick; medulla white, 87.5-157.5  $\mu\text{m}$  thick; under side pale to light brown, lower cortex prosoplectenchymatous, 28-52.5  $\mu\text{m}$  thick; rhizines black simple. **Apothecia** absent.

**Chemistry:** Thallus and medulla K + yellow, C-, KC-, P-; UV -; atranorin and zeorin present.

**Habitat:** It grows on twigs, small branches and tree trunks in fairly open sites mixed with other species of *Physcia* and *Phaeophyscia*.

**Distribution:** India (Maharashtra), South Africa and New Zealand.

**Remarks:** This species is recorded for the first time from India and can easily be recognized by the marginal soralia, which develop an undulating margin on the inner parts of the lobes. It has some similarities with *Physcia dimidiata* (Am.) Nyl. but the K + yellow medulla easily separates *P. undulata* from *P. dimidiata*.

**Specimens examined:** Maharashtra, **Kolhapur District**, Panhala, 4.9.1990, P.G. Patwardhan & B.A. Adawadkar, 90.30; 13.10.2000, U.V. Makhija & V.A. Mantri, 00.395, 00.406. **Pune District**, Sinhadag, 4.7.2003, A.V. Dube & G.S. Chitale, 03.7. **Satara District**, Mahabaleshwar, Lingmala, 15.7.2003, B.C. Behera & N. Verma, 03.142.

Genus *Physconia* Poelt.

*Nova Hedwigia* **9**: 30 (1965).

**Thallus** foliose, orbicular, dull brown to gray, lobes narrow, densely white to bluish pruinose, heteromerous, corticate on both surfaces, lower surface brown black, rhizinate, photobiont a green alga. **Apothecia** laminal and lecanorine, hypothecium hyaline to yellowish, ascospores brown, 2-celled, *Physconia* type, evenly thick walled, with large locules. Six species of *Physconia* are known from India (Awasthi, 2000).

*Physconia enteroxantha* (Nyl.) Poelt

(Pl. 2, Fig. 6)

*Nova Hedwigia* **12**: 125 (1966).

= *Physcia enteroxantha* Nyl.

*Flora* **56**: 196 (1873).

**Thallus** foliose, corticolous, suborbicular, gray to black, somewhat adpressed to the substratum, 1.5-4.4 cm in diameter, 210-231  $\mu\text{m}$  thick; lobes grayish white to black, adjacent, tips rounded, more or less dichotomously branched, 1-2 mm broad, pruinose; isidia absent; soredia marginal, sometimes laminal, capitate, grayish white, sometimes black, also some are yellow; upper surface plane to concave, smooth, upper cortex paraplectenchymatous, 27-30  $\mu\text{m}$ ; medulla yellow, 111-150  $\mu\text{m}$  thick; algal layer 27-30  $\mu\text{m}$  thick; lower cortex white to light brown, prosoplectenchymatous, 24-30  $\mu\text{m}$  thick; rhizines black, short, simple to branched, scattered. **Apothecia** not seen.

**Chemistry:** Medulla K + red-violet, C-, KC-, P-; UV -; unidentified substances present.

**Habitat** Common on tree trunks and also on mossy rocks. Only once collected in Maharashtra in evergreen forest.

**Distribution:** India (Maharashtra), Britain, Canada, Europe, Nepal, New Zealand and North America.

**Remarks:** *Physconia enteroxantha* was earlier reported from Nepal and this is the first report of this species from Maharashtra.

**Specimen Examined:** Maharashtra, **Kolhapur District**, Panhala, 13.10.1974, P.G. Patwardhan & C.R. Kulkarni, 74.1139.

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## REFERENCES

- Awasthi DD, 1988. A key to the Macrolichens of India and Nepal. *J. Hattori Bot. Lab.* **65**: 207-302.
- Awasthi DD, 2000. *Lichenology in Indian Subcontinent*. Bishen Singh Mahendra Pal Singh, Dehra Dun, India, : 1-123.
- Culberson CF & Kristinsson, 1970. A standardized method for the identification of lichen products. *J. Chromatogr.* **46**: 85-93.
- Moberg R, 1969. *Physcia kairamoi* in Scandinavia. *Sw. Bot. Tidskr.* **3**: 63.
- Makhija U, Chitale G & Dube A, 2004. The lichen genus *Heterodermia* (Family Physciaceae) from Maharashtra. *Geophytology* **34** (1&2) : 43-55.
- White FJ & James PW, 1985. A new guide to microchemical techniques for the identification of lichen substances. *Bull. British Lichen Soc.* **57**: 1-41 (Suppl.).