

## WESTERN HIMALAYAN SPECIES OF *ASCOBOLUS*<sup>1</sup>

S. C. KAUSHAL AND K. S. THIND

Department of Botany, Panjab University, Chandigarh

### ABSTRACT

Three species viz. *Ascobolus sub-alpinus* Kaushal & Thind, *A. furfuraceus* Pers. per Hook., and *A. immersus* Pers. per Pers. are described in detail. Annotated notes are given for *A. scatigenus* (Berk. & Curt. apud Berk.) Brumm., *A. carbonarius* Karst., *A. geophilus* Seaver and *A. denudatus* Fr. A key to all the Indian species of the genus is provided.

### INTRODUCTION

*Ascobolus* Pers. per Hook, is a coprophilous genus of Pezizales of Class Discomycetes and subdivision Ascomycotina. A detailed study of the genus from Western Himalayas during the last decade has necessitated a re-evaluation of its species from this region. Consequently, *A. sub-alpinus* sp. nov., *A. furfuraceus* Pers. per Hook., a highly variable species, an *A. immersus* Pers. per Pers., a poorly understood species in India, are fully described. Relevant annotated notes are included for the other four Western Himalayan species, viz. *A. scatigenus* (Berk. & Curt. apud Berk.) Brumm., *A. carbonarius* Karst., *A. geophilus* Seaver and *A. denudatus* Fr. There are five more good species of the genus known from India of which *A. viridis* Curr. was reported by Mahju (1933) and *A. minutus* Boud. by Ginai (1936). both from west Punjab, now in Pakistan. *A. lignatilis* Alb. & Schw. per Pers. has been described from Eastern Himalayas by Kar and Pal (1968). Recently Khare (1976) described two

species viz. *A. brassicae* Crouan from Varanasi and *A. behnitziensis* Kirschst from Pantnagar in Uttar Pradesh.

*A. indicus* Sanwal recorded by Sanwal (1953b) from Delhi is a nomen dubium (c. f. Brummelen, 1967). The type specimen of the species is not in existence in the herbarium of Delhi University and the fungus has not been recollected so far. *A. gollani* P. Henn., *A. magnificus* Dodge and *Aleurina orientalis* (Pat.) Sacc. & Syd. are synonyms of *A. scatigenus* and are to be sought under that species. Realizing the importance of regional floras, a much needed key to the accepted species *Ascobolus* recorded from India is rendered.

The genus, as understood here, is recognised by the following important features :

Apothecia usually small, 0.3-10 mm (rarely up to 30 mm) in diameter, superficial or immersed, sessile, rarely substipitate, subglobose, pyriform, obconical, cup or saucer-shaped, rarely lenticular; external surface smooth, furfuraceous or downy; hymenium yellowish, sometimes

1. Accepted for publication on 16 February, 1982.

The authors are grateful to the U. S. D. A. for the financial assistance under P. L. 480 Programme. One of us (SCK) is thankful to the U. G. C. New Delhi for special assistance to complete this work. The latin diagnosis was very kindly rendered by revered father J. J. Serrano, S. J. Chandigarh.

greenish. Asci 8-spored, clavate to cylindric-clavate, strongly protruding above the hymenium at maturity, apex rounded or slightly truncate, often amyloid. Ascospores biseriate or irregularly disposed, always free, ellipsoid to globose, episporial pigment violet, often becoming brownish before discharge. Paraphyses slender, not or slightly enlarged above, septate, hyaline, often embedded in yellowish or yellowishgreen muscus.

Anatomy : Excipulum mostly of textura angularis to globulosa throughout, rarely 2 or more layered.

Habitat : Predominantly coprophilous, sometimes terrestrial or pyrophilous, rarely lignicolous.

Typespecies : *Ascobolus pezizoides* Pers. in Gmelin, C. Linn. Syst. Nat. 2 : 1461, 1791. (= *A. furfuraceus* Pers. per Hook., Fl. Scot. 2 : 33, 1821; Fries, Syst. Myc. 2 : 163, 1822.

*Saccobolus* Boud., a genus closely related to *Ascobolus*, differs from it essentially in having ascospores united in a group of more or less regular fashion.

### KEY TO THE SPECIES

1. Ascospores ellipsoid with rounded or truncate ends, elliptic-fusoid to fusoid, ornamented with regular or irregular rounded warts longitudinal ridges or to more one coarse or fine striations which may or may not anastomose. 2
- 1'. Ascospores globose to spherical, ornamented with small isolated, round or angular warts. .... *A. brassicae*
- 2(1) Ascospores  $12-15 \times 7-9 \mu\text{m}$ , with regular longitudinal striations which rarely anastomose. .... *A. minutus*
- 2'. Ascospores always larger than above, with irregular rounded warts or longitudinal ridges or one to more coarse or fine striations which often anastomose. 3
- 3(2'). Apothecia usually more than 1 cm (-3cm) across; ascospores with a single fine fissure (rarely with two), or finely reticulate in over ripe or old ascospores. .... *A. scatigenus*
- 3'. Apothecia less than 1 cm across; ascospores with more than one fissure, warts or ridges. 4
- 4(3'). Apothecia on soil, .... 5
- 4'. Apothecia on dung, manured soil or rotten wood, branches, leaves. 8
- 5(4). Ascospores elliptic-fusoid to fusoid, ornamented with long or short longitudinal ridges,  $28-38 \times 11-14 \mu\text{m}$ . .... *A. viridus*
- 5'. Ascospores ellipsoid with rounded or truncate ends, ornamented with irregular or rounded, isolated warts, a pattern of short fine fissures in all directions, finally often reticulate,  $17-27 \times 9.5-13 (-15) \mu\text{m}$ . .... 6
6. Apothecia on burnt soil or charcoal or other burnt vegetable debris, rarely on humid soil; ascospores marked with irregular or rounded, isolated warts, ellipsoid with truncate ends. .... *A. carbonarius*
- 6'. Apothecia on humid soil, ascospores with fine fissures or a network of crevices from the beginning or at maturity, ellipsoid with rounded ends. .. 7
- 7(6'). Apothecia up to 5 mm in diameter; ascospores at first smooth or finely granular, at maturity developing fine fissures forming



- reticulations or warts.  
 ....*A. geophilous*
- 7'. Apothecia up to 10 mm in diameter; ascospores ornamented with network of crevices from the beginning. ....*A. behnitziensis*
- 8(4'). Apothecia 0.5-1 (-1.5) mm in diameter; ascospores (35-) 58-71 (-81)  $\times$  24-38  $\mu$ m, oblong ellipsoid; asci 490-720 (-770)  $\times$  100-130  $\mu$ m. ....*A. immersus*
- 8'. Apothecia (0.5-) 1.5-10 (-12) mm in diameter; ascospores (13-) 16-24 (-29)  $\times$  8.5-11(-15)  $\mu$ m, ellipsoid to fusiform-ellipsoid; asci 130-250  $\times$  (16-) 20-30  $\mu$ m .... 9
- 9(8'). Apothecia externally glabrous or covered with groups of subglobular, brownish, thick-walled cells. 10
- 9'. Apothecia externally furfuraceous with hyaline cells, brownish cells absent. .... 11
- 10(9). Apothecia externally glabrous; asci 135-180  $\times$  18-25  $\mu$ m.  
 ....*A. sub-alpinus*
- 10'. Apothecia externally covered with subglobular rusty brown cells; asci (120-) 170-230  $\times$  (13-) 16-23  $\mu$ m. ....*A. denudatus*
- 11(9'). Apothecia distinctly stalked, 5-12 mm in diameter, ascospores ellipsoid to fusiform-ellipsoid, 16-19.5  $\times$  8.5-10  $\mu$ m  
 ....*A. lignatilis*
- 11'. Apothecia sessile or with a very short stalk, 0.5-5 mm in diameter; ascospores (17.5)- 19.5 -28 (-32)  $\times$  10-5-14  $\mu$ m.  
 ....*A. furfuraceus*

## SYSTEMATIC ACCOUNT

*Ascobolus sub-alpinus* Kaushal & Thind,  
 sp. nov. Figs. 1-2, 7

Apothecia ad 3 mm diam. dense gregaria, singula vel parvis acervis con-

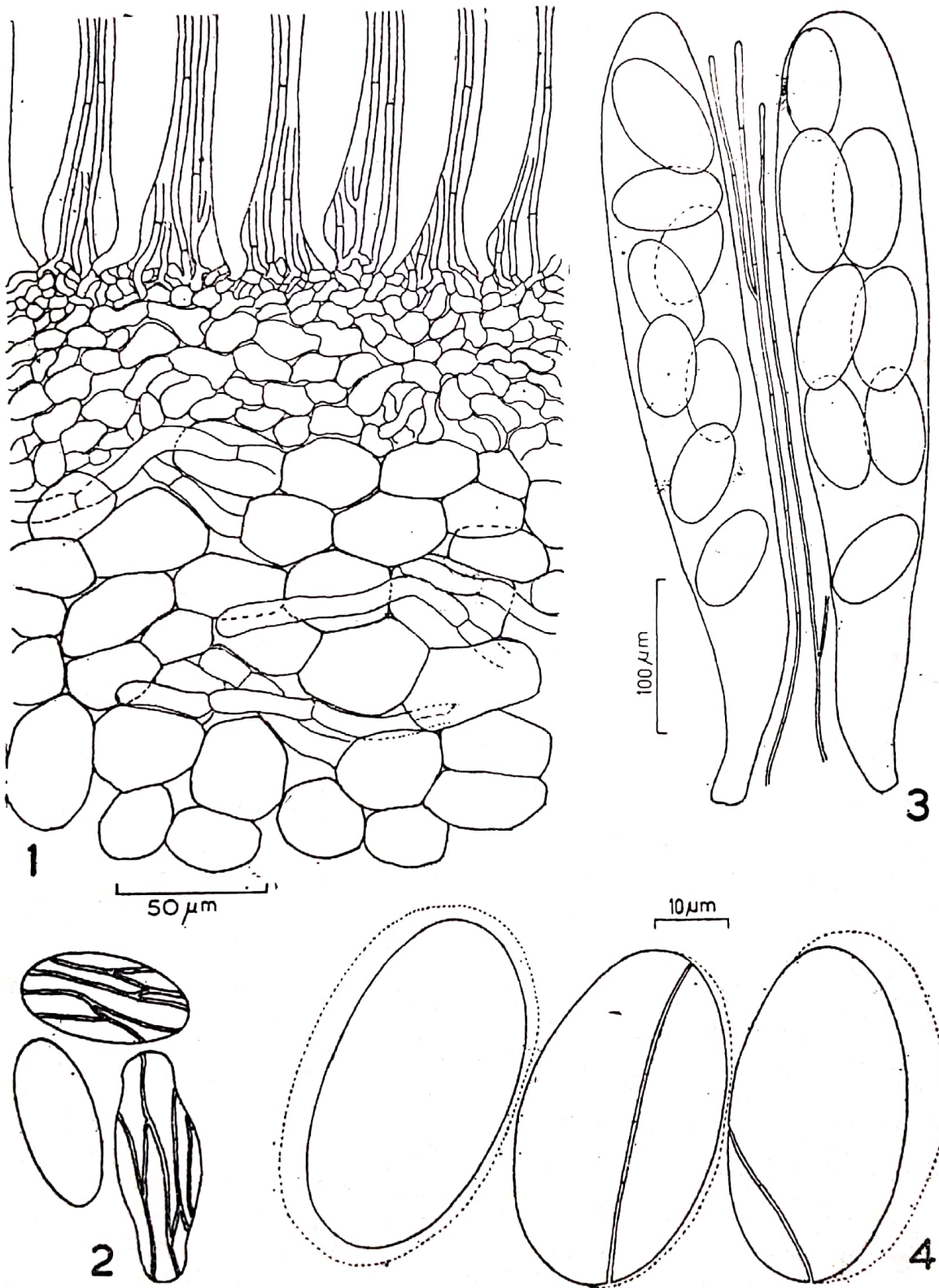
gesta, sessilia, subglobularia cum sunt tenera, postea tenuicupulata vel subscutellata, ordinata, mollia, carnosae; superficies externa fuscopallida; margo integer; hymenium fulvoaurantiacum cum recens, fuscoviolaceum cum maturum, asperum propter eminentes apices ascorum. Asci 135-180  $\times$  18-25  $\mu$ m, coctosporci, cylindrico-clavati, apex obtusus vel subtruncatus, J+ve. Ascospores 18-22.5 (-23.5)  $\times$  9-10.75  $\mu$ m, ellipsoideae, uniseriatae vel inaequaliter bisseriatae, primum hyalinacetenes, fulvopallidae et ornamentatae, ornamentum constans longis striationibus (fere 2-4) anastomosantibus, plerumque tumefactis mucilaginis substantia in uno duobus polid. Paraphyses ad 3  $\mu$ m latae infra, amplae supra ad 5  $\mu$ m, tenuitunicatae, simplices vel ramosae, rectae, in flavo muco iacentes.

*Anatomia* : Excipulum non clare differentiatum ab excipulo ectale et medullare; textura angularis, ad 142  $\mu$ m crassa, cellae ad 36  $\times$  28.5  $\mu$ m, fere horizontaliter clongatae; hypothecium ad 50  $\mu$ m crassum, textura intricata ex hyphis compaginis, tenuitunicatis, simulantibus testuram angularem, cellae ad 12  $\mu$ m latae.

*Substratum* : in stercore vaccarum.

*Holotypus* : S. Chander 2488 (PAN), in stercore vaccarum, Chandanwari, Pahalagam, J & K, Aug. 1972; S. Chander 2591 (PAN) in stercore vaccarum in itinere in Khillanmarg, Gulmarg, J & K, Aug. 18, 1974.

Apothecia up to 3 mm in diameter, densely gregarious, singly or crowded in small patches, sessile, subglobular when young, later shallow cupulate to somewhat scutellate, regular, soft, fleshy; external surface pale brown, smooth; margin entire; hymenium orange-yellow when young becoming violet-brown at maturity, roughened by protruding out ascal tips. Asci 135-180  $\times$  18-25  $\mu$ m, 8-spored, cylindric-clavate, apex obtuse to subtruncate,

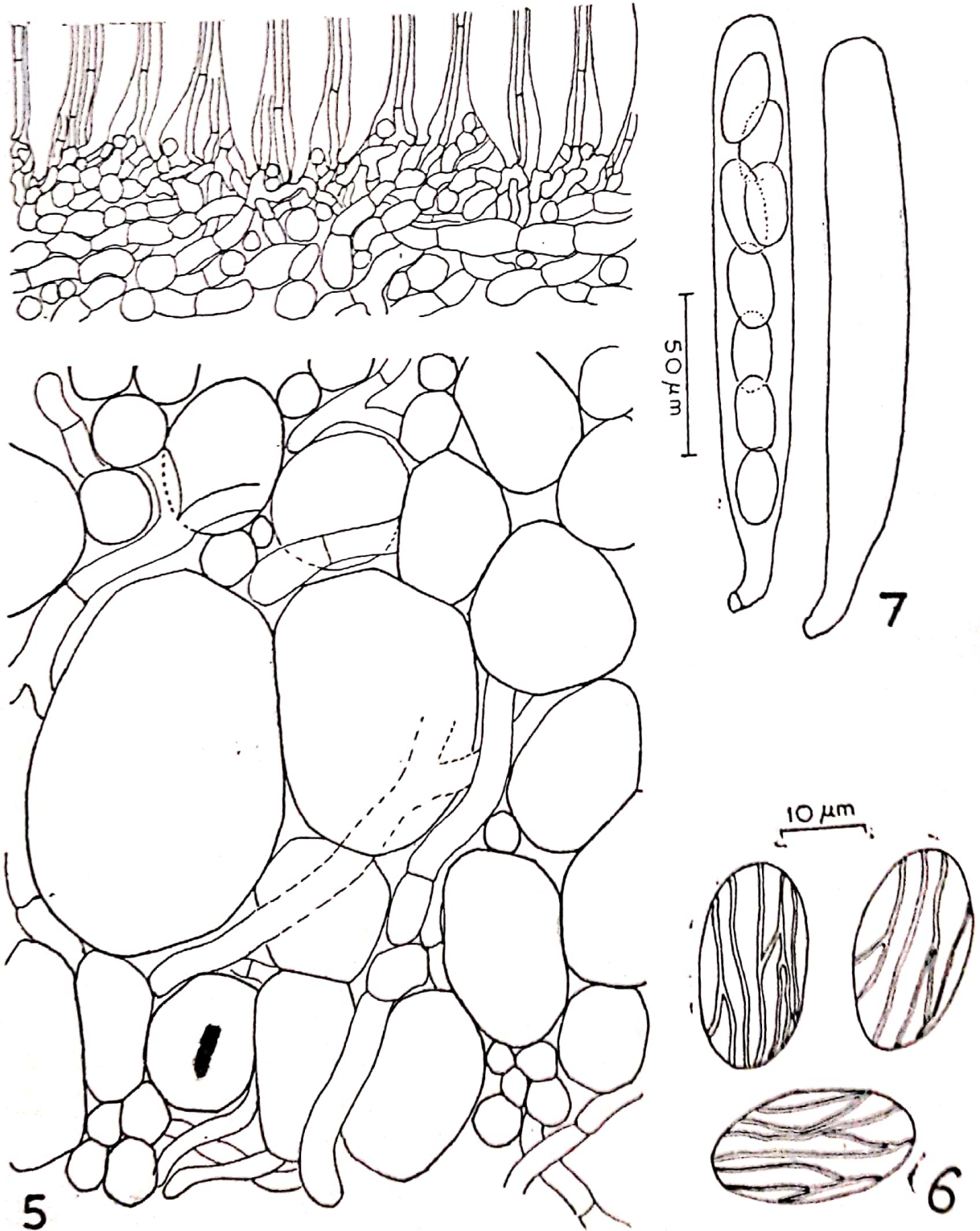


Figs. 1-2. *Ascobolus sub-alpinus* Kaushal & Thind.

Fig. 1. V. S. of the apothecium, passing through its middle. Fig. 2. Ascospores.

Figs. 3-4. *A. immersus* Pers. per Pers. Fig. 3. Asci and paraphyses. Fig. 4. Ascospore.





Figs. 5-6. *A. furfuraceus* Pers. per Hook. Fig. 5. V. S. of the apothecium, passing through its middle. Fig. 6. Ascospores.  
Fig 7. *A. subalpinus*. Asci.

J+. Ascospores 18-22.5 (-23.5)  $\times$  9-10.75  $\mu$ m, ellipsoid, uniseriate to irregularly biseriate, hyaline and smooth when young, pale-brown and ornamented at maturity, ornamentations of longitudinal (usually 2-4) anastomosing striations, mostly swollen at one or both the poles with mucilaginous substance. Paraphyses up to 3  $\mu$ m wide below, enlarged up to 5  $\mu$ m at their apices, thin-walled, simple or branched, straight, embedded in yellow muscus.

*Anatomy*: Excipulum one layered (not clearly differentiated into ectal and medullary excipulum), textura angularis, up to 142  $\mu$ m thick, decreasing towards margin, cells up to 36  $\times$  28.5  $\mu$ m, usually stretched horizontally; hypothecium up to 50  $\mu$ m thick, textura intricata of compactly packed, thin walled hyphae, simulating textura angularis, cells up to 12  $\mu$ m broad.

*Substratum*: On cow dung.

*Collections examined*: S. Chander 4888 (PAN) on cow dung, Chandanwari, Pahalgam, J & K, August 30, 1972; S. Chander 2591 (PAN) on cow dung, on way to Khillanmarg, Gulmarg, L & K, August 18, 1974.

*Distribution*: India.

*Comments*: *A. subalpinus* is close to *A. scatigenus* from which it can be differentiated by its smaller apothecia, shorter asci and the ascospores, with 2-4 anastomosing striations, *A. denudatus*, another species allied to *A. subalpinus* can be separated and recognised by presence of sub globular rusty brown cells on the external surface of the apothecia and larger asci (120—, 170-230  $\times$  13-16-23  $\mu$ m).

*Ascobolus furfuraceus* Pers. per Hook., Fl. Scot. 2 : 33, 1821, Fries, Syst. Myc. 2(1) : 163. 1822.

Figs. 5-6.

Apothecia up to 5 cm in diameter, densely gregarious to crowded together,

sessile, subglobular when young, later shallow cupulate to saucer shaped, regular, soft, fleshy; external surface light yellow, minutely furfuraceous to smooth; margin denticulate; hymenium yellow to yellow green, later becoming brown to brownish black, roughened due to dark-brown protruding out ascus tips. Asci 190-232  $\times$  17-25  $\mu$ m, 8-spored, clavate to cylindric clavate, apices obtuse to subtruncate, J+. Ascospores 17.5-27  $\times$  10.5-31  $\mu$ m, uniseriate to irregularly biseriate, ellipsoid, hyaline when young, brown to purplish brown at maturity, ornamented, ornamentations consisting of longitudinal, occasionally anastomosing striations. Paraphyses up to 3.5  $\mu$ m wide below, slightly or not enlarged above., rarely swollen up to 5  $\mu$ m, thinwalled, simple or branched below, subhyaline, straight, embedded in yellowish to yellowish-green muscus.

*Anatomy*: Excipulum one layered, not differentiated into ectal and medullary excipulum, up to 520  $\mu$ m thick, textura globulosa-angularis throughout, with several interspersed hyphae which are up to 12  $\mu$ m broad, cells upto 115  $\times$  65  $\mu$ m, becoming smaller towards hymenium, covered on the outside at places by subglobular cells, upto 14  $\mu$ m across, pale brown, there are many anchoring hyphae towards centre which sometimes form a thin mat on the outside; hypothecium up to 30  $\mu$ m thick, textura intricata of closely septate hyphae, hyphae up to 5  $\mu$ m across.

*Substratum*: On dung.

*Collections examined*: S. Chander 2631 (PAN), on cow dung, Jandri That, Dalhousie, H. P., August 29, 1974; Garaitch 2513 (PAN), on dung heap in open place, Dhanas village, Chandigarh, January 12, 1964; Waraich 2006 (PAN), on buffalo dung in coniferous forest, Jakho hills, Simla, H. P., July 23, 1965; Waraich 2084 (PAN), on buffalo dung in mixed



forest, Bakrota, Dalhousie, H. P., July 26, 1966; Waraitch 2096 (PAN), on buffalo dung in mixed forest, Bakrota, Dalhousie, H. P., July 26, 1966; Dissing s. n. (C), Draved Skov, 10 Km north of Tonder with *Lasiobolus ciliatus*, September 29, 1967.

*Distribution* : World-wide.

*Comments* : There is a wide range of variation in this species and consequently many forms, varieties and even species have been described for this fungus, mainly on the bases of lack or presence of furfuraceous hairs on the external surface of the apothecia, its size and colour. Such variations are common in the Indian collections as well.

Brummelen (1967) has studied hundreds of collections and has established that various forms (*A. furfuraceus* var. *fuscus* Pers.; *A. furfuraceus* var. *coronatus* Boud.; *A. stercorarius* var. *pusillus* Vel.; *A. furfuraceus* var. *nudus* Kickx.; *Peziza stercoria* var. *lutea* Bull.; *A. furfuraceus* var. *flavo-virens* Pers.; *A. aergineus* Fr.; *A. marginatus* Schum.; *A. furfuraceus* var. *fallons* Heim. & *A. minor* Vel.) of this fungus are linked by transitional stages. However, the distantly placed episporial striations help in separating this species from the related species.

Brummelen (1967) has described ectal excipulum (excipulum sensu Brummelen) and medullary exoepulum (flesh sensu Brummelen) as two separate zones, both made up of globular, slightly ellipsoid, oblong cells. Observations on anatomical details of the excipulum in the present study are similar except that we do not find any clear distinction between ectal excipulum and medullary excipulum.

*Ascobolus immersus* per Pers., Mycol. Eur. 1 : 341. 1822 Figs. 3-4.

Apothecia minute, 0.5-1.0 mm in diameter, scattered to gregarious, sessile, at first semi-immersed and subglobose, later superficial and short cylindric, soft,

fleshy; external surface greenish yellow, becoming pale brown at maturity, with copious attaching hyphae, specially near the base; margin indistinct; hymenium concolorous with external surface when young, later becoming dark brown due to deposition of shot off ascospores, roughened by prominently protruding out ascaltips. Asci 350-600 (-700)  $\times$  50-85 (-100)  $\mu$ m, 8 spored, thick-walled, clavate to cylindric-clavate, tapering below into a short stem-like base, tips obtuse, J+ve, at maturity projecting out more than half their length and visible as black spike-like protuberances. Ascospores 30-50 (-60)  $\times$  16-33  $\mu$ m, oblong-ellipsoid to broadly ellipsoid, uniseriate to biseriate or irregularly disposed, surrounded by a hyaline muscilaginous envelope, at first hyaline, then pale violet, finally violaceous brown, smooth or marked with single longitudinal, obliquely placed striation. Paraphyses up to 3  $\mu$ m wide below, not or slightly enlarged above at their tips, simple or branched, septate, straight, hyaline, embedded in greenish yellow muscus.

*Anatomy* : Ectal excipulum up to 60 (-85)  $\mu$ m thick, textura angularis, cells up to 30  $\times$  22  $\mu$ m, thick-walled, pale brown to brown, outer few cells giving rise to anchoring hyphae; medullary excipulum up to 200 (-225)  $\mu$ m thick in the middle, becoming thinner towards margin, textura angularis, cells up to 42  $\times$  32  $\mu$ m; hypothecium up to 35  $\mu$ m thick, textura globulosa angularis, cells upto 15 (-18)  $\mu$ m across.

*Collections examined* : Waraitch 2008 (PAN), on buffalodung, Jakoo hill, Simla H. P., July 23, 1965; Waraitch 2085 (PAN), on buffalo dung, Bakrota, Dalhousie, H. P., July 19, 1966. Collections from moist chamber at 20°C, 7885 (PAN), on camel dung from village Purchh, Chandigarh, March 23, 1980; 7886



(PAN), on mixed dung from village Purchh, April 20, 1980; 7887 (PAN), on mixed dung from Khuda Lahora, Chandigarh, May 28, 1980; 7888 (PAN), on buffalo dung from Khuda Lahora, Chandigarh, June 2, 1980.

*Comments* : *A. immersus* was enlisted from India by Sanwal (1953a) from Delhi and by Batra and Batra (1963) from Mussoorie, Dalhousie and Srinagar, but we have failed to find their collections from herbaria where these are reported to be deposited. However, we have examined the other collections of this fungus from Simla and Dalhousie hills as well as collections which appeared on dung in moist chamber at 20°C in laboratory.

The species is marked by immersed apothecia, very large asci and ascospores which are either smooth or more often with one longitudinal striation. The Indian collections have slightly smaller asci and ascospores than those reported by Brummelen (1967). *A. bistisii* (Gamundi & Ranalii, which also has immersed apothecia, large asci and ascospores, differs from *A. immersus* in spore ornamentation, consisting of papillate tubercles simulating a network in fully mature spores.

*Ascobolus scatigenus* (Berk. & Curt. apud Berk.) Brumm., *Persoonia* (Suppl.) 1 : 159. 1967.

Although not collected very often, this cosmopolitan species appears to be fairly common in the hills and plains of India. It has perhaps the largest apothecia in the genus.

As discussed by Brummelen (1967) it has been published under several names from different parts of the world. In India, it is reported under three different names viz. *A. gollani* P. Henn. by Hennings (1901) on the basis of a collection made by W. Gollan from Saharanpur (U. P.), as *Aleurina orientalis* (Pat.) Sacc. & Syd. by Sydow, H & P. and Butler (1911) on the

basis of a collection made by Butler from Bihar, and as *Ascobolus magnificus* Dodge by Thind and Batra (1957) on the basis of a collection made by Batra from Mussoorie hills. Brummelen (1967) studied the holotypes of *A. gollani* *Aleurina prientalis* and *A. magnificus* and placed the three under synonymy of *A. scatigenus*.

The Indian collections examined by us are quite typical of the species, which is characterised by its larger apothecia, pruinose external surface, and the spores having usually a single fissure.

*Collections examined* : Batra 156 (PAN), on cow dung, Jamna Bridge, Mussoorie, U. P., August 3, 1952; S. Chander 2462 (PAN), on cow dung, Khijjiar, Dalhousie, H. P., August, 5, 1972; Waraitch 2516 (PAN), on dung heap in exposed place, village Lahora, Chandigarh, February 10, 1964; Waraitch 2547 (PAN), on dung heap in exposed place, Mangitar, Sikkim, October, 3, 1964.

*Distribution* : World-wide.

*Ascobolus carbonarius* Karst., *Fungi Fenn.* 463. 1866.

This is a rare species in India and was recorded by Thind and Batra (1957) on the basis of a single collection from Mussoorie hills. A second collection of the species was made from Darjeeling (West Bengal) by Waraitch, a student of the junior author. Both the collections are quite typical of the species. The ascospores are ornamented with closely placed, irregular, isolated warts which do not form a reticulum. Thind and Batra's (1957) diagrams showing reticulate marked spores is probably a misinterpretation of darker (warted) and lighter (without warts) areas. Also, the paraphyses in their collection are mostly undulating or slightly bent, and never as strongly hooked as illustrated by them.

*Collections examined* : Batra 157 (PAN), on charcoal preparation beds, The



Mussoorie Gardens, Mussoorie, U. P., July 26, 1952; Waraich 2534 (PAN), on burnt soil and burnt wood pieces in open place, Tenzing Norkey road, Darjeeling, West Bengal, July 27, 1964.

*Distribution* : North America, Europe, Uganda, India.

*Ascobolus geophilus* Seaver, *Mycologia* 8 : 196. 1916.

Batra and Batra (1963) included this species in their check list of Indian Discomycetes and remarked that the fungus was common in Mussorie hills from August to September. However, they cited only one collection (LRB 963 = CUP-I 201). In subsequent years, many fungal forays have been undertaken by the junior author and several others but the species has not been collected again.

*A. geophilus* is restricted to humid soil covered with algae or on bark of trees covered with mud. The ascospores in this species are finely granular when young and later provided with fine fissures and finally often reticulated or warted.

*Distribution* : North America, Europe India.

*Ascobolus denudatus* Fr., *Syst. Myc.* 2: 162. 1822.

Thind and Waraich (1971) reported this fungus from Himachal Pradesh. The species is distinguished by the presence of rusty brown powder on the external surface of its aptothecia and brownish hymenium. The outside of the cup is raised to small warts made up of brown, globose, thick-walled cells. The microfeatures of the Indian collections do not differ much from the description given by Brummelen (1967) except for the size of asci, which are

smaller ( $120-180 \times 13-19 \mu\text{m}$ ) than that reported by Brummelen ( $170-230 \times 16-23 \mu\text{m}$ ).

*Collections examined* : Waraich 2443 (PAN), on buffalo dung in Oak forest, Fagu, Simla, H. P., September 2, 1961; Waraich 3037 (PAN), on dead decaying twigs of *Impatiens balsemifera*, Narkanda, Simla, H. P., August 22, 1965.

*Distribution* : North America. Europe, India, Pakistan.

## REFERENCES

- BATRA, L. R. AND S. W. T. BATRA 1963. Indian Discomycetes. *Univ. Kansas Sci. Bull.* 44 : 109-256.
- BRUMMELEN, J. VAN 1967. A world monograph of the genera *Ascobolus* and *Saccobolus* (Ascomycetes, Pezizales). *Persoonia* (Suppl.) 1 : 1-260.
- GINAI, M. A. 1936. Further contribution to a knowledge of Indian coprophilous fungi. *J. Indian Bot. Soc.* 15 : 269-284.
- HENNINGS, P. 1901. Fungi Indiae orientalis-II. *Hedwigia* 40 : 323-342.
- KAR, A. K. AND K. P. PAL 1968. Some coprophilous Discomycetes of Eastern Himalayas (India). *Mycologia* 60 : 1086-1092.
- KHARE, K. B. 1976. Two *Ascobolus* species from India. *Curr. Sci.* 45 : 385-386.
- MAHJU, N. A. 1933. A contribution to our knowledge of Indian coprophilous fungi. *J. Indian Bot. Soc.* 12 : 153-164.
- SANWAL, B. D. 1953a. Contributions towards our knowledge of the Indian Discomycetes-I. Operculate Discomycetes. *Sydowia* 7 : 191-199.
- SANWAL, B. D. 1953b. Idem. II. Two new Operculate Discomycetes. *Ibid.* 7 : 200-205.
- SYDOW, H. AND P. AND E. J. BUTLER, 1911. Fungi Indiae Orientalis Pars. III. *Ann. Myc.d.* 9 : 372-421.
- THIND, K. S. AND L. R. BATRA 1957. The Pezizaceae of the Mussoorie hills-IV. *J. Indian bot. Soc.* 36 : 428-438.
- THIND, K. S. AND K. S. WARAIK 1971. The Pezizales of India XI. *Indian J. Myc. & Pl. Pathol.* 1 : 36-50.