Subclass: *MYXOGASTEROMYCETIDAE*  Martin


Fructifications bear spores internally. On germination, spore produce one or rarely more swarm cells or myxomoebae. Sporophore development subhypothallic. Peridium continuous with stipe and hypothallus. Plasmodium of various type but never aphanoplasmadium. Calcium carbonate or calcium oxalate may present in the form of granules, crystals or scales.

Includes four orders.

**KEY TO THE ORDERS OF MYXOGASTEROMYCETIDAE**

(Adopted from Martin and Alexopoulos, 1969)

1. Spore mass dark brown or deep violet or black, lime present ........PHYSARALES

1. Spore-mass bright coloured, rarely blackish or brown but never violaceous, lime absent

2. True capillitium absent, pseudocapillitium rarely present as flaccid tubules or perforated membrane ............LICEALES

2. True capillitium typically present, rarely absent then sporophore very minute but stalked ............3

3. Fruiting minute, stipitate, white or pale coloured capillitium rarely present in the form of few delicate threads and stipe filled with granular material, columella always present, rarely absent ........ECHINOSTELIALES

3. Sporophore conspicuous, considerably large; capillitium present, rarely scanty, variously ornamented; columella never present ........TRICHIALES
Order: LICEALES John.

In Engl. & Prant., Nat. pfl. ed. 2, 2, 319, 1928

True Capillitium lacking, pseudocapillitium may present or absent; when present, in the form of irregularly sculptured tubules, perforated or fraying membranes, threads, or bristles. Columella absent. Spore mass mostly pallid to medium brown, occasionally dark brown by transmitted light or tinted to smoky or yellow-brown, never purplish brown.

KEY TO THE FAMILIES THE ORDER LICEALES

(Adopted from Martin and Alexopoulos, 1969)

1. Fruiting small, often minute sporangia, ro small, simple or sparsely branced or effused plasmodiocarps. Capillitium or pseudocapillitium or dictydin granules are absent. Spores mostly dingy to dark brown or blackish in mass, smoky under transmitted light, some times bright coloured in mass, then yellowish or ochraceous by transmitted light. .......LICEACEAE

2. Dictydine granules present. Fruiting mostly sporangiate, rarely pseudoaethallium or an aethallium. In sporangiate form, portion of peridium persisting as perforat. Dictydine granules present. Pseudocapillitium absent. .......CRIBRARIAECEAE

2. Dictydine granules absent. Fruiting mostly aethaliate or pseudoaethaliate; if sporangiate, then portion of peridium not persisting as perforated net, pseudocapillitium present. Dictydene granules absent

.......ENTERIDIACEAE
Family: LICEACEAE  Rost.

Versuch, 4, 1873.

Fructification sporangiate, often minute, sessile or stalked, or of small and unbranched or sparsely branched (rarely netted and effused) plasmodiocarps; peridium varying from thin to thick, often becoming encrusted with a dark outer layer, sometimes clearly double; neither capilllitium nor pseudocapillitium present; spores yellow brown to reddish brown (rarely blackish) in mass, rarely colourless to smoky, yellow, reddish or smoky gray or olivaceous by transmitted light, often paler on one side, smooth to minutely warted or spinulose.

Includes two genera i.e. Licea Schrad. with the characters of family and Listerella Jahn. The later is marked by the presence of slender moniliform capillitial threads attached to the base and wall, and spore mass black.

Only one genus with one species only is presented.
Genus: **LICEA** Schradr


The genus *Licea* was erected by Schrader, in 1797, with *L. pusilla* Schrad., as the type species. According to Martin & Alexopoulos (1969), originally Schrader (1797), described *Licea tubulina* Schrad., *L. clavata* Schrad., *L. Pusilla* Schrad. and *L. variabilis* Schrad. Of these former two regarded as synonym of *Tubifera ferruginosa* (Batch) J.F.Gmel. *L. pusilla* Schrad. is the typical example of the genus. *L. variabilis* Schrad. is also recognized essentially in its original application (Martin and Alexopoulos, 1969). Later one is cited as synonym of *L. flexuosa* Pers.(1801), by Hagelstein (1944), whereas Martin and Alexopoulos (1969), recognized *L. variabilis* and cited *L. flexuosa* as a synonym of former.


Martin and Alexopoulos (1969), described about 19 species and enlisted about 19 species as ‘excluded and doubtful’. Of the enlisted species six are not myxomycetes, ten are synonyms of other myxomycetes, only in case of three, identity is doubtful. About 66 species of the genus have been mentioned in the Ainsworth and Bisby’s ’Dictionary of the fungi’ (2008) from the world.

Thind and Dhillon (1967), described the genus from Indian flora for the first time with a new species *Licea erecta* Thind & Dhillon, from W. B. Shekhon (1976), from Chandigarh, described *L. pedicellata* (H.C.Gilbert) H.C.Gilbert. Lakhanpal & Mukerji (1976), described 8 species from H. P. and Delhi i.e. *L. biformis* Morgan, *L. castanea* G.Lister, *L. minima* Fr., *L. pedicellata* (H.C.Gilbert) H.C.Gilbert, *L.
perixigua Brooke & Keller, L. scypoides Brooks & Keller, L. tenera Jahn and L. variabilis Schrad. Except L. pedicellata all were addition to the list of Indian myxomycetes. Lakhanpal & Mukerji (1981), described and illustrated 12 species of which L. belmontiana Nannenga-Bremekamp, L. operculata (Wingate) Martin, L. puctiformis Martin, and L. testudinacea Nann.-Brem., constituted addition to the Indian myxomycetes. From Maharashtra the genus was reported for the first time by Ranade & Mishra (1977), who described L. sinhagadensis Patil, Ranade & Mishra, as new species and L. marginata Nann.-Brem. as a new record for India. The total number of the species of the genus Licea is reported to be about 15 from India.

1. **Licea Elloriana** Nanir & Rokade, sp. nov.

(PL. I FIG. 2)

Fructification sessile pseudoaethaliate, thin flat pulvinate, more or less circular in outline, 1.0 – 5.0 mm in diam. Sporangia compactly arranged laterally forming pseudoaethalia, yellowish brown, shining, sessile, discoid, polygonal or angular, lined by dark margin, 0.3 -0.43 mm in diam., forming ridges above radially ; ridges yellowish orange, shining, showing lines of dehiscence. Hypothallus inconspicuous. peridium double, both layers compactly adhered appearing as single, detectable only under high magnification, thick, tough, brown, semitransparent and thin towards centre. Dehiscence along the ridges or lines of dehiscence, after dehiscence peridium reflexed outwards, basal portion remain persistent as disc with black shining base. Spores dark yellow or golden yellow in mass, pale yellow under transmitted light, globose, subglobose to elliptical, 11 – 16 µm in diam., minutely and uniformly spiny, spines in lines.


**DISTRIBUTION : INDIA :** Gujrat (Salunkhe, 1995) ; M.P. (Kharat, 2000) ; M.S. (Rokade, 1989 ; Chimankar, 1993 ; Jadhav, 1994).

The species is marked by the (1) fructification flat, pulvinate, pseudoaethaloid (2) Sporangia sessile, polygonal (3) Adjuscent sporangia lined by dark margin indicating fused lateral wall (4) Peridium double ; both layers more or less fused ; outer layer cartilaginous, radially marked by ridges of dehiscence (5) After dehiscence, lobes get reflexed outwards (6) Spores 11-16 µm in diam., uniformly and minutely warted.
Among the Licea Schrad., in which dehiscence is not breaking peridium into angular platelets, it can be compared with L. marginata Nann.-Brem., L. deplanata (Kowl.) Kowl. and L. pumila Martin & Allen. Especially former two have been recorded on leaves also. L. marginata Nann.Brem., is characterized by its smaller (0.1-0.2mm), scattered or gregarious, dark brown to dull brown elongated sporangia, 3 times as long as wide, thin yellow brown peridium dehisce by longitudinal slit but wall curling inward, and spore mass pale rosy. L. deplanta (Kowl., is marked by its dark brown, scattered sporangia, brittle peridium divided into 3-4 lobes by raised ridges, margin of lobes marked by row of small papillae of 1-3 µm in diam., spores smooth with thinner paler wall on one side. L. pumila Martin & Allen, is distinguished in its scattered or gregarious smaller (0.15-0.2mm) sporangia with constricted base, circular to elliptic in outline, peridium marked with broad longitudinal or forked region of dehiscence, delicately embossed with concolorous tubercles. Moreover none of the above species have pseudoaethaloid fruiting.

SUMMARY AND DISCUSSION

The genus Licea Schradr is described and illustrated with single species in this work. Thus the genus is represented by sixteen species from Indian flora. Licea Schrad., in general, is one of the smallest and simplest Myxomycetes, Mostly found on barks. Lister (1911,1925), recognized 3 genera on the basis of the presence or absence of stalk and mode of dehiscence i.e. Licea Schrad., Orcadella Wingate, Hymenobolina Zukal. Macbride & Martin (1935), added Kleistobolous Lippert, to the above 3 genera, Hagelstein (1942), regarded all 3 as synonymous with Licea Schrad., and characterized the genus by fruitings separate, limeless, sessile or stipitate, sporangiate or plasmodiocarpous, dehiscence irregular or by plates or by lids, lacking hypothallus and lack of capillitium other than finger like protrusions form the inside of the cup of Kleistobolous (Lakhanpal & Mukerji 1981).

Nannenga-Bremekamp (1965), accepted Martin's definition on the basis of dehiscence. She proposed to divide Licea into 3 subgenera i.e. Licea Schrad., Orcadella (Wing.) Nann.-Brem., and Pleiomorapha Nann.-Brem. So far as dehiscence pattern in the genus is concerned, it is quite notable which can be considered as one of the main criteria for the species diagnosis. In this regards the views of Lakhanpal and Mukerji (1981), are followed in the present study. Capillitium or pseudocapillitium nil or absence of any capillitial or pseudocapillitial threads or finger like protrusions' concept for Licea Schrad. is followed.
Family: ENTERIDIACEAE  Farr  

Fructification aethaloid or sporangiate; the sporangia densely clustered, often united into a pseudoaethalium; pseudoaethallium usually present in the form of branched columns, which appear to represent aborted sporangia, or of bristles, or of simple to branched tubes or of frayed or perforated membranes. Spores pallid to ochraceous, olivaceous or brown (rarely yellow) in mass, hyaline or bright yellow brown by transmitted light, never smoky.

**KEY TO THE GENERA OF THE FAMILY ENTERIDIACEAE**

1. Fructification a true aethalium 
   
   1. Fructification cylindric to ellipsoidal, sporangiate, free or connate or in palisade layer fused to form pseudoaethalium. 
   
   2. Aethalium pulvinate, base broad, pleudocapillitium arising from the base frayed out or perforated membrane, spore mass brown, yellow or olivaceous. 
      
      ……Enteridium. 
      
   2. Aethalium on constricted or restricted base, subglobose or conical, pseudocapillium simple or branched tubes, spore-mass gray or ochraceous. 
      
      ……Lycogala. 

3. Fruiting effused, pulvinate pseudoaethalium of many cylindric sporangia fused laterally in a palisade layer of which thin wall disappear and wall at angles pending from the persisting cap of sporangial wall, thus forming pseudocapillitium; hypothallus inconspicuous, not massive. 
   
   ……Dictydiaethalium. 

3. Fruiting cylindric or ellipsoidal, sporangia free or connate, when pseudoaethaloid but not as above, wall persistant; capillitium absent, when pseudocapillitium present, these are bristles form sporangial wall, hypothallus massive, fibrous or spongy. 
   
   ……Tubifera.
Genus: **LYCOGALA** Adans.

**Fam. pl. 2, 7, 1763**

The genus *Lycogala* Adans. is characterized by a globose, conical, or pulvinate aethalium, resembling like a puff ball; cortex thick, firm, crustose, shell or spongy layer to a delicate membrane, nearly smooth or bearing wart like protuberances, which may be divided into tessellate chambers; pseudocapillitium rather scanty, simple or branched tubes, sculptured variously to nearly smooth, may penetrate the cortex; spores often pinkish changing to gray or ochraceous in mass, nearly colourless by transmitted light.

The genus was established by Micheli in 1729 for *Lycoperdon epidendrum* (L.) Fries. But it was before the application of the binomial nomenclature for Myxomycetes (it is 1753). Adanson (1763), was first to use Micheli's name validly. However the only name has been used till today for Myxomycetes with *Lycogala epidendrum* (L.) Fr., as the type. Since the erection of the genus only five species are known from the world (Martin & Alexopoulos, 1969; Martin, Alexopoulos & Farr, 1983). In the tenth edition of ‘Ainsworth & Bisby’s *Dictionary of The Fungi*’ (2008), mentioned 6 species of this genus from the world.

From India, the genus was described for the first time by Lodhi (1934), with *L. epidendrum* (L.) Fr., from W. B. and U.P., which was later on described from H.P. by Thind & Lakhanpal (1968), along with *L. concinum* Pers. Agnihothrudu described *L. exiguin* Morgan and *L. mysorensis* (Agnihothrudu) Agnihothrudu, form Assam and Karnataka in the year 1959 and 1966 respectively. Lakhanpal & Mukerji (1983), described *L. flavofuscum* (Ehrenb.) Rost. from, H.P. Thus, from India the genus is represented by five species.

1. **LYCOGALA EPIDENDRUM** (L.) Fries.

* Syst. Myc. 3, 80, 1829.


( PL. I FIG. 3 )

Fructification aethaloid, grouped on colony, globose to subglobose, grayish to olive brown, 2.9 – 7.2 mm in diameter, and 2.5 – 5.9 mm in height. Cortex thick, leathery, opaque, covered with blackish brown to honey coloured, scattered, circular or discoid, lobed or elongated scales which are upto 1.0 mm in diam.; dehiscence
irregular from upper side. Pseudocapillitium abundant, subhyaline to ochraceous, tubular, sparingly branched, marked with transverse folds, unequal in thickness, 2.5 – 12.7 µm in wide, with large swelling and blunt to clavate free ends. Spore grayish brown in mass, ochraceous under transmitted light, globose, 4.1 – 6.9 µm in diam., reticulate to subreticulate.

**COLLECTION EXAMINED:** RRT / 8643, July- 2006, Hatkanangale, Kolhapur dist. On dry sugarcane stick.


*Lycogala epidendrum* (L.) Fr., is characterized by scattered, globose to subglobose, aethalia look like puffball. Cortex thick, covered with blackish brown to honey coloured scale. Dehiscence irregular from upper side. Pseudocapillitium tubular, sparingly branched. Spore brown in mass, globose, reticulate or subreticulate, 4 – 7 µm in diam.

*L. epidendrum* (L.) Fr. can be compared with *Lycogala conicum* Pers. However later is marked by conical fruiting, capillitum lax, lacking reticulate marking on the cortex and in the possession of brown pseudocapillitial threads marked by faint transverse wrinkles. and spore 5 – 6 um in diam.

**SUMMARY AND DISCUSSION**

The species of *Lycogala* Adans., are distinguished mainly by size, shape, and the nature of the cortex and its markings (Martin, 1967). The latter are formed from the slime sheath encasing the plasmodium (Eliasson and sunhede, 1980). The genus consists of six species, of which *L. epidendrum* (L.) Fries and *L. exiguum* Morgan are cosmopolitan; *L. flavofuscum* (Ehrenb.) Rost. and *L. conicum* Pers. are widely distributed. Two additional species have been described from India.

Another name which was validly published and has priority over *Lycogala* is *Lycoperdon* proposed by Linnaeus (1753). Linnaeus however, included 9 species in this genus, of which only *L. epidendrum* (L.) Fr., was validly published. Out of the rest, five species belonged to “Gasteromycetes”. one was rust and two tuberaceous ascomycetes with starting points 1821, 1823 and 1929, so that none of them would be
included in *Lycoperdon* today. This genus is now, restricted to Gasteromycetes, although it was most validly published as a genus of myxomycetes. Martin (1966) expressed his view in favour of conservation of *Lycogala* against *Lycoperdon* and *Galeperdon.*” The genus *Lycogala* comprises about six species. These species, have been demarcated on the shape and size of aethalia, size of spore and capillitium and on the presence or absence of tessellate scales in the cortex.
Family: **CRIBRARIACEAE** Rost.

**Versuch**, 5, 1873.

Fruiting sporangiate, usually stalked (in *Lindbladia* Fr. sessile and pleudoaethalium or aethalium); capillitium lacking, all parts of sporophore (including spore) bear minute, typically dark dictydine granules; peridium (in *Lindbladia* Fr. continuous or nearly so or if netted interstices, rarely fugacious) netted over the entire surface or over the upper part, the interstices fugacious, so that at maturity the peridium is represented or over the either by complete net or net above and calyculs below; spores yellow, brown, red or purple in mass; pale or bright-coloured by transmitted light. Includes three genera.

**KEY TO THE GENERA OF CRIBRARIACEAE**

(Adopted from Martin and Alexopoulos, 1969)

1. Fruiting sporangiate, closely aggregated into a pseudoaethalium or aethalium; hypothalus extensive, often thick and spongy; peridial net lacking or scantily developed, then rarely dehisce between the meshes; dictydine granules few and concolorous with membrane. 

   .......Lindbladia.

1. Sporangia free, aggregated or scattered; hypothallus delicate; peridial net always present and well developed; dictydine granules numerous, darker than spores.

   ------2

2. Threads of net short, nodes thickened and expanded.

   .......Cribraria.

2. Threads of net long, stout, longitudinally by subparallel, atleast below; connected by very delicate transverse threads; peridium sometimes netted.

   .......Dictydium.
The genus *Cribraria* Pers., is characterized by the sporangia stipitate, globose or pyriform. Hypothallus thin and delicate. Sporangial wall thickened, often net-like above, at maturity fugacious between the meshes leaving netted portion above and a cup like calyculus below; veins of the net short, meeting at expanded nodes. Dictyidine granules present on cup, net and usually on spores.

The genus *Cribraria* Pers., was erected by Persoon in 1794, described *C. rufescens* Pers., as the type species. It is now considered as synonyme of *C. rufa* (Roth) Rost.

*Cribraria* Schrad. ex J. F. Gmel. (1791), with *C. pallida* Schrad. ex J. F. Gmel, as the type species, has a priority over the Persoon's publication (1794). But, according to Martin & Alexopoulos (1969), “the generic description is vague and the species, otherwise unknown, is merely named with the cited ‘Schrader’s Fung. ind.’”


The genera *Lindbladia* Fr., and *Dictydium* Schard., are very close to *Cribraria* Pers. These three have been weakly defined. However, *Lindbladia* Fr., is distinguished in its closely aggregated sporangia on thick and spongy hypothallus, net lacking or scantily developed and, granules few and concolourous to peridium. *Dictydium* Schard., is differentiated by its stout, longitudinal main threads of net connected by very delicate transverse threads.
Lindbladia tubulina Fr. (the only species of genus) resembles certain phases of Cribraria argillacea. (Pers.) Pers. Dictydium mirabile (Rost.) Meylan, and D. cancellatum (Batch) Macbr., are more like Cribraria Pers. Therefore Nannenga-Bremekamp (1962), proposed to unite the genera Cribraria Pers. and Dictydium Schard. But Martin (1962), did not agree. According to the Martin & Alexopoulos (1969), it is merely a question as to how they are best interpreted.

Martin & Alexopoulos (1969), described about 24 species as valid from the world. In Ainsworth & Bisby's Dictionary of the Fungi (2008), 40 species are mentioned from the world.


Thus total number of species represented from India are about 16 and 2 varieties. The two species of the genus are being described in the present work for the first time form this region.

KEY TO THE STUDIED SPECIES OF CRIBRARIA Pers.

1. Fruiting dusty to ochor. Stipe translucent above ----- C. tenella.
1. Fruiting deep brown. stipe opaque ----- C. intricata.

1. CRIBRARIA INTRICATA Schrad.


Fructification sporangiate, stipitate, scattered to loosely gregarious, nodding, deep brown, 1.1 to 2.7 mm tall. Sporangia globose to pyriform, 0.2 to 0.9 mm in diam. Stipe long, thick, stout, erect or bending, subulate, dark brown to black, paler, twisted and tapering towards the apex, and broader towards the base, vertically rugose, shining, opaque, 0.85 to 2.1 mm long. Hypothallus concolorous to stipe, small, rotate, membranous, transparent. Peridium fugacious above, persistent at the base of sporangium in the form of calyculus and netted above, network prominent, consists of nodes and internodes; nodes dark brown, globose, elongated or pulvinate filled with dictydine granules; dictydine granules dark brown, globose up to 1.5 µm in diam.; nodes connected by 5-12 pale brown, tubules or internodes of which 3-7 are joined to other nodes and remaining are free; meshes irregular. Calyculus small and conspicuous, thin, membranous, marked with ribs and dictydine granules. Spores dusty brown in mass, purple or pallid under transmitted light, globose, 4.0 – 7.0 µm in diam., minutely warted or verrucose, warts scattered, with few dictydine granules.

**COLLECTION EXAMINED:** RRT / 8578, oct.-2005, Mahabaleshwar; 8585, oct.-2005, Pratapagad, Dist.-Satara. On dead wood, bark of angiospermic plants and on humus rich soil.

**DISTRIBUTION: INDIA:** M. S. (Chimankar, 1993); M.P. (Khart, 2000); U. P. (Thind and Lakhanpal, 1977); W. B. (Lodhi, 1934).

In *C. Intricata* Schrad. and *C. languescens* Rex., beside other resemblance sporangia are similar. However, the calyculus of *C. intricata* is small about one-fourth of the height of the sporangia, where as it is large, about one-half of the height of the sporangia in case of *C. longuescens* Rex.

The *C. intricata* Schrad. is characterized by its sporangia globose, stipe long with twisted and tapering at upper part, peridium fugacious but persistent below in the form of calyculus and as a net above and calyculus, small, thin, membranous, marked with ribs and dictydine granules, spores minutely warted or verrucose, warts scattered

---

2. **Cribaria Tenella** Schrad.

*Nov. Gen.* pl., 6, 1797.


**(PL. II FIG. 5)**
Fructification sporangiate, stipitate, gregarious, scattered, mostly nodding, sometime erect, dusty brown to yellowish brown, 1.3 to 2.8 mm tall. Sporangia globose to broadly pyriform, 0.25 to 0.35 mm in diam. Hypothallus rotate, small, membranous, non-limy, blackish brown to dark brown. Stipe long, subulate, flexuous, thin, dark brown, translucent above, longitudinally rugose, twisted with deposit of granular material, 0.25 to 2.5 mm long. Peridium fugacious except the lower part which persist as a shallow calyculus and the net above; calyculus with vertical ribs arising from the stipe, marked by dictydine granules, dictydine granules small, dark brown. Upper net consists of globose, reniforme, pulvinate, dark violaceous brown nodes studied with dictydine granules; nodes connected by 3-6 delicate, hyaline internodes, free ends absent. Spore dusty brown in mass, ochraceous under transmitted light, globose, 4 to 9.5 µm in diam., minutely verrucose.


According to Martin and Alexopoulos (1969) the species is sometime difficult to define. However *C. tenella* Schrad., is characterized by somewhat smaller and more delicate sporangia with few or no free ends in the reticulum. The species is close to *C. intricata* Schrad. Later is differentiated by its larger sporangia, expanded and angular pulvinate nodes and net with numerous free ends. Indian population reported earlier have larger sporangia with short stipe (Thind, 1977) and slightly smaller spores (Lakhanpal, 1981).

**SUMMARY AND DISCUSSION**

*Cribraria* Pers., is the well marked genus, sporangiate phases of *Lindbladia tubulina* Fr., do resemblance certain phases of *C. argillacea* (Pers.) Pers., but in the former the net, if present, is superimposed on the persistent peridium, whereas in the latter the peridium is much thinner and falls away from the interstices of the net. Some fruitings of *Dictydium mirabile* (Rost.) Meylan, are quite *Cribraria* Pers., like, as are occasional fruitings of *Dictydium cancellatum* (Batsch.) Macbr., particularly those which have developed under alpine conditions. For these reasons, Nannenga-
Bremekamp(1962), proposed to unite these two genera. Martin (1962), studied the same problem independently and decided they were better kept separate. There is no serious disagreement about the facts involved. It is merely a question as to how they are best interpreted. For the present it seems advisable to maintain the separation.

The species often present great difficulty. All the characters used to distinguish them tend to be inconstant and vary with the maturity of the collection and the conditions under which it may have ripened. This is well illustrated by the presence or absence of a calyculus. Probably all species have a peridium which tends to persist at the base longer than above. In the majority of species this is fixed. In other, of which *C. microcarpa* (Schrader) Pers. and *C. intricata* Schrader, are the commonest example, the basal portion, in well developed specimens, tends to disappear at maturity, but in specimens which have been checked by drying before full maturity a calyculus may be present, although often rudimentary or incomplete. Some collections may show a range in this character, with sporangia in exposed areas having a calyculus while those in more sheltered portions lack it. The distinctions between flat and thickened nodes is useful and fairly constant, but intermediate phase do occur. This character is best seen in mounts in which the nodes may be observed in profile at the margins of the sporangia. Color of sporangium and of spore mass is distinctive in some species, but not in all. Size of spores is useful for a few species and the same is true for color and size of plasmodic (dictydine) granules. This is the large genus with about two dozen species are worldwide in distribution. The most common and widely reported species are *Cribraria intricata* Schrader, *C. longuescens* Rex, *C. microcarpa* (Schrader) Pers., *C. tenella* Schrad.and *C. violacea* Rex.
Genus: **DICTYDIUM** Schrader

**Nov. Gen.** pl. 11, 1797.

The genus Dictydium Schrad., is characterized by globose or subglobose stipitate sporangia, often umbilicate above or below or on both side. Peridium delicate, evanescent except for the net and basal portion which may remain as a calyculus. Dictyidine granules prominent, usually dark, densely aggregated on all parts of net, calyculus (rarely when present) and spore. Net composed of stout longitudinal ribs connected by delicate transverse filaments, especially below, upper portion sometimes more or less netted without thicken nodes.

Schrader, erected the genus *Dictydium* in 1797, and described five species. Of these, except *Dictydium umbilicatum* Schrad., remaining four are now referred to *Cribraria* Pers. Hence *Dictydium umbilicatum* Schrad., stands as the type species, which unquestionably is now called as *D. cancellatum* (Batsch) Macbr. Because, Batch’s (1789) taxa *Mucor cancellatum* and Schrader’s (1797) taxa *D. umbillicatum* Schrad., *Dictydium cancellatum* (Batsch) Macbr. (1899) is the correct name.

The genus is represented by only three species from the world i.e. *D. cancellatum* (Batsch) Macbr., *D. mirabile* (Rost.) Meyl., *D. rutilum* G. Lister (Martin and Alexopoulos, 1969 ; Martin, Alexopoulos and Farr, 1983).

From India, the genus was reported for the first time by Thind and Sohi (1956) described *D. cancellatum* from U. P. Earlier to it Lister, (1925), mentioned the species under habitat, without any mention of its collector and locality. Later on, the same species was described by Agnihothrudu (1954), from Assam ; by Kar (1964), from W.B.; by Lakhanpal and Mukerji (1981), from H.P. Thind and Lakhanpal (1968), described *D. mirabile* (Rost.) Meylan, from H.P.

Two species of the genus are known from India flora. The genus is being described first time with one species from this region.

1. **DICTYDIUM CANCELLATUM** (Batsch) Macbr.

**N. Am. Slime-moulds**, 172, 1899.


(PL. III FIG. 6)
Fructification sporangiate, stipitate, gregarious, erect or nodding, deep reddish brown to violaceous brown, 1.5 – 5.4 mm tall, depressed globose, with or without umbilicus above, small disc or calyculus at the base of sporangium from which 25 to 30, subparallel, brown to violaceous brown ribs are given out that are connected by, thin, delicate, pale transverse bands towards the apex forming network. Dark spherical dictydine granules 0.29 – 0.55 um in diam. are attached on the ribs and spores. Stipe long, subulate, erect or nodding, twisted, attenuating above, dark brown to purple brown, translucent above, 1.2 – 5.1 mm long. Hypothallus rotate, membranous and concolorous to stipe. Spore deep reddish brown or violaceous brown in mass, reddish or purple under transmitted light, globose, 4 – 7 µm in diam., minutely warted or smooth, with 3 – 4 dictydine granules.


**DISTRIBUTION**: INDIA: Asam (Agnihothrudu, 1959); H.P. (Lakhanpal and Mukerji, 1981); M.S. (Chimankar, 1993); M.P. (Kharat, 2000); U.P. (Thind and Sohi, 1956); W. B. (Kar, 1964).

The species is characterized by the, stipitate, depressed globose sporangia. Stipe long, erect or nodding, subulate, twisted attenuating towards the apex. Hypothallus rotate, membranous and concolorous to stipe. Spore deep reddish or violaceous in mass, 4 – 7 µm in diam., minutely warted or smooth with 3-4 dictydine granules.

*Dictydidum cancellatum* (Batsch) Macbr. can be compared with *Dictydidum mirabile* (Rost.) Macbr. However later is marked by fructification yellow brown to dark purplish brown, total height upto 4.6 mm in tall. Large number of peridial ribs present. Stipe 3 – 4 mm long. Spore dark brown in mass, palid by transmitted light, minutely verrucose.

**SUMMARY AND DISCUSSION**

Schrader (1797), erected the genus *Dictydidum* Schrader, to include those *Cribraria* – like species which lacked calyculus. The present concept of the genus is that of Rost. (1875). Nannenga-Bremekamp (1962), merged *Dictydidum* Schrader, with *Cribraria* Pers., and pointed out that presence or absence of calyculus is not constant and net of *Dictydidum* Schrader, merges into that of *Cribraria* Pers... However, ‘in the presence sense *Dictydidum* Schrader, is atleast as constant as many of
the other genera. Its common species is readily recognized and it seems more convenient to retain such a familiar and well known genus’ (Martin and Alexopoulos, 1969; Martin, Alexopoulos and Farr, 1983). From the experience of Indian collections, two genera are well demarcated from each other and can easily be identified (Thind, 1977).
Order: TRICHIALES Macbride


Fructification plasmodiocarpous or sporangiate, rarely pseudoaethaliate, sessile or stalked. Columella never present. Spores in mass typically bright coloured, white to yellow, orange or red by transmitted light, hyline to bright-coloured (blackish brown in mass and dusky by transmitted light in *Listerella*). Capillitium thread like, solid or tubular, smooth or sculptured, free or attached.

Includes two families.

**KEY TO THE FAMILIES OF TRICHIALES**

(Adopted from Martin and Alexopoulos, 1969)

1. Capillitium of solid or nearly solid threads, attached to the base and often to sporangial walls, never united int net

   ......Dianemaceae

1. Capillitium of tubular threads, free or attached to the base of sporangium, often united into net

   ......Trichiaceae
Family: TRICHIACEAE Rost

*Versuch*, 14, 1873.

Fruiting sporangiate, sessile or stalked or plasmodiocarpous. Capillitium tubular, sculptured in characteristics fashion or nearly smooth, consisting of simple or branched thread called “elaters” or united into a net, free or attached to the base. Spores white or bright coloured in mass, hyline, to bright yellow or red by transmitted light.

Includes 11 genera.

**KEY TO THE GENERA OF TRICHIACEAE**

(Adopted from Martin and Alexopoulos, 1969)

1. Capillitium coiled, simple or sparsely branched, penicillatly divided above or may be anastomosed at the base & the tip
   
   ......2

2. Capillitium threads tubular, smooth to spiny on one side, bulbous ends, intercalary swellings and expanded junction often filled with bacteria
   
   .....Minakatella.

3. Capillitium bearing 2-6 well defined spiral bands
   
   ......4

4. Peridium cartilaginous, thick; dehisces usually by preformed lid; elaters spiny
   
   ......Metatrichia.

5. Peridium membranous, dehiscence irregular, lobate, if by lid then cup and lid both membranous, elaters spiny or smooth
   
   ......5

6. Capillitium intricate net, free ends few
   
   .....Hemitrichia.

7. Capillitium broken into short, unbranched or rarely branched elaters, free ends many
   
   ......Trichia.
6. Capillitium of free, short, simple or sparsely branched elaters; rarely long, forming a complete net

6. Capillitium of long, profusely branched and anastomosed threads forming net

7. Elaters spiny, warty, smooth or minutely annulate, peridium rather thick appearing double, fruiting may be densely clustered but not heaped

7. Elaters bearing faint and irregular spirals or nearly smooth, peridium thin, fruiting, densely aggregated, usually heaped

8. Capillitium marked like Oligonema but threads united into an incomplete net

8. Capillitium variously marked but rarely with spirals then with calyculus, upper peridium fugacious

9. Peridium well defined, upper peridium fugacious, capillitium strongly elastic

9. Peridium persisting below but not as morphologically well defined calyculus, capillitium somewhat elastic

10. Capillitium bearing prominent coarse rings which may be smooth or spinous

10. Capillitium marked by warts or spines

Perichaena.

Oligonema.

Calonema.

Perichaena.

Oligonema.

Calonema.

Perichaena.

Oligonema.

Calonema.

Arcyria.

Arcyodes.
The genus *Arcyria* Wiggers, is characterized by its sporangia stipitate to sessile, cylindric ovoid to globose. Peridium, thin, fugacious above, typically separated by a definite line of dehiscence just above the base of sporangium which remains persistent as a calyculus. Stipe often packed with spores like vesicle, generally larger than the spores. Capillitium netted, with or without free ends, elastic, expanding more than half of the original height, remain attached at the centre, or on the side or at the margin of the calyculus, variously ornamented like spines, warts, cogs, half or complete rings (very rarely with faint spiral bands). Spore-mass concolorous, hyaline or faintly coloured under transmitted light.

The genus was erected by Wiggers (1780), who described *Arcyria clathroides* (Scop.) Wiggers. Hagelstein (1944), mentioned *Stemonitis incarnata* Pers. (1791), as the type species, whereas Martin & Alexopoulos cited *Clathrus denudatus* L. (1753), as the type species. However, the year of publication of *Stemonitis incarnata* Pers. and *Arcyria incarnata* (Pers.) Pers., were 1791 and 1796 respectively. Whereas Wiggers, publication of *Arcyria* Wiggers, was in 1780. His species, *Arcyria clathroides* (Scop.) Wiggers, was based on *Mucor clathroides* Scop. (1772). Wettstein 's *A. denudata* (L) Wettst. (1886), was based on *Clathrus denudatus* L. (1753). Scopoli's *Mucor clathroides* is conspecific with Linnaeus' *Clathrus denudatus*. Hence *Clathrus denudatus* L. (1753), should be the type species and all are synonyms of *A. denudata* (L.) Wettst.

Since the erection of the genus, from different part of the world, several species were described and reported by many workers, e.g. Persoon (1994, 1796, 1801), Schumacher (1803), Ditmer (1813), Greville (1824), Buchet (1827), Emoto (1828), Horenemann (1829), Wallroth (1833), Corda (1838), Sauter (1841), Berkeley (1842), Fries (1818, 1829, 1849), Montegne (1855), Wiggand (1863), Berkely & Curtis (1858, 1873), Berkely & Brooms (1876), Rostafinski (1875, 1876), Hazslinski (1877), Phillips (1877), Spegazzini (1880), Kalchbrenner & Cooke (1882), Peck (1883), Raciborski (1884, 1911), Raunkier (1888), Masssee(1892), Celakovski (1893), Rex (1893), Schroeter (1896), A. Lister (1894, 1908), Torrend (1908), G. Lister (1911, 1921), Macbride (1922), Wiggers (1923), Hertel (1954), Farr & Martin (1958), Alexopoulos (1965), Farr (1959, 1967, 1969), Martin & Alexopoulos (1969),

The genus has been described with about 21 species from the world by Martin & Alexopoulos (1969), and listed about 34 species as excluded or doubtful., Forstener (1976), Farr et al. (1979), Flatau & Schirmer (1983), described A. forstneri Brandza, A. olivaceoglobosa Farr et al., A. oerstedtioides Flatau & Schirmer, as new species respectively. In Ainsworth & Bisby's Dictionary of The Fungi (2008), about 50 species of the genus are mentioned from the world.

From the Indian flora, the genus Arcyria Wiggers, was reported for the first time by G.Lister (1924), who described A. intricata Pers. and A. stipitata (Schw.) A. Lister, from U.P. First Indian workers who reported the genus from India were Bruhl & Gupta (1927), who described 4 species from W. B. i.e. A. cinerea (Bull.) Pers., A. denudata (L.) Wettst., A. ferruginata Souter., A. insignis Kalchbr. & Cooke. Lodhi (1934), described 4 species from North India., of which A. globosa Schw., A. nutans (Bull.) Grev., were new records to Indian flora. Agnihothrudu (1954, 1956, 1958,1959), described 5 species from Assam and A.P., of these A. assamica Agnihothrudu, as new species and A. versicolour Phill., as new records to Indian flora. Thind et al. (1956, 1958, 1963, 1968, 1973), described 9 species from east-west of Southern Himalayas. They added A. occidentalis (Macbr.) G. Lister, to the earlier list of the Indian myxomycetes. Singh and Pushpvyathy (1965), described A. oerstedtii Rost. from Delhi. Indira (1968), reported 4 species from Karnataka and Tamil Nadu. Lakhanpal (1973), described 3 species from Himachal Pradesh. Lakhanpal & Mukerji (1976, 1979, 1981), described 5 species from H. P. and Delhi, of these A. brooksea Lakhan. & Muker. as new species and A. affinis (Rost.) Nann.-Brem., A. gulielmae Nann.Brem., A. magna Rex, A. virescence G. Lister, as addition to the list of Indian myxomycetes. Dhillon & Nannenga-Bremekamp (1977, 1979), described two more species from North-western part of Himalayas i.e. A. fasciculate Dhillon & Nann-Brem. and A. glauca A. Lister. Lakhanpal & Mukerji (1981), described one more species i.e. A. nigella Emoto from Delhi.

Thind (1977), described 9 species. Lakhanpal & Mukerji (1981), described the genus with 14 species.
The genus remained unreported from Maharashtra until Nanir (1984), who described two species i.e. *A. cinerea* (Bull.) Pers. and *A. incarnata* (Pers.) Pers., for the first time from marathwada region. In the present work three species of the genus are being described for the first time from this region. Thus the represented by about 19 species from Indian flora.

**KEY TO THE STUDIED SPECIES OF THE GENUS ARCYRIA** Wiggers

2. Sporangia globose to subglobose, calyculus cuplike, capillitium verrucose or warded

   ------

   A. globosa.

2. Sporangia cylindrical, sub-cylindrical, calyculus shallow, capillitium with spines and rings

   ------

   A. cinerea.

3. Capillitium highly elastic, lax and drooping at maturity; sporangia bright Yellow; calyculus shallow, translucent

   ------

   A. nutans.

1. **ARCYRIA CINEREA** (Bull.) Pers.

   *Syn. Fung.*, p. 184, 1801.


   (PL. III FIG. 7)

   Fructification sporangiate, stipitate, scattered to gregarious, sometimes 2 – 8 sporangia are fascicled or clustered on fused common stalk, grayish –white to ash coloured or cinereous, 1.3 to 2.7 mm tall. Sporangia cylindric, subcylindric or ovate, with obtuse apex, 0.65 – 1.7 x 0.3 – 0.75 mm in diam. Stipe cylindric, vertically rugose, blackish brown, sometime concolorous to fruiting, 0.4 – 1.2 mm long, expanded at apex forming calyculus, filled with spore like vesicles of 7.5 – 20.5 µm in diam. Hypothallus distinct concolorous to stipe, small, rotate, thin, shining. Peridium early evanscent, often persistent as flakes attached to calyculus; calyculus concolorous to stipe, shining, small, shallow, externally vertically rugose with dentate margin, inner surface echinulate or warded, 0.20 to 0.35 mm in diam. Capillitium profuse, more or less elastic, firmly attached to the centre of calyculus, long, slender, branched and anastomosing forming network of irregular meshes, threads cinereous marked with spines and rings, also with spindle or rectangular swellings at the junction, free ends blunt or rounded. Spores bluish white in mass, subhyaline under transmitted light, globose, 5.5 – 8.5 µm in diam., marked with few scattered warts, appearing nearly smooth.

DISTRIBUTION: INDIA: Assam (Agnihothrudu, 1959); Delhi, (Lakhanpal & Mukerji, 1981); Gujrat (Salunkhe, 1995); H. P. (Lakhanpal, 1973); U. P. (Thind & Sohi, 1956); Karnataka (Indira, 1968); M. P. (Kharat, 2000); M. S. (Nanir, 1984; Rokade, 1989; Chimankar, 1993; Jadhav, 1994); Orissa (Ghosh & Dutta, 1962); T. N. (Agnihothrudu, 1954); W. B. (Bruhl & Gupta, 1927; Lodhi, 1934).

Extremely variable, species showing all the gradation of characters, from small globose to long subcylindric, scattered to fascicled sporangia, whitish to yellowish in colour; capillitium marked with spined rings. Sometimes aggregation of one variable would tempt to segregate the population from species complex.

Arcyria cinerea (Bull.) Pers., is compared with A. promiformis (Leers) Rost. In A. promiformis (Leers) Rost. sporangia are yellow, more or less ovoid, scattered to clustered; short stipitate; capillitium expands laterally occasionally with clavate or rounded free ends.

2. ARCYRIA GLOBOSA Schw.


(PL. III FIG. 8)

Fructification sporangiate, stipitate, scattered to gregarious, forming colony of 4.2 - 25.5 mm across, 1.1- 1.4 mm in total height. Sporangia globose to subglobose, pale grey with a yellow tinge or light yellowish grey, 0.63 – 0.80 mm in diam. Stipe erect, slender, broad at the base, longitudinally rugose, yellowish brown, filled with spore like cells, 0.51 – 0.55 mm long. Hypothallus rotate, blackish brown, membranous. Peridium single, demarketed into upper half and lower half thin and fugacious. Upper half embossed by spores and hence papillose. Lower half thick,
persistent as deep cup like calyculus; calyculus longitudinally rugose below, but transversally rugose above, striate on the outside; dehiscence irregular. Capillitium abundant, elastic, yellowish dark brown, colourless by transmitted light, composed of a network formed by branching and anastomosing threads, small or closely meshed, threads often interwined, profusely verrucose, warts spine-like but blunt, arranged somewhat spirally, filament with nodular swelling, free ends few. Spores pale ochraceous or very dull grayish yellow in mass, pale to subhyaline in transmitted light, globose, very minutely verrucose or roughened, appearing nearly smooth, 5.5 – 9.7 µm in diam.


**DISTRIBUTION:** INDIA: W. B. (Thind and Sehgal, 1957; Thind and Dhillon, 1964).

The species is easily distinguished by the presence of small pale grayish, globose sporangia and the characteristic demarcation of the peridium into fugacious upper and persistent lower halves.

*A. globosa* Schw. can be compared with *A. cinerea* (Bull.) Pers. However *A. cinerea* (Bull.) Pers. can be differentiate by the cylindric, subcylindric or ovate sporangia; vertically rugose, blackish brown stipe; peridium evanescent and externally vertically rugose; spores marked with few scattered warts.

From Indian flora species was reported from W. B. only. It is being described for the first time from Maharashtra.

3. **ARCYRIA NUTANS** (Bull.) Grev.

*Fl. Edin.*, p. 455, 1824.


(PL. III FIG. 9)

Fructification sporangiate, stipitate, crowded, 1.3 – 2.7 mm in total height after dehiscence. Sporangia cylindrical, nodding, and drooping after dehiscence, bright yellow, fading to ochraceous, 0.63 – 1.1 mm long, 0.38 - 0.51 mm in diam. Stipe weak, rugose, filled with spore-like but larger cells, 0.38 – 1.1 mm long. Hypothallus
confluent and concolorous. Peridium fugacious except the basal calyculus; calyculus small, shallow, translucent, spinulose – reticulate within, striated distinctly. Capillitium bright yellow, easily detach from the calyculus, elastic, threads branched and anastomosed into a close network, 3 - 4 µm in diam., upto 7 µm at the free clavate ends, marked by complete and half rings, profusely verrucose elsewhere, apparently united into a reticulum. Spore-mass bright yellow, ochraceous or colourless in transmitted light, globose, 5.5 – 8.3 µm in diam., smooth but marked by a few scattered warts.


*A. nutans* (Bull.) Grev., is characterized by the fructification stipitate; bright yellow drooping sporangia with elastic and radially detachable capillitium; shallow calyculus; peridium fugacious; hypothallus concolorous; spore smooth but marked by a few scattered warts.

*Arcyria nutans* (Bull.) Grev. is marked by sporangia cylindrical, bright yellow; stipe filled with spore-like but larger cells; capillitium extremely elastic, the threads 3 – 4 µm in diam.; spores bright yellow. *A. nutans* is compared with *A. annulifera* Torrend. However *A. annulifera* Torrend is characterized by its sporangia ovoid, buff yellow; stipe filled with spore-like but smaller cells; capillitium scarcely elastic, the threads 1 – 1.5 µm in diam.; spores pale yellow.

The present report is a second report from Indian flora after Thind and Lakhanpal (1968). It is an addition to the list of myxomycetes of Maharashtra.

**SUMMARY**

In this work the genus *Arcyria* is described by three species i.e. *A. cinerea* (Bull.) Pers., *A. globosa* Schw. & *A. nutans* (Bull.) Grev. All have been described for the first time from this region. About 50 species of the genus have been described form the world. Of these about 19 species have been reported from the Indian flora. From Maharashtra the genus is represented by about 8 species.

The genus *Arcyria* Wiggers is close to *Hemitrichia* Rost. The later is differentiated by its capillitium bearing two or more distinct or conspicuous spiral thickening and no distinct calyculus.
HEMITRICHIA Rost.

Versuch p. 14, 1873.

The genus Hemitrichia Rost. is characterized by the fructification mostly stalked or sessile sporangiate, sometime plasmodiocarpous. Peridium membranous or tough or subcartilaginous, persistent below as irregular cup. Stalk when present, filled with spore-like vesicles or amorphous material. Capillitium composed of tubular threads, branched and anastomosed into an elastic net, with two or more spirals bands. Spore-mass yellow, yellowish brown, orange or reddish, bright and pallid by transmitted light, verrucose or reticulate.


From Indian flora for the first time the genus was reported by Bruhl & Gupta in 1927, who described *H. karstenii* (Rost.) A. Lister, from W. B. Lodhi (1934), described *H. clavata* (Pers.) Rost., *H.karstenii* (Rost.) A.Lister, and *H. serpula* (Scop.) Rost., from Darjeeling (W.B.). Thind et al. (1956, 1958, 1968), reported 4 species of the genus from Himalayas, of which *H. stipitata* (Massee) Macbr. (=*H.calyculata* (Speg.) Farr, was an addition to the Indian myxomycetes. Agnihothrudu (1959), from Assam, Ghosh and Dutta (1962) from Orrisa, described
H. serpula and H. stipitata, respectively. Singh & Pushpavathy (1965), from Delhi, Indira (1968), from Mysore, described one species each. Lakhanpal (1974), reported three species of the genus from H. P. In 1982 Lakhanpal & Mukerji added H. abietina (Wigand) G. Lister, to the Indian Myxomycetes. For the first time from Maharashtra, Nanir (1983), described two species of the genus.

Thind (1977), described and illustrated only four species of the genus from India. Lakhanpal & Mukerji (1981), gave an account of 5 species. In the present work three species of the genus are being described.

**KEY TO THE STUDIED SPECIES OF HEMITRICHIA** Rost

1. Fructification plasmodiocarpous, plasmodiocarps netted  ---------  H. serpula.

1. Fructification sporangiate stipitate  ---------  2.

2. Sporangia pyriform, short stipitate, appearing to be subsessile; calyculus vase like  ---------  H. clavata.

2. Sporangia globose, delicately stipitate, calyculus bowl like  ---- H. calyculata.

1. **HEMITRICHIA CALYCALUTA** (Speg.) Farr


(PL. IV  FIG. 10)

Fructification stipitate, scattered, yellowish brown, 1.2 to 2.0 mm tall. Sporangia obovate, 0.95 to 1.1 mm long, 0.65 to 0.75 mm in diam. Stipe erect, slender, expanded at the apex, reddish brown to dark brown, filled with spore like vesicles, 0.3 to 0.55 mm long. Hypothallus concolorous to base of stipe, rotate, thin, membranous. Peridium single, thin, shining, membranous, transparent; dehiscence irregular, rupturing from above, lower part persistent as calyculus. Calyculus broad, funnel shaped, 0.30 to 0.55 mm wide, vertically rugose or veined. Capillitium abundant, elastic, attached to the calyculus, brownish yellow, yellow under transmitted light, branched, forming coarse network, threads long, 7.0 to 9.5 µm wide with 4 to 6 spiral bands, free ends few blunt or rounded. Spore-mass yellow or yellowish brown, pale yellow or lemon under transmitted light, 7.0 to 7.5 µm in diam., minutely warty or verrucose.


*Hemitrichia calyculata* (Speg.) Farr and *H. clavata* (Pers.) Rost. are two closely related species and the former is distinguished by its small and well defined calyculus; smooth capillitial threads and a stipe which is clearly demarcated from the sporangium. In both the basal capillitial threads are smooth and slightly thick walled and extend nearly to the base of the stipe. In *H. stipitata* (Massee) Macbride, they show a tendency to form H-shaped pieces. In this species the stalk-cells are also larger than those of *H. clavata* (Pers.) Rost..

In *H. calyculata* (Speg.) Farr, the fruiting bodies are scattered or loosely gregarious whereas in *H. clavata* (Pers.) Rost., they are densely clustered.

Lister (1925), Hagelstein (1944), did not recognise *Hemitrichia stipitata* (Massee) Macbr., as a distinct species and cited as one of the synonyms of *H. clavata* (Pers.) Rost. Martin & Alexopoulos (1969), treated *H. clavata* and *H. stipitata* as two distinct species, former is differentiated from the latter by its Vase-like aspect, the peridium merging gradually into the thick, short, the much deeper cup, the rougher capillitium and the slightly larger and usually somewhat reticulate spores.

Lister (1965), cited *Hemiarcyria calyculata* Speg. (1880) and *Cornuvia leocarpoides* Speg. (1881), as synonyms of *Hemitrichia clavata* (Pers.) Rost. (1873). Martin & Alexopoulos (1969), suggested that former two, probably belong to *H. stipitata* (Massee) Macbride. According to Farr (1974), Spegazzini's taxa are conspecific with *H. stipitata* (Massee) Macbride. Therefore she suggested a new combination according to the rules of Binomial Nomenclature i.e. *Hemitrichia calyculata* (Speg.) Farr, of which *Hemiarcyria calyculata* Speg. (1880), is the basionym, thus *Hemitrichia stipitata* (Massee) Macbr., as a synonym of *Hemitrichia calyculata* (Speg.) Farr. Lakhanpal & Mukerji (1981), accepted Farr's combination.

2. *HEMITRICHIA CLAVATA* (Pers.) Rost.
Fructification sporangiate, stipitate, in small clusters to scattered, ochraceous, 0.7 to 1.16 mm in tall. Sporangia obovate to pyriform, yellow, limeless, 0.3 – 0.5 mm tall and 0.4 – 0.8 mm wide. Stipe erect, short, cylindrical, smooth, lustrous, liver brown or dark violet brown to dark ruby 0.47 – 0.66 mm long, hollow, double layered, distinct towards the base, filled with spore like bodies of 9 – 12 um in diam. towards the upper region and of 15 – 28 um in diam. towards the base. Hypothallus pulvinate or thin, concolorous to stipe. Peridium single, smooth, yellow, iridescent and punctate on inner side, dehiscence irregular circumsessile from upper region, persistent as deep cup like calyculus; wall of calyculus thicker and semicartilaginous, thin at margin. Capillitium golden yellow, consists of long tubular, elastic elaters branched dichotomously, with 5 – 6 spiral bands. variously twisted forming an elastic net, free ends few, attached to the centre of the calyculus and also extended in the stipe to a certain extent elaters are extended upto the base of the stipe and marked by the prominent ringe at defiance intervals, threads 5 – 7 um in diam. Spores-mass golden yellow, faint lemon yellow under transmitted light, globose to subglobose, appearing almost smooth but inconspicuously and faintly warted, warts in delicate reticulation, 7 – 9 um in diam.


**DISTRIBUTION**: INDIA: H. P. (Mrs. Drakes, 1912; Thind & Sekhon, 1965; Thind & Lakhmanpal, 1965); M. S. (Rokade, 1989); U. P. (Mrs. Drakes, 1917; Thind & Sohi, 1952).

*H. clavata* (Pers.) Rost. is distinguished by its fructification stipitate, small clusters to scattered, sporangia obovate to clavate; stipe short filled with spore-like bodies; hypothallus concolorous to stipe; Peridium yellow; capillitium golden yellow, elastic elaters branched; spore-mass golden yellow appearing almost smooth but inconspicuously and faintly warted.

*H. clavata* (Pers.) Rost. is compared with *H. stipitata* (Massee) Macbr. *H. clavata* (Pers.) Rost. is marked by its fructification stipitate in small clusters to scattered; sporangia typically clavate; capillitium minutely roughened; stalk short,
expanding and merging into the base of sporangium above is compared with \textit{H. stipitata} (Massee) Macbr. is characterized by its fructification stipitate to clusters; sporangia typically pyriform; capillitium smooth; stalk long not expanding and not merging into the base of sporangium.

3. \textbf{HEMITRICHIA SERPULA} (Scop.) Rost.

In Lister, \textit{The Mycetozoa}, p. 179, 1894.


(PL. IV FIG. 12)

Fructification plasmodiocarpous, Plasmodiocarps large, branched forming net up to 31.9 to 45.5 mm across, bright yellow, to golden yellow, terete; strands, 0.12 to 0.22 mm wide. Hypothallus inconspicuous. Peridium single, thin, membranous, transparent, thicker and darker towards the base; dehiscence irregular from upper portion, lower portion persistent. Capillitium abundant, yellowish brown to golden yellow, elastic, filamentous, sparsely branched, coiled, filament 4.1 to 12.4 \(\mu\)m in diam., marked with 3 to 6 spiral bands which are connected by striae and bearing prominent straight or curved spines of 2 to 4 \(\mu\)m long, ends of filament blunt or pointed with 3 to 4 spines at the tip. Spore-mass yellow or golden yellow, pale yellow under transmitted light, globose, 11.1 to 15.2 \(\mu\)m in diam., banded reticulate, reticulation complete, coarse, meshes unequal in size.


\textbf{DISTRIBUTION: INDIA:} Assam (Agnihothrudu, 1959); Delhi (Singh and Pushpavathy, 1965); Gujrat (Salunkhe, 1995); H. P. (Lakhanpal, 1974); M.S. (Nanir, 1983, 1992; Rokade, 1989; Chimankar, 1993; Jadhav, 1994); M. P. (Kharat, 2000); Orissa (Ghosh and Dutta, 1961); U.P. (Thind and Sohi, 1956); W. B. (Lodhi, 1934).

\textit{H. serpula} (Scop.) Rost., appears to be widely distributed in India. It is easily recognized by large, yellow, completely netted plasmodiocarps, spinulose capillitium and with 3-6 spiral, reticulate spores. The spiral bands on capillitium are usually narrow and often interconnected by profuse striae. The reticulate bands on the spores are complete and marked by a few pits.

\textbf{SUMMARY AND DISCUSSION}
The genus *Hemitrichia* Rost. is differentiated from *Trichia* Haller, in its long branched elaters forming net and from *Metatrichia* Ing., in its thin membranous peridium, intricate net of capillitium. Spore like vesicles in stipe are the character of *Arcyria* Wigger. It often found in the stipitate species of *Hemitrichia* Rost.

From Indian flora seven species of the genus have been described. *H. serpula* (Scop.) Rost. seems to be widely distributed in India. Earlier workers described *H. calyculata* (Speg.) Farr, as *H. stipitata* (Massee) Macbr. Lakhanpal & Mikerji (1981), accepted the correct nomenclature.

From the Maharashtra State, Nanir (1983), have described the genus for the first time with two species i.e. *H. serpula* (Scop.) Rost. and *H. stipitata* (Massee) Macbride (now *H. calyculata* (Speg.) Farr.). In the present work only the four species of the genus has been described.
Order : PHYSARALES Macbride

*N. Amer. Slime-mould ed.*, 2nd., 22, 1922.

Fructification stipitate to sessile, sporangiate to plasmodiocarpous. Spores black, deep purplish, or violaceous brown in mass, deep purplish brown to violaceous by transmitted light; lime (Calcium carbonate) usually visible, often abundant, in any, some, or all parts of the sporophores except the spores (except in *Protophysarum* and family Elaeomyxaceae). Capillitium of tubular or thread like filaments throughout, or bearing limy nodes. Assimilative stage is a phaneroplasmodium. Sporophore development subhypothallic.

Includes 2 families i.e. Physaraceae and Didymiaceae. Martin Alexopoulos & Farr (1983), classified Eleomyxaceae under Physarales and also under Stemonitales. Subhypothallic development of sporophore showing its position in the Myxogastromycetidae. Members of Elaemyxaceae shows absence of lime and presence of wax and lime nil in sporophore. Hence tentatively placed in Stemonitales.

**KEY TO THE FAMILIES OF THE ORDER PHYSARALES**

1. Capillitium limy, intricate
   1. Capillitium limeless

......Physaraceae.

......Didymiaceae.
Family: PHYSARACEAE Rost.

Versuch, 9, 1873

Capillitium netted, limy, very rarely nearly limeless, composed of calcareous tubes of nearly uniform in diameter or calcareous nodes connected by slender, hyaline limeless tubules, or of a combination of these and other characters. Peridium usually limy. Spores black, deep violaceous, or dark gray in mass, deep purplish brown to violaceous brown or pale violaceous by transmitted light. Includes 9 genera.

KEY TO THE GENERA OF PHYSARACEAE

(Adopted from Martin and Alexopoulos, 1969)

1. Fructification very minute and without visible lime ........Protophysarum.

1. Fructication larger and lime often present ........2

2. Capillitium duplex i.e. composed of two distinct systems; one a network of limeless threads with limy nodes and other of limy tubules, spikes or trabacules ........3

2. Capillitium homogenous ........5

3. Fruiting plasmodiocarpous or pseudoaethaloid; capillitium of angular flattened nodes massed transversely into plates, tending to divides plasmodiocarp into segments, and slender anastomosing threads forming a net bearing few limy nodes and numerous hooked spines ....Willkommlangia.

3. Fruiting sporangiate; capillitium duplex but not dividing fruiting into segment nor bearing spine ........4

4. Peridium three layered; outer thin and cartilaginous; middle thick and limy; inner thin and membranous. Sporangia obovoid ellipsoid to cylindric ........Leocarpous.


5. Capillitium a network of limy tubes of uniform diameter, limeless connecting tubules if rarely present are very few and short ........Badhamia.

5. Capillitium a network of hyaline, limeless tubules with lime nodes at many junctions ........6

6. Fructification an aethalium, pseudocapillitium often more conspicuous than true capillitium ........Fuligo.
6. Fruiting sporangiate to plasmodiocarpous, rarely approaching an aethalium  ..7

7. Peridium cartilaginous, sporangia cyathiform, dehisce more or less by preformed lid, lower portion persistent as a well defined cup  ..........Craterium.

7. Peridium not cartilaginous, fruiting not as above, dehiscence may be regular but well define cup is not formed  ..........8

8. Fruiting plasmodiocarpous, cylindric, pendent, anastomosing to form three dimensional net  ..........Erionema.

8. Fruiting sporangiate to plasmodiocarpous to pseudoaethalium, but not in three dimensional net  ..........Physarum.
BADHAMIA Berk.

*Trans. Linn. Soc.*, 21, 153, 1953

The genus *Badhamia* Berk., is characterized by the fructification stalked to sessile sporangiate, varying to plasmidiocarpous; peridium thin nearly limeless to thickly encrusted with lime; capillitium a network of limy tubules with nodes little or not at all enlarged; sometimes with a few hyaline, limeless tubules, then approaching *Physarum*; stipe when present is a little more than an extension of hypothallus to stout and well defined; collumella present or absent; spores black in mass, free or in cluster.

The genus is very much allied to *Physarum* (Pers.), from which it is delimited by a capillitium of a network of calcareous tubules. Originally, Berkeley restricted the genus for clustered spores. Carter and Nannenga-Bremekamp (1972), emphasized the capillitium as a distinguishing feature in separating *Badhamia* Berk., and *Physarum* Pers. Farr (1976), stated that "typical species of *Badhamia* Berk. with clustered spores and uniformly tubular capillitium seems to constitute reasonably well defined nucleus ".


Martin & Alexopoulos (1969), have described 19 species as valid and listed about 9 species as doubtful. Of these doubtful species, 4 are not Myxomycetes. Gottesberger (1972) added one more species i.e. *B. calcaripes*. Kowalski (1975), while reinvestigating the Myxomycetes taxa described by Charls Meylon, reinstated *B. gonispora* Meyl. and *B. orbiculata* Rex. Whitney (1978), described *B. bispora* from California. Some other species of the genus were described by several worker i.e. 7 *B. semiannulata* by Thomas J. Raub et al. (1979), *Badhamia carssipella* by

From India, the genus, for the first time was collected by Mrs. Drake (1911), from Bhimtal, U.P. and it was incompletely described by Lister in 1924. (Thind, 1977), Authentically for the first time the genus was described from India by Agnihothrudu (1959), with *B. viridescens* Meyl. from Assam. Thind & Sehgal (1960), Thind & Manocha (1963), described *B. capsulifera* (Bull.) Berk. and *B. papaveracea* Berk. & Rev. from W. Bengal and U.P. respectively. Indira (1968), reported *B. macrocarpa* (Ces.) Rost. from Karnataka. *B. nitens* Berk. was added to the list of Myxomycetes by Sekhon (1979) from Chandigarh. Lakhanpal & Mukerji (1981), described two more species from Indian flora from H.P. i.e. *B. obovata* (Peck.) S.J. Smith and *B. cuticularis* (Bull.) Berk., *B. affinis* (Rost.) reported genus by Chimankar (1993) and Kharat (2000) from Maharastra and M. P. respectively. The genus is represented from Indian flora by about 9 species. Only one species of the genus studied in this work are presented herewith.

1. **BADHAMIA MACROCARPA** (Ces.) Rost.

   *Monogr. Mycetozoa, p. 143, 1874.*

   *(PL.V FIG. 13)*

   Fructification stipitate, scattered, grayish white or yellowish gray, up to 0.40 to 0.95 mm tall. Sporangia subglobose to depressed globose, slightly darker at the base, 0.30 to 0.6 mm long, 0.30 to 0.75 mm wide. Stipe erect, wrinkle, frosted, translucent, pale brown to pale blackish brown at the base, ochraceous to pale honey yellow, 0.12 to 0.35 mm long. Hypothallus rotate, thin, membranous, dark brown to blackish brown. Peridium, single, thicker, spotted and veined, limy, lime granular; dehiscence irregular from upper part, persistent below; columella absent. Capillitium well developed, consists of a network of limy tubules. Spore-mass brown to blackish brown, pale brownish under transmitted light, globose, 8.5 to 12.5 µm in diam., minutely warted.


The species characterized by subglobose to depressed globose sporangia; stipe wrinkle, pale brown to pale blackish brown at the base; peridium single; consists of network of limy tubules capillitium with minutely warted spores. It is being reported for the first time from Maharashtra state.

SUMMARY AND DISCUSSION

The genus *Badhamia* Berk., is closely related to *Physarum* Pers. but can ordinarily be distinguished by wholly calcareous capillitium. The genus was erected by Berkeley in 1853, for those species of *Physarum* Pers. which possessed clustered spores. Berkeley believed that each cluster was originally encased in a vesicle which disappeared at maturity. Berkeley described six species. *B. capsulifera* (Bull.) Berk., *B. utricularis* (Bull.) Berk., and *B. nitens* Berk. with *B. versicolor* A. Lister, *B. papaveracea* Berk. & Rav. and *B. populina* A. & G. Lister constitute a coherent generic group. Of the remaining species, some have typical *Badhamoid* capillitium while in others which are regarded as representative of the same species, the capillitium is very uneven, with large angular nodes connected by slender limy strands; sometimes some of the latter are limeless, as in *Physarum* Pers. Rostafinski (1874) in his ‘monograph’ widened the concept of this genus to include species with free spores as well. Presently there are some species in *Badhamia* Berk. in which the capillitium varies greatly from badhamoid to physaroid and it has been suggested that some of these should be transferred to *Physarum*. Furthermore, the spores are free. It has been suggested that some of these species should be transferred to *Physarum* Pers. but only after detailed study of materials (Martin and Alexopoulos, 1969). Crater and Nannenga-Bremekamp (1972) emphasized the capillitium as the distinguishing character in separating *Badhamia* Berk. and *Physarum* Pers., but neither clustering of spores nor tubular capillitium should be considered alone. A recently described exception is *B. calcaripes* Gottsberger, which, according to its discoverer (Gottsberger, 1972), has clustered spores in conjunction with traits not
characteristic of *Badhamia* Berk. & (excluding *B. obovata* (Peck.) S. J.), such as a calcareous stipe, presence of columella, and physaroid capillitium. As stated earlier (Farr, 1976) “typical species of *Badhamia* combine clustered spores with uniformly tubular capillitium and seem to constitute a reasonably well defined nucleus. As currently circumscribed, *Badhamia* is one of the larger myxomycete genera, including about more than twenty species. The internodal limeless threads are very few or altogether lacking. This is in strong type of capillitium in which the internodal connecting threads are well represented.”
Genus: **CRATERIUM** Trent.

*in Roth Catalecta Bot.*, 1, 224, 1797.

The genus *Craterium* Trent., is characterized by the fructification sporangiate, stipitate to sessile or partly plasmodiocarpous occasionally. Sporangia cyathiform or globose. Peridium thick, cartilaginous, impregnated with lime, lower portion persistent as deep cup; dehiscence circumsessile or irregular form the apex or by preformed lid. Capllitium a network of hyaline limeless internodes and limy nodes, later often aggregate in the centre to form pseudocolumella. Spores dark in mass varying from deep rose to purple to black.

Trentepohl (1797), erected the genus *Craterium* Trent., with the type species *Craterium pedunculatum* Trent., which is now treated as one of the synonyms of *C. minutum* (Leers) Fries. Since the erection of the genus, several species were described by many workers, e.g. Schumacher (1803), Ditmer (1813), Link (1833), Fries (1818, 1829, 1836), Rabenhorst (1844), Corda (1868), Berkeley & Curtis (1873), Rostafinski (1874), Spegazzini (1886), Masses (1892), Morgan (1893), Rex (1893), Jahn (1904), Torrend (1908), Macbride (1922), (c.f. Martin & Alexopoulos, 1969), Lister G. (1911, 1925), Hagelstein (1944), Martin (1949), Farr (1959, 1969), Alexopoulos & Henney (1971), Nannenga-Bremekamp (1961, 1973), Ortega (1979), Li, H. et al. (1993), Moreno, G. et al. (2009).

Martin & Alexopoulos (1969) described about six species from the world as valid and cited 7 species as excluded and doubtful. In Ainsworth and Bisby’s ‘**Dictionary of the Fungi**’ (2008), mentioned 16 species of the genus from the world.

Lodhi (1934), described *Craterium aureum* (Schum.) Rost., *C. concinnum* Rex, *C. leucocephalum* (Pers.) Ditm., and *C. minutum* (Leers) Fries, from India for the first time. Earlier to it, Lister (1925), mentioned the Indian collection under habitat only including above species along with *C. rubronodum* Lister. Since then *Craterium* Trent., was described from different region of India by many workers i.e. Thind & Rehill (1958), Thind & Sehgal (1963), from Mussoorie Hillies; Agnihotrudu (1959), from Assam; Kar (1964), from W. Bengal; Indira (1968), from Karnataka; Lakhanpal (1974), from Himachal Prades; Nanir (1983), from Maharashtra. Thind (1977), Lakhanpal & Mukerji (1981), described 3 species i.e. *C. aureum* (Schum.) Rost., *C. leucocephalum* (Pers.) Ditm., *C. Minutum* (Leers) Fries, from North India. Dhillon &
Nannenga-Bremekamp (1977), described *C. costatum* as new species to science from north western Himalayas.

From Maharashtra only one species was described by Nanir (1983), i.e. *C. leucocephalum*. Nanir et al. (1983), described the genus from India at monographic level for Indian species. In the present study three species described i.e *C. leucocephalum* (Pers.) Ditm., *C. minutum* (Leers) Fr., and *C. concinnum* Rex.

**KEY TO THE STUDIED SPECIES OF CRATERIUM** Trent.
1. Dehiscence irregular or circumsessile. There is no preformed lid

   ----------  *C. leucocephalum*.

1. Dehiscence is by well defined preformed lid

   ----------  2.

2. Peridium double. Lid sunken, margin of peridium ridged & reflexed. Spores without compression ridges

   ----------  *C. minutum*.

2. Peridium single. Lid not sunken. Spores with 3 to 5 compression ridges

   ----------  *C. concinnum*.

1. **CRATERIUM CONCINNUM** Rex


   *(PL. V FIG. 14)*

   Fructification sporangiate, stipitate, scattered to gregarious, brownish, 2.3 to 2.4 mm tall. Sporangia broadly funnel shaped, bowl like, 1.4 to 1.5 mm long, 1.6 to 1.7 mm in wide. Stipe short, thick, cylindric, dark brown, nonlimy, 0.59 to 0.68 mm long, vertically rugose, merged with the base of sporangium in the form of veins. Hypothallus small, rotate, concolorous to base of stipe, thin, nonlimy. Peridium single, thick, cartilagenous, impregnated with lime granules, smooth, pinkish upwards, dark brown and nonlimy towards the base; dehiscence by preformed lid, after dehiscence a broad cup of peridium is persistent. Operculum is more or less convex, often with central depression, thin, limy, turbid white to pale brown in contrast with calyculus, marked with darker distinct rim. Capillitium a network of limy nodes and nonlimy internodes, more or less elastic; nodes many, pinkish brownish, globose to angular, irregular in size, larger nodes towards the centre connected by short delicate, thin, tubular, hyaline, nonlimy internodes. Columella
absent. sometimes nodes aggregate in the centre to the form pseudocolumella. Spore-mass black, purplish brown to violaceous brown under transmitted light, globose, 9.5 to 11.0 μm in diam., with 3-5 compression ridges, minutely warted or verrucose, warts in small lines.


**DISTRIBUTION : INDIA :** Gujrat (Salunkhe, 1995) ; M. S. (Nanir et al., 1993, 1994) ; M. P. (Kharat, 2000) ; W. B. (Lodhi, 1934).

*Craterium concinnum* Rex, is closely related to *C. minutum* (Leers) Fries. It is an uncommon species, is very small in size and brown in color. These characteristics, as well as the broad, shallow sporangia and sharply differentiated pinkish operculum make it one of the easiest *Craterium* species to recognize, from *C. minutum* (Leers) Fries.

The species is marked by its small size, brown colour, goblet or wide funnel shaped sporangia; pale operculum in contrast with darker calyculus and brown nodes. Deeper (Martin and Alexopoulos, 1969) and shallow calyculus (Lister, 1925, Farr 1976) are frequent in the same fruiting. The species seems to be rare ('infrequently collected' according to Farr, 1976, possibly because of its minutes size). From eastern hemisphere it was described by Hattori from Japan in 1935 (Martin and Alexopoulos, 1969). From India the species was collected by Mrs. Drake from U.P. and was described by Lodhi (1934).

2. **CRATERIUM LEUCOCEPHALUM** (Pers.) Ditmer

   in Sturn, Deutes. *Fl. Plize*, 1, 21, 1813.


   (PL. V FIG. 15)

   Fructification sporangiate, stipitate, sometime sessile, scattered, turbid white to grayish white, yellowish or pinkish white, 1.4 to 2.4 mm tall. Sporangia cyathiform, 0.97 to 1.9 mm long, 0.68 to 0.80 mm wide, base venulose and reddish, orange or brown. Stipe short cylindric, stout, erect, vertically rugose, merged at the base of sporangium in the form of veins, reddish brown to dark brown, 0.25 to 0.93 mm long. Hypothallus distinct, small, rotate, concolorous to stipe, venulose, thin, nonlimy. Peridium single, mealy, fragile, thick below, thinner above, impregnated
with granular lime, lower portion brown, upper half yellowish white, sometimes completely brown; dehiscence irregular circumsessile from apical part, rest of the peridium persists as deep cup. Capillitium abundant, physooid, consists of network of limy nodes and nonlimy internodes; nodes, large, white globose to irregular in shape and size, 1.0 to 4.0 um in diam. contain lime granules; internodes short, tubular, hyaline. Columella absent; pseudocolumella white, limy, club shaped, spiny or rough. Spore-mass black, purple brown under transmitted light, globose 7.0 to 9.5 um in diam., minutely warted appearing nearly smooth.


**DISTRIBUTION : INDIA :** Assam (Agnihothrudu, 1959); Gujrat (Salunkhe, 1995); H. P. (Lakhanpal, 1974); Karnataka (Indira, 1968); M. P. (Kharat, 2000); M.S. (Nanir et al, 1983; Rokade, 1989; Chimankar, 1993, Jadhav, 1994); U.P. (Thind and Sohi, 1955), W. Bengal (Lister, 1925; Lodhi, 1934; Thind and Sehgal, 1963).

This species is widely distributed in India. It is characterized by the peridium white mealy fragile and thin above, brown, and thicker below; dehiscence circumsessile, the upper fragile portion breaking irregularly, while lower firm portion of peridium remaining persistent as a deep cup. There is no preformed lid. Lister (1925), mentioned the presence of disc shaped crystalline bodies in the sporangial wall and globular ones in the lime knots. Hagelstein (1944), commented that these bodies were absent in the American populations. Martin and Alexopoulos (1969), observed that the distribution of such bodies was abundant in some, sparse in others and completely lacking in many.

*Craterium leucocephalum* (Pers.) Ditmer *C. aureum* (Schum.) Rost., are closely related with each other. *C. aureum* (Schum.) Rost. is characterized by the yellow sporangia, and irregular dehiscence, the large upper thin portion usually rupturing irregularly, whereas the small lower firm portion persistent as a very shallow cup with uneven margin, and capillitial nodes are yellow.

It is one of the most common species found abundantly. Specimen studies herewith are more close to the description of Thind (1977), Lakhanpal & Mukerji
Lister recognised 3 varities i.e. var. *cylindricum* (Massee) G. Lister (1911), for cylindrical sporangia; var. *scyphoides* (Cooke & Balf) Lister (1911), for globose or slightly turbinate sporangia with poorly defined lid; var. *rufum* G. Lister (1925), for short stalked, reddish brown, cylindric sporangia with well defined lid. Hagelstein (1944), stated that variation in the form and colour of the sporangia are found merging one into another, often in the same large colony. The recognized varities are therefore centres around which the others are clustered. Martin & Alexopoulos (1969), Farr (1976), Thind (1977), Lakhanpal & Mukerji (1981), did not recognize any varietal forms.

3. **CRATERIUM MINUTUM** (Leers) Fries  
   *Syst. Mycol.* 3, 151, 1829.  
   *(PL. V FIG. 16)*

Fructification sporangiate, stipitate, scattered, pale brown to honey brown, 2.2 to 3.0 mm tall. Sporangia goblet shaped, 1.4 to 1.7 mm long, 0.89 to 1.1 mm wide with preformed paler, flat, sunken operculum, margin of the cup raised and reflexed. Stipe short, cylindric, yellow orange, rugose, translucent, nonlimy, filled with refuse matter, merged at the base of cup in the form of veins, 0.72 to 1.3 mm long. Hypothallus distinct, rotate, venulose, reddish brown, thin, nonlimy, contain refuse matter. Peridium double layered, both layer adhered, tough, cartilaginous, orange brown; dehiscence by preformed lid, peridium persists as a cup like goblet. Capillitium physaroid, network of limy nodes and nonlimy internodes; nodes white, globose, angular or irregular in shape; internodes short, delicate, hyaline. Columella absent, sometimes nodes massed in the centre to form cylindric or angular pseudocolumella. Spore-mass black, violaceous brown under transmitted light, globose, minutely wart, 8.3 to 11.00 µm in diam.


**DISTRIBUTION: INDIA:** Assam (Agnihothrudu, 1956); Gujrat (Salunkhe, 1995); H. P. (Thind, 1977, Lakanpal & Mukerji, 1981); M. P. (Kharat, 2000); M. S. (Rokade, 1989; Chimankar, 1993; Jadhav, 1994); U. P. (Lodhi, 1934); W. Bengal (Lister, 1925; Lodhi, 1934; Thind and Sehgal, 1960).
The species is distinguished by goblet shaped yellowish brown to reddish brown sporangia, flat grayish white sunken lid and raised rim, whole peridium persistent as a goblet. The species is close to *C. concinnum* Rex. However, later is differentiated on the basis of colour of sporangia, the size and colour of nodes. Indian population have smaller sporangia (Lakhanpal & Mokerji, 1981). Hagelstein (1944), mentioned that this species is said to have yellow threads and yellow white nodes in the capillitium at time. According to him the species occurs in two phases i.e. (1) the smaller and darker with lid below the rim (2) the larger paler forms with convex lid extending above the rim. The present specimens seem to belong to the first category.

**SUMMARY AND DISCUSSION**

The genus is very close to *Physarum* Pers., from which it is differentiated on the basis of the shape of sporangia, cartilaginous peridium and special mode of dehiscence. *Craterium obovatum* (Peck) S.J. is the only species with badhamoid capillitium, was treated under *Badhamia* Berk. as *B. obovatum* (Peck) S.J. Smith by Martin & Alexopoulos (1969). However, Farr (1976), Martin, Alexopoulos & Farr (1983), reinstated it as distinct species of *Craterium* Trent.

Uptill now, from India, the genus is represented by six species. Of these *C. concinnum* Rex and *C. rubronodum* Lister, were collected once by Mrs. Drake. These were determined by G. Lister. Since then these were not collected form India (Thind, 1977).
Genus: **FULIGO** Haller


The genus *Fuligo* Haller, is characterized by its fruitification aethaloid; aethalia pulvinate, subglobose or elongated becoming subplasmodiocarpous. Cortex thin or thick, limy. Columella absent. Capillitium physaroid, often scanty, composed of network of limeless internodes and limy nodes. Pseudocapillitium of interfused sporangial limy wall conspicuous than capillitium. Spore-mass dark.

Haller erected the genus Fuligo, in (1768), with *Mucor septicus* L., as the type species which is considered as a synonym of *Fuligo septica* (L.) Wiggers. Since the erection of the genus, several species were described from different parts of the world by many workers, e.g. Wiggers (1780), Persoon (1796, 1799, 1801), Schumacher (1803), Albertini & Schweinitz (1805), Sommerfelt (1826), Duby (1830), Karsten (1876), Peck (1879), Raciborski (1885, 1887), A. Lister (1894), Morgan (1896), G. Lister (1911, 1925), Fries (1912), Sturgis (1913), Macbride & Martin (1934), Buchet (1935), Hagelstein (1944), Martin (1949), Ortega and Calenge (1989), Blackwell & Gilbertson (1980), Eliasson (1981), Keller, H. W., and J. D. Schoknecht (1989), CH. CHUNG et al. (1991).

Martin & Alexopoulos (1969), described 5 species and cited one species as doubtful, from the world. In the tenth edition of Ainsworth and Bisby’s ‘*Dictionary of the Fungi*’ (2008), mentioned 7 species of the genus from the world.

The genus *Fuligo* Hall. was reported for first time by Agnihothrudu, from Indian flora, who described *F. septica* (L.) Wiggers, from Madras in 1954 and later on from Assam in 1959. Third & Rehill (1957), described *F. cinerea* (Schw.) Morgan and *F. septica* (L.), Wiggers, from Mussoorie, U. P. From H. P., Lakhanpal (1973), described *F. septica* and Sekhon (1978), described *F.megaspora* Sturgis, from Chandigarh. Thus, three species of genus are known from Indian flora. In the present work one species is collected and described.

1. **FULIGO SEPTICA** (L.) Wiggers.


(PL. VI  Fig. 17)
Fructification aethaliate, white, yellowish or yellowish brown, pulvinate, heaped, compactly arranged, 11.5 to 25.5 mm long, 7.8 to 18.1 mm broad and 1.7 to 5.3 mm thick. Cortex single, thick, crustose, brittle, rough or wrinkled, limy, lime granular, dehiscence irregular. Hypothallus distinct, extensive, yellowish white or yellowish brown, limy, perforated. Capillitium duplex; true capillitium, physaroid, a network of nodes and internodes; nodes abundant, limy, spherical, spindle shaped, white, smooth; internodes hyaline, delicate, limeless, tubular. Pseudocapillitium consists of thin wall chambers, white, limy, with granular lime. Spores-mass dark brown to black, pinkish or violaceous brown under transmitted light, globose to ellipsoidal, 7.0 to 9.5 µm in diam., minutely warty, warts in small lines and clusters.


**DISTRIBUTION : INDIA :** Assam (Agnihothrudu, 1959); Chandigarh (Lakhanpal and Mukerji, 1981); Gujrat (Salunkhe, 1995); H. P. (Lakhanpal, 1973); M. P. (Kharat, 2000); M. S. (Rokade, 1989; Chimankar, 1993; Jadhav, 1994); T. N. (Agnihothrudu, 1954); U. P. (Thind and Rehill, 1957).

This species appears several color phases. It is extremely common myxomycetes. Its typical form is recognized without difficulty by the large pulvinate aethalia, with well developed crustose, rough or wrinkled, cortex; lime granular; dehiscence irregular; distinct, yellowish white or yellowish brown hypothallus; capillitium duplex, composed of network of nodes and internodes, nodes abundant, white, limy, smooth, spherical; internodes delicate, limeless, tubular; pseudocapillitium consists of thin wall chambers, white with granular lime; spore-mass dark brown to black, pinkish or violaceous brown under transmitted light, small, delicately marked with spherical to ellipsoidal spores; the later structures also identify the occasional ecorcticate fruiting consisting of densely clustered, irregular or interwoven sporangia on a common hypothallus.

*Fuligo septica* (L.) Wiggers and *F. cinerea* (Schw.) Morgan, are related to each other. Both are common but highly variable species. Weathered specimens may appear similar but the spores differ markedly. In *F. septica* (L.) Wiggers, spores are small, 6.9 to 9.7 µm in diam., where as in *F. cinerea* (Schw.) Morgan, spores, are 9 to 13 µm in diam.
SUMMARY AND DISCUSSION

The genus *Fuligo* Haller, is very close to Physarum Pers., particularly when it is in small fruiting phase approaching densely massed sporangia. However according to Farr (1976), The genus is well defined entity. In the present work one species is described i.e. *F. septica* (L.) Wiggers. From India genus is represented by five species.
Genus: **PHYSARELLA** Peck

_Bull. Torrey Bot. Club, 9, 61, 1882._

The genus _Physarella_ Peck, is distinguished by cylindric or cupulate, introverted sporangia, appearing cylindric thimble shaped, borne on hollow stalk, rarely sessile. Capillitium duplex, consists of stout calcareous spines borne on the inner surface of the outer peridium and penetrates into interior, and delicate network of limeless tubules bearing limy nodes. Inner peridium forming hollow columella in the centre. Outer peridium membranous more or less encrusted with lime. Spore dark in mass.

The genus was erected by Peck in 1882, with _Physarella mirabilis_ as the type species. It is treated as one of the synonyms of _Physarella oblonga_ (Berk. & Curt.) Morgan. Hagelstein (1944), Thind (1977) have not mentioned the type species of the genus. The nomenclatural history of the genus is reviewed by Martin & Alexopoulos (1969), Farr (1976). Up till now, the genus is represented by a single species from the world i.e. _P. oblonga_ (Berk. & Curt.) Morgan, (Hagelstein, 1944; Martin & Alexopoulos, 1969; Farr, 1976, Ainsworth & Bisby's _Dictionary of The Fungi_, 2008; Martin, Alexopoulos and Farr, 1983). Alexopoulos (1964), described an albino mutant of _P. oblonga_ (Berk. & Curt.) Morgan, which show consistant transmission of character under laboratory conditions and named it as _P. oblonga f. alba_ Alexop. It is justified by Martin & Alexopoulos (1969), Martin, Alexopoulos and Farr (1983). According to Farr (1976), ' stability of the distinct colour differences may indicate that _f. alba_ Alexop. is a separate species '.

From Indian flora Lodhi (1934), described _P. oblonga_ (Berk. & Curt.) Morgan, for the fist time from Darjeeling. Later on it was described by Thind & Rehill (1958), from Dehra Dun; by Ghosh & Dutta (1963), from orissa; by Singh et al., (1979), from Delhi. From Maharashtra it was described by Nanir (1985), along with _f. alba_ Alexop. Thind (1977), described _P. oblonga_. Lakhanpal & Mukerji (1981), described _P. oblonga f. alba_ only.

1. **PHYSARELLA OBLONGA** (Berk. & Curt.) Morgan


(PL. VI FIG. 18)
Fructification sporangiate, stipitate, scattered to gregarious, grayish white to ochraceous white, erect or nodding, 1.5 to 2.5 mm tall. Sporangia cupulate, funnel like introverted, somewhat obconic, hollow in the centre, 0.93 to 1.0 mm long, 0.76 - .89 mm in diam., Stipe 0.59 – 1.5 mm long, 0.25 to 0.29 mm wide, yellow brown to dark brown, erect, hollow, limeless, cylindrical, spotted. Hypothallus distinct, rotate, venulose, brown to blackish, limeless, shining. Peridium double; outer peridium thick, semicartilaginous, yellow, impregnated with sparse, white, irregular, small, limy flakes, which penetrate peridium in the interior in the form of white and thick spike or rods; dehiscence irregular from above into lobes, lobes reflexed outward, persistent, showing spiny or spiky inner surface of outer peridium. Inner peridium consists of tubular hollow columella, which is just an extension of hollow stipe. Capillitium duplex, consists of limy spikes from inner surface of the outer peridium, and network of non-limy, hyaline tubules with few, small, white limy nodes. Spore black in mass, pinkish brown to blackish brown under transmitted light, 6.9 to 8.3 μm in diam., globose, minutely and sparsely verrucose.


**DISTRIBUTION: INDIA:** Assam (Agnihothrudu, 1959), Delhi (Singh, Pushpavathy and Sethi, 1979); Gujrat (Salunkhe, 1995); M. P. (Kharat, 2000); Maharashtra (Nanir, 1985; Rokade, 1989; Jadhav, 1994); Orissa (Ghosh and Dutta, 1963); Punjab (Thind, 1977); U. P. (Thind and Rehill, 1958; Thind, 1977); W. Bengal (Lodhi, 1934).

The thimble shaped sporangia, after dehiscence exposing the limy spikes protruding from the inner surface of the outer peridium and the tubular inner peridium protruding as pseudocolumella, distinguishes the species from all other myxomycetes. Hence, Hagelstein (1944), said that it is "one of the most beautiful of the mycetozoa and fortunately not uncommon, for can it be confused with any thing else ". In the present work only one species is reported.
The genus *Physarum* Pers., is characterized by the fructification stipitate to sessile, sporangiate or simple to branched plasmodiocarpous to pseudoaethaloid, very rarely aethaloid. Peridium single or double, limy, lime granular (infrequently subcrystalline, believed to be due to the alternate wetting and drying). Stalk when present tubular and transluscent, stuffed with amorphous material or lime externally. Capillitium a network of hyaline and limeless tubules (internodes) connecting calcareous nodes, attached to base and peridium. Lime in peridium, capillitium and stalk granular. Columella may be present or absent; pseudocolumella may or may not be present. Spore-mass black, violet brown or violaceous under transmitted light.


Martin & Alexopoulos (1969), accepted and described about 84 species from the world and enlisted above 100 names as 'excluded and doubtful' in the appendix. Martin, Alexopoulos & Farr (1983), mentioned the genus with over 120 species. In
Ainsworth and Bisby’s ‘Dictionary of the Fungi’ (2008), mentioned about 135 species from the world.

From Indian flora the genus was reported for the first time by G. Lister in 1924, who described 3 species from Serampur (W.B.). Second report of the genus was made by Bruhal & Gupta (1927), from West Bengal with four species. In 1934, Lodhi described about 10 species from Mussoorie and Darjeeling and added about 9 species to the earlier list. From Assam and Karnataka, Agnihothrudu (1954, 1955, 1956, 1959, 1962, 1965, 1968) described about 24 species, of these about 16 species were addition to the List of Myxomycetes of India. In a series of papers, Thind et al., (1955-1973), from east west part of the Southern Himalayas, described about 36 species and extended the list of Indian Myxomycetes by 18 species. Lal & Yadav (1965), reported one species from Bihar. Indira (1968, 1975), described about 14 species from Tamil Nadu, of which two species were new records to Indian flora. From Delhi, Singh & Pushpavathy (1965, 1966, 1979), described about 5 species with one species new to science and one addition to the Indian Myxomycetes. Sekhon (1978), reported a one species form Chandigarh. From H.P., Lakhanpal (1973), described about 7 species. Lakhanpal & Mukerji (1978, 1979, 1980), from H.P. and Delhi, illustrated and described two species and one variety as new to science and added about 4 more species new to the list of Indian myxomycetes.

From the state of Maharashtra, genus was remained unrecorded until Patil & Ranade (1977), who described an a typical form of *P. pusillum* (Berk & Curt), Lister. In the present work twenty three species are being described for the first time from the region.

**KEY TO THE STUDIES SPECIES OF GENUS PHYSARUM** Pers.

1. Peridium double or triple
   1. Peridium single
   2. Fruiting sessile sporangiate
   2. Fruiting plasmodiocarpus
3. Sporangia densely gregarious somewhat dorsiventrally depressed and are in tessellate colony. Dehiscence circum sessile; after dehiscence hole fruiting looks like honey comb. Spore minutely verrucose and spore wall paler to one hemisphere.

---

*P. tessellatum.*
3. Sporangia not so more or less obovate arranged in crowded colony but not as above. Dehiscence irregular. Spore papillate with compression ridge appearing almost Smooth  

4. Fruiting strongly compressed laterally  

4. Plasmodiocarp terete and not laterally compressed  

5. Spore minutely verrucose. Fruiting after dehiscence looks like bivalve mollusc Smooth

5. Spore distinctly and conspicuously spiny-warted which are joned to form reticulum dehiscence irregular  

6. Spores minutely verrucose. Fruiting dull ochraceous, peridium triple  

6. Spores banded reticulate, fruiting white, peridium double  

7. Fruiting clean white to cinereous white in colour  

7. Fruiting colour may yellow, lemon, lemon yellow, orange to brownish  

8. Sporangia sessile  

8. Sporangia stipitate  

9. Stipe long, subulate, reddish brown, non-limy; sporangia reticulate  

9. Stipe short somewhat cylindric whitish, limy; sporangia globose  

10. Sporangial base as limeless disc; columella thin pistillate or spikelike whitish; reaching up to three-fourth of sporangial cavity  

10. Sporangia without such limeless base; columella very small and conic at the base of the sporangia  

11. Fructification stipitate sporangiate  

11. Fructification sessile, sporangiate to plasmodiocarpus  

12. Sporangia compressed laterally giving fan shaped appearance or broad flat Conic  

12. Not as above  

13. Sporangia discoid with conspicuous upper depression or umbilicus; spore 11-16 µm in diam.  

13. Sporangia mostly globose, subglobose, depressed globose; rarely discoid then not as above; spores smaller

P. panchaganiensis.  

P. bivalve.  

P. echinosporum.  

P. bogoriense.  

P. dictyosporum.  

P. decipiens.  

P. viride.  

P. kowalskii.  

P. melleum.  

P. compressum.  

P. megalosporum.
14. Sporangia often with small, white columnellae present at the base of

\[ \text{Sporanigium} \]

---

\[ P. \text{nucleatum}. \]

14. Columella none

---

---

15. Stipe straw colour or may be whitish, may be little darker towards the base --

15. Stipe dark brown to reddish brown to blackish

---

16. Stipe subulate whitish but darker towards the base; sporangium lenticulate;

spore with clusters of warts, 8.5-11 \( \mu \text{m} \) in diam.

---

\[ P. \text{nutans}. \]

16. Stipe somewhat darker and twisted; sporangia depressed globose; spore

uniformly warded, 10-14 \( \mu \text{m} \) in diam.

---

\[ P. \text{leucophaeum}. \]

17. Stipe thick strong blackish brown; peridium thick rough; spores darker heavily

and uniformly warded

---

\[ P. \text{notabile}. \]

17. Stipe thinner reddish brown merging as reddish brown base of sporangium;

peridium thin as compared to above; spore warded with clusters of warts

---

\[ P. \text{pusillum}. \]

18. Sporangia obovate arranged in compact colony become angular due to

mutual compression. Lime deposition more or less heavy forming loose

layer giving double wall appearance of peridium. Inner peridium thick

eaereolate ridges forming reticulum. Spore papillate with compression ridges

9.5-13.5 \( \mu \text{m} \) in diam.

---

\[ P. \text{nannengae}. \]

18. Not as above

---

19. Fruiting primarily plasmodiocarpus

---

19. Fruiting primarily sessile sporangium

---

20. Fruiting pearly white; lime deposition forming smooth but folded outer

Peridium that give rugose appearance. Hypothallus deposition heavy with
discoid globules. Capillitium node smooth discoid with pearly shining spore
thin wall and verrucose, 7-8.5 \( \mu \text{m} \) in diam.

---

\[ P. \text{panhalensis}. \]

20. Fruiting cinereous; peridial lime deposition and hypothallus not as above;
capillitium lime knot spiny angular. Spore walls unequal in thickness, thinner
one hemisphere, minutely verrucose, 10-14 \( \mu \text{m} \) in diam.

---

\[ P. \text{lakhanpalii}. \]

21. Sporangia globose, subglobose pulvinate scattered to crowded to heaped, mixed

with short simple plasmodiocarp, 0.3-0.5 mm in diam. Cinereous, sporangial wall
included with clusters of lime. Capillitial knot vary in shape and size appearing
badhamoid. Spores spinules appearance almost smooth 7-10 \( \mu \text{m} \) in diam.

---

\[ P. \text{cinereum}. \]
21. Subglobose sporangia crowded mixed with short or long plasmodiocarpus 0.5-1 mm in diam. Lime deposition densely charged giving rugulose appearance. Capillitial knot angular and branched. Pseudocolumella frequently present. Spores spinulose 9-12 µm in diam. 

--- 

P. vernum.

21. Fruiting primarily straight or curved or irregular plasmodiocarps with pulvinate mixed with sporangiate form 0.5-0.8 mm in diam., white. Peridial minutely roughened with deposition of lime living smoother area where lime is scanty. Capillitial knot rounded. Spore warted, 9-11 or 9-10 x 11-12 µm often encircled by pale line 

---

P. ovisporum.

1. PHYSARUM BIVALVE Pers.


(PL. VI FIG. 19)

Fructification plasmodiocopous mixed with few sessile sporangia, scattered to gregarious. Plasmodiocarps short or long, simple to branched, segmented, strongly compressed laterally with upper fissure appearing as bivalve like mollusc, ochraceous to yellowish brown, 0.38 to 11.2 mm long, 0.21 to 0.46 mm in height. Sporangia small, on constricted base, appearing like stalk. Hypothallus inconspicuous. Peridium double; outer layer thick, pale yellowish towards the upper part and darker towards the base, dehiscence along the upper fissure, after dehiscence it looks like bivalve mollusc; inner peridium grayish white, sprinkled with lime, thin, membranous, transparent, dehisce irregularly, but remain intact for longer time. Capillitium abundant, composed of limy nodes and nonlimy internodes; nodes many white, globose, subglobose, irregular, smooth; internodes short, thin tubular, delicate, hyaline, connected to the nodes forming a network. Columella absent. Spore mass black, deep violaceous brown under transmitted light, globose, 7 to 11 µm in, minutely warted, warts in small curved line.


Strongly laterally compressed, sinuous plasmodiocarps, double peridium; preformed longitudinal fissure, minutely and uniformly spinulose, paler spores of 8-10 µm in diam., are the marks of the species which are differentiating it from *P. bitectum* G. Lister. Dehisced sporangia of *P. bivalve* Pers. appear like bivalve mollusc easily distinguishes it from others. The species may vary from simple to branched plasmodiocarp to sporangiate form. It is close to *P. leavosporum* Agnihothrudu. However later is marked by smaller spores, terete, slightly laterally compressed, yellowish brown or grayish brown fruiting with quite larger nodes upto 100 µm in diam. and irregular dehiscence.

It can be compared with *P. echinosporum* Lister is characterized by strongly compressed chalk-white fructification, a double peridium and dark and strongly verrucose (or spinulose) larger spores, 7 – 11 um in diameter. The spiny warts are arranged in irregular lines, forming very incomplete and very irregular reticulation.

2. *PHYSARUM BOGORIENSE* Racib

*Hedwigia*, 37, 52, 1898.


(PL. VII FIG. 20)

Fructification scattered to gregarious, plasmodiocarpous, mixed with few sessile sporangia, pale yellowish brown, sometimes with pinkish or violaceous tint. Plasmodiocarps, upto 12 mm long, 0.25 to 0.63 mm wide, simple to branched, terete. Sporangia sessile, globose, subglobose to elongate, 0.25 to 0.6 mm in diam. Hypothallus inconspicuous. Peridium triple; outer and middle layer closely adhered hence appearing as double, rarely separate; outer layer consist of lime, thick, corrugated, forming pentagonal or hexagonal yellowish brown patches or plates marked with paler or whitish lines or dehiscence, inner side white, paler towards the upper part, darker towards the base, smooth, dehisces along with pale lines in the form of lobes and reflex outwards and remain persistent at the base, middle layer white, limy, thin, membranous; inner layer thin, membranous, transparent, iridescent,
sometimes covered by thin lines of lime forming reticulum, remain intact for longer
time and dehisces irregularly. Columella absent. Capillitium abundant, a network of
limy nodes and limeless internodes; nodes, small, white, globose, subglobose,
angular or irregular; internodes short, thin delicate, tubular, hyaline; sometimes
nodes massed together forming pseudocolumella. Spore mass black, pinkish or pale
violaceous brown under transmitted light, globose to oval, 7 to 9.5 µm in diam.,
minutely warded, with faint curved lines and clusters of warts.

**COLLECTION EXAMINED:** RRT / 8027, Aug.-2003 ; 8030, 8330, 8371, 8413,
Sept.-2003, Panhala, 8337, 8392, 8395, 8418, 8421, Sept.-2004 Radhanagari, Dist.-
Kolhapur ; 8310, 8317, 8323, 8377, 8393, 8403, 8405, 8425, 8433, 8434, July-2004,
Chandoli, Dist.-Sangli. On dry leaves of angiospermic plants.

**DISTRIBUTION : INDIA :** Assam (Agnihothrudu, 1959) ; Gujrat (Salunkhe, 1995)
; H.P. (Thind and Lakhanpal, 1968) ; Karnataka (Indira, 1968) ; M. S. (Chimankar,

The species is characterized by the terete plasmodiocarps, double or triple
peridium; outer layer light brown, smooth, showing paler whitish lines of dehiscence,
where it ruptures into angular lobes which are reflexed and persistent; nodes large,
white, spores minutely verrucose.

It differs from *P. bivalve* Pers. and *P. bitectum* G. Lister. In former the
plasmodiocarp is laterally compressed, dehiscence is by performed longitudinally
ridge. In later the dehiscence is irregular, spore larger (10 to 13 um in diam.), coarsely
and irregularly spiny.

3. **PHYSARUM CINEREUM** (Batch) Pers.


(PL. VII FIG. 21)

Fructification sporangiate to plasmodiocarpous, white to grayish white,
scattered to gregarious. Sporangia globose to subglobose, 0.2 to 0.4 mm diam.
Plasmodiocarps small, straight or curved, with few branches, small segmented, terete,
constricted at the base. Hypothallus inconspicuous, thin membranous, transparent,
limeless. Peridium single, thin, membranous, iridescent, transparent, hyaline,
impregnated with lime granular, densely or sparsely covered with white lime globules
of granular lime. Dehiscence irregular. Capillitium abundant, network of limy nodes
and limeless internodes along with the many limeless junctions; nodes white, small, globose, oval, spindle or rod like or angular; internodes thin, short, tubular, hyaline. Columella absent; rarely white, limy pseudocolumella may be present. Spore mass brown, pale purple brown under transmitted light, globose, 7.0 to 15 um in diam., minutely warted, warts, in small short lines.


**DISTRIBUTION : INDIA :** Assam (Agnihothrudu, 1959); Delhi and H.P. (Lakhanpal and Mukerji, 1981); Gujrat (Salunkhe, 1995); Karnataka (Indira, 1968); M.S. (Nanir, 1978; Rokade, 1989; Chimankar, 1993; Jadhav, 1994); M. P. (Kharat, 2000); Punjab (Thind, 1977); T. Nadu (Agnihothrudu, 1955); U. P. (Lodhi 1934; Thind and Sohi, 1955).

*Physarum cinereum* (Batchs) Pers., is characterized by profuse growth, ash-coloured sporangiate to plasmodiocarpous fructification, plasmodiocarps being small and unbranched, fragile peridium bearing calcareous flakes, and purplish brown, minutely verrucose species of 8 – 10 um in diameter. It is compared with *P. vernum* Somm. ex Fries is marked by darker, larger, and prominently verrucose spores. Besides, the calcareous nodes of the capillitium are often massed in the centre to form a pseudocolumella in the case of *P. vernum* Somm. ex Fries but this is not observed to occur in *P. cinereum* (Batchs) Pers. The two species are hard to differentiate by superficial characters. Both have intermixed sporangia and plasmodiocarps in the same collection. However, plasmodiocarps are reported to be longer and even netted in the case of *P. vernum* Somm. ex Fries while this is not so in *P. cinereum* (Batchs) Pers.

It is one of the commonest species occurring abundantly, grows even of the living herbaceous plants. Population studied show some differences from earlier reports from India. Habit as noted is both sporangiate and plasmodiocarpous, one dominate the other, gregarious to heaped. Peridium cinereous to pinkish ash gray with irregular to petaloid dehiscence. In some cases capillitium appears badhamoid, nodes massed in the centre to form pseudocolumella. Spore size recorded for the species is variable i.e. 7-10 um (Lister, 1925; Hagelstein, 1944). For Indian specimen, 8-10 um
Thind, 1977), 8-11um (Lakhanpal & Mukerji, 1981). Population studied mostly have spore size in the range of (7-) 8-14 (-15) um.

4. **PHYSARUM COMPRESSUM** Alb. & Schw.

*Consp. Fung.* p. 97, 1805.


(PL. VII  FIG. 22)

Fructification sporangiate, stipitate, sometimes subsessile, solitary or in clusters, grayish or ash white, 0.68 to 1.0 mm tall, erect or slanting. Sporangia laterally compressed, 0.25 to 0.5 mm x 0.4 to 0.9 mm in size and 0.25 to 0.3 mm in thickness, obconic fan shaped, lobed. Stipe thick, stout, opaque slightly tapering upwards, somewhat flattened, vertically rugose, yellowish brown towards the base, limeless or densely sprinkled with lime towards the apex, 0.34 to 0.63 mm long. Hypothallus well developed, rotate, thin membranous, non-limy, brown, venulose. Peridium single, ashes gray, membranous, impregnated with white, globose to subglobose or irregular lime globules forming more or less reticulum hence become thick and brittle. Dehiscence irregular, from upper part. Columella absent. Capillitium dense, network of limy nodes and non-limy internodes; nodes many, white, globose, fusiform angular, connected by short, delicate, tubular, hyaline, internodes, towards the base appears to be badhamoid. Spore-mass black, violaceous brown under transmitted light, globose to subglobose 9.5 to 12.5 um in diam., minutely warted, warts in small lines, sometimes with faint compression ridges.


The species is characterized by its laterally compressed fan shaped sporangia. Thind (1977), mentioned the occurrence of ' always stipitate sporangia ' in Indian population without limy stalk. Indira (1968), reported stipitate as well as sessile sporangia and plasmodiocarps in cultural study.
5. **Physarum decipiens** Curtis


(Pl. VII fig. 23)

Fructification plasmodiocarpous to sporangiate, scattered to gregarious, dull to bright yellow in colour, 0.6 – 0.7 mm long, 0.3 – 0.4 mm in wide. Sporangia globose to subglobose, pulvinate, 0.4 – 0.5 mm in diam. Hypothallus small, circular to more or less venulose, membranous, brown. Peridium single, membranous, rugose, sparsely impregnated with yellow lime; dehiscence irregular, fugacious above, persistent below. Capillitium abundant, composed of network of limy nodes and nonlimy internodes; nodes many, limy, irregular in shape, small elongated, angular, branched or stellate, orange; internodes hyaline, delicate, short, tubular. Columella none. Spore dull black in mass, dark brown under transmitted light, globose, 8.3 – 11.1 µm in diam., smooth or minutely spinulose.

**COLLECTION EXAMINED:** RRT/ 8407, 8314, 8316, July-2004, Chandoli, Dist.- Sangli. On dry leaf of angiospermic plant.

**DISTRIBUTION:** INDIA: Punjab (Thind K. S., 1977); Delhi (Kalyansundaram & Lakhanpal, 1993).

Because of uniformly calcareous capillitium *P. decipiens* Curtis for a long time was retained in *Badhamia* Berk., Farr (1961), reconfirmed the presence of limeless connecting filament and physaroid lime nodes and advocated the return of the species to its original position in *Physarum*.

*P. decipiens* Curt., characterized by the fructification plasmodiocarpous with globose to subglobose sporangia, hypothallus small, peridium single and sparsely impregnated with yellow lime, capillitium profuse compose of nodes and internodes, spore dull black in mass with smooth or minutely spinulose.

6. **Physarum dictyosporum** Martin


(Pl. VIII fig. 24)
Fructification plasmodiocarpous, intermixed with some sporangia. Plasmodiocarps small, straight or curved, white or pallid or with yellowish tint, terete on a narrow or broad base, sometimes longer plasmodiocarps branched with both ends swollen, upto 1.0 – 4.2 mm long and 0.4 – 0.5 mm broad ; Sporangia 0.4 – 0.6 mm in diam. Peridium double ; outer layer thick, white, limy, brittle, smooth, porcelain –like ; inner layer thin, membranous, delicate, iridescent, violaceous brown to pink, distant. Dehiscence irregular ; Capillitium abundant to scanty, network of limeless internodes and limy nodes ; internodes short, thin, tubular, colourless, transparent ; nodes large, smooth, pinkish or white, spindle or rod like or elliptic, sometimes angular and branched, attached to peridium. Columella absent ; sometimes white, limy, smooth pseudocolumella may present at the base or centre. Spore-mass black to coffee black, dark violaceous brown or pink under transmitted light, globose, 12.5 – 16.5 µm in diam., prominently and sparsely warted, warts joined by membranes, appear banded reticulate, warts upto 4 um long.


The collection described by Thind (1977) fructification plasmodiocarpus, more sporangiate with smaller spore size 11.5 – 13 µm in diam. In this study spore size is 12.5 – 16.5 µm in diam., fructification more plasmodiocarp and intermixed with some sporangia.

*P. dictyosporum* Martin is characterized by fructification plasmodiocarpous, plasmodiocarps white or pallid or with yellowish tint, peridium double, capillitium abundant to scanty, spores prominently and sparsely warted and warts formed by membranes, appears to banded reticulate *P. dictyosporum* Martin, is closely related to *P. psittacium* Ditm. However *P. psittaculum* Ditm., is marked by its stipitate, sporangia bronze to purplish blue in colour, peridium single, capillitium abundant and spores minutely but profusely verrucose.
After erection of the species by Martin (1962), from U.S.A., it was collected from Chandigarh, India once only (Thind). Since then it was not reported from other part of India. However, it is being reported from Indian flora for the second time and it is an additional to the list os Myxomycetes of Maharashtra.

7. **PHYSARUM ECHINOSPORUM** Lister

*J. Bot.*, **37**: 147, 1899.


(PL. VIII FIG. 25)

Fructification plasmodiocarpous, mixed with few sessile sporangia, glossy chalky to pearly white, scattered to gregarious. Plasmodiocarps short simple to branched, upto 7.4 mm long, and 0.3 to 0.85 mm tall, strongly compressed laterally; Hypothallus inconspicuous. Peridium double, both layer remote; outer limy layer white, shining, smooth, egg shell-like; dehiscence irregular or along with the upper fissure; inner layer thin, membranous, gray, transparent, iridescent, dehisces irregularly. Columella absent. Capillitium abundant, a network of limy nodes and non-limy internodes; nodes are larger, white, angular, elongated, connected by thin, tubular hyaline, transparent internodes, connected to inner peridium, rarely nodes massed together to form pseudocolumella. Spore black in mass, violet brown under transmitted light, globose, 8.0 to 15 mm in diam., distinctly spiny, spines straight or curved, unequal in length, forming incomplete reticulum.


**DISTRIBUTION : INDIA**: Assam (Agnihothrudu, 1959); Gujrat (Salunkhe, 1994); M. P. (Kharat, 2000); M. S. (Nanir et al, 1998; Rokade, 1989; Chimankar, 1993; Jadhav, 1994); T. N. (Agnihothrudu, 1955; Indira, 1968); Punjab (Thind, 1977); U. P. (Thind and Rehill, 1957); W.B. (Bruhl and Gupta, 1927).

A very distinctive species, with laterally compressed, fruiting which resembles *P. bivalve* Pers., and *P. retisporum* Martin, Thind and Rehill. *P. bivalve* possesses spore minutely warted or spinulose and 7-10 um in diam., whereas, in *P. retisporum*, spores are strongly and perfectly reticulate, without spines. In *P.*
echinosporum Lister, spores are conspicuously spiny with short ridges forming incomplete reticulum. Spores size given by Lister (1925) is 8 µm. Martin and Alexopoulos (1969), mentioned spore size as 10 to 12 um in diam. Thind (1977), recorded spores of 9 to 13 um in diam. for Indian population.

8. **PHYSARUM KOWALSKII** Nanir & Rokade, sp. nov.

(PL. VIII FIG. 26)

Fructification sporangiate, stipitate, scattered to gregarious, erect or nodding, yellow, 0.42 to 2.1 mm tall. Sporangia globose, 0.25 to 0.45 mm in diam., with nonlimy circular brown base. Stipe cylindric, broader at the base, attenuating towards apex, white or with yellowish tint, smooth, filled with white lime granules, translucent upwards, merged at the base of sporangium in the form of veins, 0.17 to 0.72 mm long. Hypothallus inconspicuous, when present rotate, membranous, pale brown or yellowish brown. Peridium single, thin, membranous, transparent, impregnated with lime granules and covered with agglomeration of yellow lime granules; dehiscence irregular, sometimes petaloid, basal part persistent as a irregular disc. Capillitium composed of dense network of limy nodes and nonlimy internodes; nodes pale yellow, or whitish, angular, spindle shaped or irregular; internodes, thin, tubular, hyaline, transparent; columella is an extension of stipe, thin, spore like, blunt or pointed, hyaline or yellowish, hallow, slightly limy at the base, may reach up to the tip of the sporangial cavity smooth or capillitial threads are attached on the surface giving branched appearance. Spore dark brown to black in mass, pale violaceous brown or pink under transmitted light, globose, 7.0 to 9.5 µm in diam., minutely or uniformly warted or spinulose, warts arranged in clusters and small lines.


Distinctive features the species are globose yellowish sporangia; single limy peridium; yellow lime; white tapering stipe filled with lime granules, (Diacheoid);
columella hollow cylindric or pointed limeless, more or less reaching up to the tip of sporangial cavity; sporangial base limeless veinulose persistent as a disc.

In its overall appearance it may be compared with *P. penetrale* Rex. The later is delimited by subulate, rugose, nonlimy, dull red or orange brown stipe; elliploidal or prolate or pyriform sporangia which are greenish gray or yellowish green, fruiting taller (1-2 mm); columella orange brown dull yellow. *P. melleum* (Berk & Br.) Massee, can be compared with this species because of its white stipe and yellowish sporangia. But *P. melleum* (Berk and Br.), is differentiated by its larger spores, columella very small and conic, and short stipe. Due to its yellow sporangia present population may be compared with *P. citrinum* Schum. But later is marked by its scanty lime deposition on peridium, yellow stipe, small conic, yellow columella, which may be replaced by limy pseudocollumella, rounded yellow nodes; spore –mass black and spores larger.

9. **PHYSARUM LAKHANPALII** Nann.-Brem. & Y. Yamam


(PL. VIII FIG. 27)

Fructification plasmodiocarpous, scattered to gregarious, terete, yellow to yellowish brown mixed with few sessile sporangia. Plasmodiocarps vermicular, rarely simple, sometimes, branched.,05 to 3.0 mm long, more or less 0.4 mm wide. Sporangia sessile, globose, subglobose, reniform or worm like, pulvinate, 0.4 to 0.45 mm in diam. Hypothallus inconspicuous. Peridium single, thick, covered with irregular elongated yellow nodules of granular lime forming reticulum, mostly on upper side, lower part more or less limeless, brown on inner side; dehiscence from apical longitudinal cracks, basal part persistent. Columella absent. Capillitium abundant, a network of limy nodes and nonlimy internodes ; nodes many, pale yellow, spiny, branched ; badhamoid, sometime nodes attached to peridium, internodes short, delicate, tubular, hyaline, transparent. Spore black in mass, deep violaceous brown under transmitted light, clustered, 4 to 8 spores in a clusters, globose to subglobose, 10 to 14 um in diam., minutely and unequally warted, warts in lines, attached end are more or less flat with few warts.

**COLLECTION EXAMINED:** RRT / 8356, 8412, July-2004, Chandoli, Dist.-Sangli; On dry leaf and stem of angiospermic plant.

**DISTRIBUTION : INDIA :** M. P. (Kharat, 2000) ; M. S. (Chimankar, 1993)
The species is marked by the spores in cluster of 4-8 spores, 10-14 µm in diam., peridium ashy, encrusted with lime granules and deposition of conspicuous, large, irregularly shaped lime agglomerations in the form of confluent protuberances and fruiting predominantly vermicular plasmodiocarps on narrow base, peridial lime nodes yellow. The species can be compared with *P. auriscalpium* Cooke, *P. decipiens* Curtis, *P. serpula* Morgan. But none of these later three species shows spores in clusters. Whereas the clustered spores are the distinguishing characters of *P. lakhanpalii*.

10. **Physarum leucophaeum** Fries  
*Symb. Gast.*, 24, 1818.  
*(PL. IX FIG. 28)*

Fructification sporangiate, stipitate, scattered to gregarious, erect or nodding, ash white to grayish white, 0.65 to 1.35 mm tall. Sporangia globose to subglobose or depressed globose with more or less flat below, 0.3 to 0.6 mm in diam. Stipe cylindric, narrow towards the apex, twisted, vertically rugose, nonlimy, yellowish to yellowish brown, often darker brown at base, translucent, 0.35 to 0.75 mm long. Hypothallus rotate, thin, nonlimy blackish brown. Peridium single, thin, brittle, impregnated with white lime granules and covered by irregular limy globules. Dehiscence irregular from above, persistent at the base irregularly. Capillitium abundant, network of limy nodes and nonlimy internodes; nodes white to pinkish white, globular, fusiform, angular to branched; internodes short, delicate, tubular, hyaline, transparent. Spore dark brown in mass, pinkish brown under transmitted light, globose, 10 to 14 µm in diam., minutely warted, warts in few curved lines.


**DISTRIBUTION: INDIA:** Assam (Agnihothrudu, 1959); Gujrat (Salunkhe, 1994); M. S. (Nanir, 1978; Rokade, 1989; Jadhav, 1994); U. P. (Thind and Rehill, 1958).
P. leucopheum Fries is distinguished by fructification stipitate; sporangia depressed above with shallow umbilicus below; stipe vertically rugose, rarely frosted with lime granules; hypothallus blackish brown; peridium single impregnated with white lime granules; capillitium abundant, nodes white to pinkish white; spores minutely warted, warts in few curved lines.

Indian population are typically stipitate. Lister (1925), Hagelstein (1944), listed the species as a variety of P. nutans Pers. However P. nutans Pers., is characterised by its lenticulate and nodding sporangia, long and slender stipe, larger fusiform or elongated limy nodes and dichotomously branched internodes.

11. **Physarum megalosporum** Macbr.

*N. Am. Slime-Moulds, ed. 2, 63, 1922.*


(PL. IX FIG. 29)

Fructification sporangiate, stipitate, scattered, ashy white, 0.6 to 0.7 mm tall. Sporangia hemispheric discoid, flattened above or depressed, umbilicate below, more or less saddel shaped, 0.4 to 0.5 mm in diam., some sporangia are fused laterally with individual stipe. Stipe long, cylindric, erect, stout, longitudinally rugose, more or less twisted attenuating towards the apex, broad towards the base, black, frosted with ash coloured lime granules, 0.4 to 0.45 mm long. Hypothallus distinct, rotate, black to blackish brown, dusted with refused matter. Peridium single, iridescent, evanscent above, white to gray, frosted with ashy white lime granules, membranous. Dehiscence irregular from above, lower part persistent. Columella absent. Capillitium abundant, network of nodes and internodes; nodes large, long, angular, fusiform, globose; internodes short, hyaline, delicate, tubular. Spore brown in mass, pinkish brown under transmitted light, globose, 11.0 to 16.5 µm diam., verrucose or faintly warted, warts forms straight and curved lines.

**COLLECTION EXAMINED:** RRT / 8460, July-2005, Malsiras, Dist.-Solapur. On dry leaf of angiospermic plant.

**DISTRIBUTION : INDIA :** M.S. (Jadhav, 1994).

*Physarum megalosporum* Macbr., distinguished by fructification sporangiate, stipitate; sporangia hemispheric, discoid, flattened or depressed above, however, possesses sessile or shortly stalked sporangia; stipe long, longitudinally rugose,
frosted with ash coloured lime granules; hypothallus distinct & rotate; peridium single, membranous, impregnated with ashy white lime granules; columella absent; capillitium abundant; spore globose, verrucose or faintly warded.

*P. megalosporum* Macbr., are close to *P. javanicum* Racib. is marked by the annulate or discoid, dorsoventrally depressed and compressed sporangia; spore reported to be smooth, the columella and pseudocolumella are usually absent but sometimes conspicuous pseudocolumella is formed by massing together of the nodes in the centre. The species is being described for the second time from India.

12. **PHYSARUM MELLEUM** (Berk. & Br.) Massee
   
   *Myxogaster*, 278, 1892.
   
   
   *(PL. IX FIG. 30)*
   
   Fructification sporangiate, stipitate, scattered, erect, rarely nodding, honey yellow to orange yellow, 0.55 to 1.0 mm tall. Sporangia globose, 0.25 to 0.55 mm in diam. Stipe cylindric, broader at the base, smooth, white, slightly rugose, packed with white lime granules, 0.35 to 0.6 mm long. Hypothallus rotate, conspicuous, white to faint brownish, thin, membranous, nonlimy. Peridium single, membranous, thin, thicker towards the base, impregnated with orange or honey yellow lime granules, rarely lime white. Dehiscence irregular. Columella very small, convex or conic, white to pale yellow white, limy. Capillitium composed of network of limy nodes and nonlimy internodes; nodes abundant, white, spindle, globose, oval, angular, rod shaped, smooth, many attached to peridium, badhamoid towards the base of sporangium; internodes tubular, hyaline, transparent. Spore-mass brown, light brown under transmitted light, globose, 7.0 to 10 μm in diam., faint on one side, minutely warted.


**DISTRIBUTION : INDIA :** A. P., T.N., (Agnihothrudu, 1956) ; Chandigarh, Punjab (Thind, 1977) ; Gujrat (Salunkhe, 19945) ; H.P. (Lakhanpal, 1973) ; M.S. (Rokade,
The species is recognized by its yellow to orange, globose sporangia; white and limy stipe; small limy columella; white and large nodes; minutely verrucose spores. It is close to *P. citrinum* Schum., but distinguished in its characters of peridium, stipe columella and nodes. In *P. citrinum* sporangia are bright yellow; stipe, short and yellow; columella yellow or lacking, nodes yellow. Thind (1977), noted spore size quite typical for the species. 7.5-8.5 µm spores size is recorded by Lakhanpal and Mukerji (1981).

13. **PHYSARUM NANNENGAE** Rokade & Nanir sp. nov.  
(Pl. X Fig. 31)

Fructification sporangiate, sessile, gregarious to crowded, rarely superimposed, white to grayish white. Sporangia subglobose to oval or obovate on restricted base, surface wrinkled, 0.35 – 0.4 mm tall, 0.59 – 0.85 mm in diam. Hypothallus yellowish brown, distinct, stranded or branched, limeless, rarely sprinkled with lime, common for clusters. Peridium single, cartilaginous, thick, tough, wrinkled, sparsely covered with scattered limy flakes; nonlimy, iridescent, violet brown at the base, gradually become faint above; dehiscence irregular along the wrinkles from upper region, persistent below as a cup. Capillitium abundant; limy nodes small, white, smooth, globose, oval, fusiform, few angular, connected by short, tubular, hyaline, internodes and forming a network. Columella none; sometimes pseudocolumella is present as an irregular, white limy rods. Spore-mass black, dark violaceous brown under transmitted light, globose, 9.7 – 13.8 µm in diam., conspicuously warted, papillate, warts in small curved lines, with distinct compression ridges forming lax reticulum.


**DISTRIBUTION**: INDIA: Gujrat (Salunkhe, 1995); M. P. (Kharat, 2000); M. S. (Rokade, 1989; Chimankar, 1993; Jadhav, 1994).

*P. nannengae* Rokade & Nanir sp. nov., is distinguished by the following characters – 1. sessile, bronze to tar black sporangia. 2. Stranded or branched hypothallus. 3. Tough or cartilaginous peridium with wrinkles and lines of dehiscence.
along the folds, sparsely covered with lime flakes. 4. Columella absent. 5. Spore-mass black. 6. Spores pappillate, conspicuously warted with distinct compression ridges, 9.7 – 13.8 \( \mu m \) in diam.

In their limeless characters of peridium, *P. nudum* Macbr., and *P. conferatum* Macbr., can be compared with the present species. But in *P. nudum* Macbr., peridium is delicate, gray when limy and dark gray when limeless, fruiting is pulvinate on restricted base with reticulate hypothallus, capillitium is apparently badhamoid but scantily limy with many junctions, spore-mass dark brown and are minutely spinulose. *P. conferatum* Macbr., is distinguished by its dull violaceous brown to blackish and closely gregarious often confluent fruitings, peridium thin, lime deposition is in reticulate manner, capillitium is scanty with many limeless junctions and spores are minutely warted. Apparently in sporangial shape and hypothallus it looks like *P. gilkeyanum* H. C. Gilbert, but the spores and peridium of *P. nannengae*, are quite distinct to differentiated it from other species.

14. **PHYSARUM NOTABILE** Macbr.

* N. Am. Slime-moulds, 2\textsuperscript{nd} ed, 30, 1922.


(PL. X FIG. 32)

Fructification sporangiate, stipitate, scattered to gregarious, ash white to grayish white, 0.55 to 0.80 mm in total height. Sporangia globose, subglobose to depressed globose, rarely kidney shaped, umbilicate below, 0.3 to 0.4 mm in diam. Stipe short, cylindrical, filled with refuse matter, vertically rugose, blackish brown, opaque, broader at the base, narrow towards the apex, nonlimy, sometime frosted with lime, 0.3 to 0.5 mm long. Hypothallus rotate, smooth, concolorous to stipe, nonlimy, dusted with refuse matter. Peridium single, thin, membranous, grayish, densely encrusted with lime granules and covered with irregular white lime, rarely base limeless; dehiscence irregular, basal part persistent as a limeless basal disc. Columella absent. Capillitium abundant, elastic, delicate, composed of network of limy nodes and nonlimy internodes; nodes abundant, contains granular lime, irregular, fusiform, white, mostly angular to branched, appearing badhamoid towards the base; internodes long, hyaline, with many limeless junction forming network.
Spore brown in mass, pinkish brown under transmitted light, globose, 8 – 10 µm in diam., warted, warts in clusters and lines.


**DISTRIBUTION : INDIA :** Delhi (Lakhanpal, 1975) ; Delhi, H. P. (Lakhanpal & Mukerji, 1978, 1981) ; M. S. (Chimankar, 1993). The species can be characterised by its sporangia; dark, stout, opaque stipe filled with refuse matter, irregular deposition of lime on peridium leaving basal part as limeless disc and minutely warted spores. Martin and Alexopoulos (1969) reported presence of plasmodiocarps along with clusters of sporangia.

*P. notabile* Macbr. species can be compared with *P. tropicale* Macbrid. *P. tropicale* Macbrid marked by depressed subglobose sporangia, stipitate or sessile ; the stout dark brown stipe ; spore mass black, minutely but densely verrucose.

**15. PHYSARUM NUCLEATUM** Rex


(PL. X FIG. 33)

Fructification sporangiate, stipitate, gregarious, grayish white, 1.0 to 1.2 mm in total height. Sporangia globose, subglobose to depressed globose, frequently with very small umbilicate above, 0.35 – 0.6 mm in diam. Stipe long, slender, erect, mostly nodding, broader at the base, narrow at the apex, vertically rugose, yellowish brown to blackish brown, translucent towards the apex, nonlimy, merged at the base of sporangium in form of veins, 0.35 – 0.9 long, base brown to black, opaque, filled with refuse matter. Hypothallus thin, rotate, pale brown, nonlimy. Peridium single, thin, membranous, hyaline, covered with scattered, white lime granules aggregated into flakes. Dehiscence irregular, basal portion persistent, fugacious above. Capillitium scanty, composed of network of limy nodes and nonlimy internodes ; nodes small, white, globose, elongated, angular, calcareous ; internodes thin, tubular, branched, hyaline, transparent, many junction limeless, attached to the peridium. Columella none. Spore mass black, violaceous brown under transmitted light, globose, 8 – 11 µm in diam., minutely warted, warts in faint clusters and small curved lines.


*Physarum nucleatum* Rex is distinguished by a central nucleus formed by the aggregation of limy nodes. Its sporangia are small and white, the stipe long, the peridium is thick at base which persists as a deep collar after dehiscence and, the spores are minutely spinulose.

In general the rather small, long-stalked sporangia suggest *p. globuliferum* (Bull.) Pers. But in *P. nucleatum* Rex, usually there is no columella, stalk is nonlimy and small, pale violet spores. It differs from *P. nucleatum* var. *nucleatum* in respect of total height, spore size and absence of pseudocolumella.

16. **PHYSARUM NUTANS** Pers.


(PL. X FIG. 34)

Fructification sporangiate, stipitate, scattered to gregarious, nodding, 0.7 to 0.9 mm tall. Sporangia lenticulate or discoid, flat, without umbilicate, 0.4 to 0.55 mm in diam. Stipe long, subulate, broad at the base, erect or nodding, wrinkled, merged at the base of the sporangium as veins, blackish brown, 0.4 to 0.6 mm long, wavy, close and parallel ribs throughout its length, covered by white lime granules. Hypothallus distinct, blackish brown rotate, thin, concolorous to the stipe. Peridium single, thin, membranous, colorless, transparent, impregnated with white lime granules and covered with limy flakes ; dehiscence irregular, upper part flucose, lower part persistent as disc or plate. Capillitium abundant, composed of limy nodes and nonlimy internodes ; nodes spherical, white, oval, fusiform, many junction limeless ; internodes long, tubular, colorless, some attached to the peridium. Columella absent.
Spore brown in mass, pinkish brown under transmitted light, globose, 8.3 – 11.1 µm in diam., minutely warted.


The species seems to be common in India (Thind, 1977). Stipe may limeless (Martin & Alexopoulos, 1969 ; Thind, 1977 or may be limy (Hagelstein, 1944 ; Lakhanpal, 1973 ; Lakhanpal & Mukerji, 1981). Species is marked by discoid or lenticular often nodding sporangia; stipe long, subulate long and dark brown, opaque towards lower half, paler or white towards upper half; dehiscence is irregular or petaloid, lower discoid part persistent where apex of the stipe merges as veins; capillitium with very few, small, fusiform or globular nodes, appearing limeless in superficial observations. The species is close to *P. leucophaeum* Fries and *P. stellatum* (Massee) Martin. From former it is characterised by its lenticular nodding sporangia; small fusiform nodes and small bright spores. Later is distinguished by its peridium with limy scales and dehisce in floriform fashion and stalk more or less limy throughout, formation of pseudocolumella, delicate capillitium with few nodes. In case of scanty lime or 'bleached' specimens (Martin & Alexopoulos, 1969; Farr, 1976) sporangia of *P. viride* (Bull.) Pers., looks like *P. nutans* Pers. But dehiscence of peridium into "floccose" manner; yellow or reddish orange shade of peridium, nodes and stipe, brighter spore distinguish *P. viride* (Bull.) Pers., from *P. nutans* Pers.

17. **PHYSARUM OVISPORUM** Lister

Fructification primarily sessile sporangiate, tending to be plasmodiocarpous, scattered to gregarious, white to grayish white. Sporangia globose, oval or obovoid on broad base, 0.25 to 0.46 mm in diam. Plasmodiocarp terete, small, simple, to branched, 0.34 to 1.8 mm long, 0.25 to 0.4 mm in diam. Hypothallus inconspicuous. Peridium single, thin, membranous, transparent, iridescent, densely covered with white lime deposition; dehiscence irregular, mostly from upper part, petaloid in sporangiate form, basal part persistent. Capillitium abundant, a network of limy nodes and nonlimy internodes; nodes white, globose, angular, branched, fusiform, often massed together forming limy pseudocolumella; internodes hyaline, delicate, thin, tubular. Spore black in mass, dark violaceous brown under transmitted light, globose or subglobose, 9.5 – 12.5 µm in diam., minutely warted, warts in small lines.


**DISTRIBUTION : INDIA :** Delhi (Lakhanpal & Mukerji, 1978) M. P. (Kharat, 2000); M. S. (Nanir, 1978; Rokade, 1989; Chimankar, 1993); Gujrat, Salunkhe, 1995).

The species is very close to *P. cinereum* (Bastch.) Pers. and *P. vernum* Sommerf. ex. Fr. These three species are difficult to differentiate from each other. Farr (1976), merged the species with *P. vernum* Lister (1925). Hagelstein (1944), mentioned ovoid spores with pale line of dehiscence. Oval spores had not been observed by Thind (1972), Martin and Alexopoulos (1969), Lakhanpal and Mukerji (1981). However the species is differentiated from both the allied species in its very dark spores encircled by a pale line, peridium with heavy lime and nodes smaller. These features or characteristics have not been found in the other species. Moreover spores are larger. Until further investigation, populations are placed in *P. ovisporum*.

**18. PHYSARUM PANCHAGANENSIS** Nanir & Tembhurne sp. nov.

Fruiting sessile sporangiate, compactly arranged or clustered appeared to be heaped, turmeric yellow. Sporangia globose to ovate to heart shaped, 0.93 – 1.0 mm
in diam. Hypothallus inconspicuous. Peridium double, very compact, ordinarily not visible, outer smooth, shining, yellow, egg shell like; inner ashy, thin rough appressed to outer layer. Dehiscence irregular. Capillitium lax, a network of limy nodes and limeless internodes, nodes white, smooth, globose, large. Spores black in mass, violaceous brown under transmitted light, globose, 11.1 – 13.8 µm in diam., with compression and equatorial ridge, minutely warded.


**DISTRIBUTION:** INDIA: M. S.

Distinct features of the species are – 1) fruiting sessile. 2) sporangia ovate to heart shaped. 3) yellow in colour. 4) peridium double, both the layer appressed, smooth. 5) capillitium with small limy nodes. 6) hypothallus absent. 7. spores large 11 – 14 µm in diam., with compression and equatorial ridge.

*Physarum* panchaganiensis Nanir & Tembhurne sp. nov.; is marked by fruiting sporangiate sessile; sporangia clusters with turmeric yellow; peridium double; hypothallus inconspicuous; capillitium lax, nodes white; spore black in mass, violaceous brown by transmitted light. *Physarum* spp-II is compared with *Physarum leucophaeum* Fries. However *Physarum leucophaeum* Fries is characterized by fruiting sporangiate stipitate; sporangia scattered with grayish white; Peridium single; hypothallus prominent; capillitium abundant nodes pinkish white; spore brown in mass, pinkish brown by transmitted light.

As there is only specimens, it is pending for further investigation and collection of more sample.

19. **PHYSARUM PANHALENSIS** Nanir & Tembhurne sp. nov.

(Pl. XI Fig. 37)

Fruiting sporangiate and plasmodiocarpous, milky or curdy white, scattered. Sporangia globose to subglobose, 0.34 - 0.38 diam. Plasmodiocarps terete, simple, short or branched, 0.42 – 2.7 mm long. Hypothallus massive, heavily deposited, white or pearly white, forming cushion below the fruiting, strands extended beyond fruiting. Peridium pearly white, thick, smooth, shell like, corrugated, thicker at the folding reveals under microscopes, as a result peridium divided into polygonal platelates, dehiscences irregularly, after dehiscence lower part persistent showing heavy
deposition of lime in the form of smooth globules, pearly white in appearance. Capillitium a network of limy nodes and limeless short internodes; nodes white smooth, mostly globose, doscoid, large. Spores black in mass, purple under transmitted light, globose, appears to be smooth but very minutely verrucose with clusters of warts 6.9 – 8.3 µm in diam.

**COLLECTION EXAMINED:** RRT/8021, July-2003, Panhala, Dist.-Kolhapur.

**DISTRIBUTION:** INDIA: M. S.

Distinct feature of the species are – 1) fruiting sporangiate and short plasmodiocarps. 2) milky or pearly white. 3) peridium smooth folded or corrugated, thick, milky or pearly white. 4) heavy deposit of lime at folds. 5) massive deposition of pearly white hypothallus which form more or less cushion below the fruiting and extend beyond fruiting. 6) nodes are large and mostly globose discoid and smooth.

In spores character and fruiting habit it is very close to *P. cinereum* Schum., *P. ovisporum* G. Lister, *P. vernum* Somm. ex Fries and *P. sessile* Brandza. But none of these species have the characters of peridium, hypothallus and nodes exhibited by this species.

As there is only single specimens, it is pending for further investigation and collection of more sample.

---

**20. PHYSARUM PUSILLUM** (Berk & Curt) G. Lister

*Mycetozoa, 2nd ed.,* 64, 1911.


(*PL. XII FIG. 38*)

Fructification sporangiate, stipitate, scattered, grayish white, 0.5 to 1.3 mm in total height. Sporangia globose to subglobose with orange or reddish orange basal disc, 0.3 to 0.5 mm in diam. Stipe erect or bent, cylindric, vertically rugose, sometimes twisted, nonlimy, shining, reddish brown, opaque, incorporated with refuse matter towards the base, reddish brown or orange and translucent towards the apex, merged at the base of sporangium in the form of veins, 0.3 to 0.9 mm long. Hypothallus blackish brown, rotate, membranous, nonlimy. Peridium single, thin and delicate, membranous, hyaline, thicker and yellowish brown towards the base, impregnated with lime granules and covered with white lime globules forming rough surface; dehiscence irregular, basal part, persistent as a irregular basal disc.
Capillitium abundant, composed of limy nodes and nonlimy internodes; nodes many, globose to fusiform; internodes delicate, tubular, hyaline, sometimes lime extends into the internodes and capillitium appears as badhamoid mostly towards the base. Columella absent, rarely limy nodes massed in the centre to form pseudocolumella. Spore mass black, violaceous brown under transmitted light, globose, 8.5 to 12.4 µm in diam., minutely warted, warts arranged in clusters and curved lines.


**DISTRIBUTION : INDIA:** Delhi, H.P. (Lakhanpal and Mukerji, 1981); Gujrat (Salunkhe, 1995); M.P. (Kharat, 2000); M.S. (Patil and Mishra, 1977; Nanir, 1978; Rokade, 1989; Chimankar, 1993; Jadhav, 1994), Punjab, W.B. (Thind, 1977); T.N. (Indira, 1975); U.P. (Thind and Manocha, 1957).

The species can be distinguished by its globose or slightly flattened sporangia with brown or orange thickened base; thin peridium; cylindrical stalk; absence of columella or pseudocolumella; spores 9-12 µm in diam. Thind (1977), reported spore size up to 13 µm, with clusters of warts and fruiting up to 1.8 mm tall. The populations studied in the present work are quite similar to Indian populations.

*P. pusillum* (Berk. & Curt.) G. Lister can be compared with *P. dudlianum* Lakhanpal & Mukerji. However, *P. dudlianum* Lakhanpal & Mukerji, is characterized by prominent pseudocolumella, depressed globose umbilicate sporangia, long capillitial nodes and larger and less prominently marked spores.

21. **PHYSARUM TESSELLATUM** Martin & Farr

*Lloydia, 22*, 300, 1960.


*( PL. XII FIG. 39)*

Fructification sporangiatic, sessile, compactly grouped into pseudoaethalia, gray to chalky white with yellow tint. Sporangia dorsoventrally, flattened, polygonal, become angular due to mutual lateral pressure, 0.34 to 0.85 mm in diam. Hypothallus white, common for a colony, limy, lime granular or nodular. Peridium double, closely appressed; outer layer thick, chalky white, consists of lime granules, flaking away readily forming tessellate crust over a group of sporangia; inner layer thin,
membranous, transparent, limy, pale yellow to pallid ; dehiscence irregular, lower part persistent as a shallow cup, base yellow within. Columella absent. Capillitium abundant, consists of a network of limy nodes and limeless internodes ; nodes large, globose, angular, elongated ; lime granules white or pale yellow ; internodes short, tubular, hyaline, connected to base and peridium. Spore brown in mass, violaceous brown under transmitted light, globose, 11 to 14 µm in diam., distinctly warted with compression ridges.


**DISTRIBUTION: INDIA:** Delhi (Thind, 1977) ; Gujrat (Salunkhe, 1995) ; H. P. (Lakhanpal & Mukerji, 1983) ; M. P. (Kharat, 2000) ; M. S. (Jadhav, 1994).

*P. tessellatum* Martin & Farr and *P. spumarioides* Lakhanpal & Mukerji, are close in habit and absence of columella. *P. tessellatum* Martin & Farr, is marked by sessile sporangia, the capillitium is abundant, peridium double, columella absent, spore mass brown, spores distinctly warted with compression ridges. *P. spumarioides* Lakhanpal & Mukerji, is differentiated by, the scanty capillitium, single peridium, well developed pseudocolumella, spore mass black, prominently warted with conspicuous lines of warts.

22. **PHYSARUM VERNUM** Somm. ex. Fries in Fries Syst. Myc, 3, 146, 1829.


(PL. XII FIG. 40)

Fructification sessile sporangiate to plasmodiocarpous, scattered to gregarious, grayish white to ash coloured. Plasmodiocarp small, rarely branched, terete, 0.55 to 3.4 mm long and 0.42 to 0.46 mm wide and 0.25 to 0.34 mm tall. Sporangia globose, subglobose or ellipsoidal on broad base, 0.34 to 0.42 in diam. Hypothallus inconspicuous. Peridium single, thin, membranous, transparent, iridescent, covered with small, spherical or irregular lime globules, fugacious above, persistent below; dehiscence irregular. Columella absent. Capillitium abundant, a network of limy nodes and nonlimy internodes; nodes many, white, spherical, angular ; internodes short, thin, delicate, tubular, hyaline. Spores dark violaceous brown in mass, pinkish
or pale violaceous brown under transmitted light, globose, 7.0 to 11 µm in diam., minutely and uniformly warted, warts in small lines.


Comparative comparison and similarities of *P. vernum* Somm. ex. Fries, *P. ovisporum* Lister and *P. cinereum* (Batch) Per. *P. vernum* Somm. ex. Fries, marked by fructification sessile sporangiate to plasmodiocarpous, grayish white to ash colored, scattered to gregarious ; Plasmodiocarp small, rarely branched, terete : Sporangia globose, subglobose or ellipsoidal on broad base ; Hypothallus inconspicuous ; Peridium single ; Columella absent ; Capillitium abundant ; Spores dark violaceous brown in mass, minutely and uniformly warted, warts in small lines, *P. cinereum* (Batch) Per. characterized by fructification sporangiate to plasmodiocarpous, white to grayish white, scattered to gregarious ; Plasmodiocarps small, straight or curved with few branched, small segmented, terete, constricted at the base ; Sporangia globose to subglobose ; Hypothallus inconspicuous ; Peridium single ; Columella absent, rarely white, limy pseudocolumella may be present ; Capillitium abundant ; Spores mass brown, minutely warted, warts in small short lines and *P. ovisporum* Lister marked by fructification primarily sessile sporangiate tending to be plasmodiocarpous, white to grayish white, scattered to gregarious ; Plasmodiocarps small, terete, simple to branched ; Sporangia globose, oval or obovoid on broad base ; Hypothallus inconspicuous ; Peridium single ; Often massed together forming limy pseudocolumella ; Spores black in mass, minutely warted, warts in small lines

The species is widely distributed. It resembles to *P. cinereum* (Batch.) Pers., for their number of characters. However *P. vernum* Somm. ex. Fries is plasmodiocarpous, peridium is single, thin, membranous, transparent with small, spherical or irregular lime globules ; spores darker, larger and prominently warted.
23. **Physarum viride** (Bull.) Pers.  


(PL. XII FIG. 41)

Fructification sporangiate, stipitate, scattered to gregarious, erect or nodding, yellow to yellowish brown to greenish yellow, 0.35 to 1.3 mm tall. Sporangia subglobose, discoid, 0.25 to 0.5 mm in diam., sometimes with upper umbilicus but often with nonlimy basal disc. Stipe long, subulate, erect or nodding, sometimes twisted towards the apex, yellow, translucent above, brown in middle, dark brown to black below, filled with refuse matter towards the base, vertically rugose, merged in the base of sporangium in the form of veins, 0.3 to 1 mm long. Hypothallus rotate, thin, yellow, shining, membranous, nonlimy, contains refuse matter. Peridium single, thin, membranous, transparent, yellow to dull yellow, iridescent, covered with globose to irregular, scattered, yellow lime, forming subreticulate pattern, basal disc nonlimy; dehiscence from above, lower part persistent. Columella absent. Capillitium abundant, delicate, radiating from sporangial base and attached to peridium, consists of nodes and internodes; nodes yellowish, large, angular, fusiform, calcareous; internodes thin, delicate, nonlimy, hyaline, frequently both nodes and internodes attached to the peridium. Spore-mass dark brown, violaceous brown under transmitted light, globose, 8 – 10 µm in diam., minutely warted, or appearing smooth, warts in faint clusters.


**DISTRIBUTION:** INDIA: Delhi, H. P. (Lakhanpal & Munkerji, 1981; Lakhanpal, 1973); H. P. & U. P. (Thind, Khara & Sohi, 1971); Gujrat (Salunkhe, 1995); M. P. (Kharat, 2000); M. S. (Nanir, 1978; Rokade, 1989; Chimankar, 1993; Jadhav, 1994); U. P. (Lister, 1925; Thind & Sohi, 1956).

*P. viride* (Bull.) Pers. is characterized by fructification stipitate; sporangia discoid, sometimes upper umbilicus; stipe long, filled with refuse matter towards the base, vertically rugose; peridium single; columella absent; capillitium abundant; spores-mass dark brown, minutely warted or appearing smooth, warts in faint clusters.

*P. viride* (Bull.) Pers. and *P. nutans* Pers., have yellow or yellowish peridium, stipe and nodes, even the faded form of *P. viride* retain some yellow tints which
distinguishes it from \textit{P. nutans}. Indian populations described earlier mostly from Himalayas possess smaller spores.

**SUMMARY AND DISCUSSION**

The genus \textit{Physarum} Pers. is the largest genus of Myxomycetes, includes about 135 species from the world over. Uptill now about 61 species have been described from Indian flora, mostly from Assam, Bihar, Chandigarh, Delhi, H. P., Karnataka, Orissa, T. N. and W. Bengal. About 26 species are being described for the first time from this region particularly from South-Western ranges. All the species described above except \textit{Physarum decipiens} Curtis, \textit{Physarum serpula} Morgan, \textit{Physarum sessile} Brandze, are new record for the Maharashtra. With additions of new species and new records, the total number of species of the genus represented from the India is sixty eight.

The genus \textit{Physarum} Pers., is distinguished by limy peridium, capillitium and stipe; lime granular, capillitium consist of limeless tubular internodes connected to limy nodes.

The genera \textit{Fuligo} Haller, \textit{Badhamia} Berk. and \textit{Craterium} Trent., are close to \textit{Physarum}, Subaethaloid fruiting of \textit{P. gyrosum} Rost. and similar other species approach \textit{Fuligo} on one hand and some fruiting of \textit{Fuligo septica} (L.) Wiggers, \textit{F. intermedia} Macbr. and \textit{F. cinerea} (Schw.) Morgan, approach very closely to densely massed sporangia of \textit{Physarum} on other hand. Therefore, Locquin (1954) suggested to unite \textit{Fuligo} and \textit{Physarum} (Locquin, 1954). However, it would make the genus more heterogenous and complex. There seems to be no practicable convenience. An aethaloid fruiting and presence of pseudocapillitium conspicuous than capillitium are the quite firm and uniform features to justify \textit{Fuligo} Haller as a distinct genus. \textit{Physarum} Pers., \textit{Craterium} Trent. and \textit{Badhamia} Berk. have great tendency to merge with each other. Many species of \textit{Physarum} Pers., possess sporangia which after dehiscence have the tendency of persistent peridium as cupulate basal part, similar to nonoperculate \textit{Craterium} Trent., in which dehiscence is not circumsessile. However the genus \textit{Craterium} Trent., is characterised by its cartilaginous peridium encrusted with lime granules, and after dehiscence persist as a deep cup, and hence "it is worthy of maintaining as a convenience ---", (Martin & Alexopoulos, 1969). The capillitium in certain species of \textit{Physarum} Pers. and \textit{Badhamia} Berk., is "badhamoid" and "physaroid" respectively and cause repeated confusion. According to Martin & Alexopoulos (1969) ", transter of additional species of \textit{Badhamia} Berk. to Physarum
Pers. would make both genera more natural and formal at least more homogenous ". " It has also been suggested by, returning to Berkeley's original circumscriptions and including only those species with clustered spores and continuous capillitium reticulum of uniform calcareous tubules (Farr, 1976).
Family: DIDYMIACEAE Rost

Versuch, 12, 1873

Capillitum typically limeless, threads like, purple-brown to pallid, rarely totally absent. Peridium usually more or less densely calcareous (limeless in Diachea), the lime either in the form of amorphous granules and then aggregated into a shell-like outer layer or peglike protusions, or embedded in a cartilaginous wall, or in the form of crystals and then sprinkled over the surface as scattered crystals or platelike scales. Spores black in mass, dark purple brown to pale violaceous brown by transmitted light.

Includes NINE genera.

KEY TO THE GENERA OF FAMILY DIDYMIACEAE

(Adopted from Martin G. W. and C. J. Alexopoulos, 1969)

1. Lime completely absent; capillitium of vertical tubules extending from apex to the base; fruiting strongly flattened
   1. Lime present on peridium or in stalk or in both; combination of characters not as above
      2. Peridium thin, iridescent, limeless; lime in stalk and columella
         2. Peridium membranous to cartilaginous, limy; stalk and collumella when present may be limy or limeless
            3. Peridial lime amorphous granular
               3. Peridial lime stellate, rhomboidal crystals or scales may be united into flakes or continuous crust
                  4. Peridial lime scanty often with plasmatic deposition; capillitium netted with basal nodes flattened
                     4. Peridial lime abundant; capillitium radiating from columella or thickened base
                        5. Outer peridium bearing numerous blunt limy peg like protuberances
                           5. Outer peridium not so
                              6. Capillitium lacking, very rarely rudimentary small one or two tubules may present
                                 6. Capillitium conspicuous and well developed
                                    --------Trabrooksia.
                                    ----2
                                    ----Diachea.
                                    ----3
                                    ----4
                                    ----6
                                    ----Wilczekia.
                                    ----7
                                    ----Physarina.
                                    ----Diderma.
                                    ----Squmuloderma.
7. Fruiting aethalioid consisting of numerous anastomosing tubes filled with spores, and capillitium limeless, pseudocapillitium lamy

7. Fruiting not aethalioid; limy pseudocapillitium never present

8. Peridial lime in the form of limy scales

8. Peridial lime stellate crystalline

9. Peridium cartilaginous

9. Peridium membranous

--------Mucilago.

--------Mucilago.

--------Lepidoderma.

--------Lepidodermopsis.

--------Didymium.
**DIACHEA** FR.

*Syst. Orbis Veg*, p. 143, 1825.

The genus is characterized by globose or cylindrical to subcylindrical, stipitate or sessile sporangia. Peridium without lime, membranous, iridescent. Columella generally present. Columella, stipe, hypothallus limy. Generally lime granular, may be nodular. Capillitium dense or lax, anastomosing, limeless. Spore-mass dark.

Fries (1825), erected the genus *Diachea* Fries., on the type species *Stemonitis elegans* Trent. (1797), which is now regarded as one of the synonyms of *Diachea leucopodia* (Bull.) Rost. Martin & Alexopoulos (1969), Martin et al (1983), suggested *Diachea* as an alternative spelling.

Since the erection of the genus, several species were described from different parts of the world by many authors e.g. Fries (1829), Schweinitz (1832), Rostafinaki (1874, 79), Raciborski (1892), Rex (1892, 1894), A. Lister (1898), G. Lister (1911, 1916, 1925), Macbride and Martin (1934), Hagelstein (1944), Martin (1949), Alexopoulos (1965), Reynolds & Alexopoulos (1971), Kowalski (1975), Farr (1959, 1969, 1974, 1979), Nannenga-Bremekamp and Yamamoto (1986, 1987), Li, H. (1988), Keller, H. W. et al. (2004), Yamamoto Yukinori (2007).


From India, the genus was reported for the first time by Lodhi (1934), who described *D. leucopodia* (Bull.) Rost. from Mussoorie. Thind et al (1956, 1957, 1959), described four species from Mussoorie hills. Agnihotru (1956, 1959), reported two species from Assam and Karnataka. Ghosh & Dutta (1661, 1962), described two species from Orissa. Most of these authors reported species have already been described by Thind et al (1956, 1957, 1959). Thind and Manocha (1964) described *D. megalospora* Thind and Manocha, from Mussoorie hills as new to science. Singh & Pushpavathy described two species from Delhi and added *D. radiata* Lister & Petch, as new records to Indian flora. Indira (1968), from Tamil Nadu, reported two species. Lakhanpal (1974), described one species from Himachal Pradesh, and from Chandigarh, Sekhon (1977), reported one species. Thus from India the genus is represented by Six species.
For the first time from Maharashtra State. Nanir (1978), described three species from Marathwada region. Rokade (1989), described four species from North Maharashtra. Chimankar (1993), described four species from East Vidarbha and Jadhav (1994), described three species from Northern Eastern ranges of Western Ghat. The species studied in this work are described and illustrated as follow.

**KEY TO THE STUDIED SPECIES OF *DIACHEA* FR.**

1. Sporangia cylindric
   
   ----- *D. leucopodia*.

1. Sporangia globose to subglobose

2. Spore spiny or warty reticulate
   
   ----- *D. subsessilis*.

2. Spore may be spiny or warted but not reticulate
   
   -----3

3. Sporangia 0.3-0.5 mm in diam; stipe 0.65-0.75 mm long, broader at the base, columella branch ochræeous; spores warted 11 – 14 µm in diam.

   -----D. verrucospora.

3. Sporangia 0.5-0.8 mm in diam; stipe 0.45-0.65 mm long, bulbous at the base, columella dirty white, spores sparsely and distinctly spiny 9.5 – 14 µm in diam.

   -----D. megalospora.

1. **DIACHEA LEUCOPODIA** (Bull.) Rost.

*Mycetozoa,* p. 190, 1874.


(PL. XIII FIG. 42)

Fructification sporangiate, stipitate, scattered to gregarious, iridescent peacock feather like, 0.63 to 2.0 mm in total height. Sporangia cylindric to ellipsoidal, 0.34 to 1.1 mm long, 0.21 to 0.63 mm in breath. Stipe long, cylindric, broader at the base, white to dull white, smooth, 0.21 to 0.93 mm long, 0.17 to 0.34 mm broad, contains white lime granules. Hypothallus well developed, often confluent forming reticulum, white, contains rhomboidal lime. Peridium thin, membranous, iridescent, with metallic lusters, lower part peacock feather-like iridescent, aeriolate or smooth mostly evanescent. dehiscence irregular ; Columella long, slender, tapering upwards with obtuse apex, concolorous to stipe, more than ¾ of the sporangium, often reaching to the apex of sporangium, contains lime granules. Capillitium abundant, arising from entire columella, filamentous, stiff, violet brown, ends paler, dichotomously branched.
and anastomosing forming network of irregular meshes, and pointed ends free. Spore black in mass, violaceous brown under transmitted light, globose, 7 to 11 µm in diam., minutely warted, warts in cluster and lines.


**DISTRIBUTION**: INDIA: Assam (Agnihothrudu, 1959); Gujrat (Salunkhe, 1995); H. P. (Thind, 1977; Lakhanpal and Mukerji, 1981); Karnataka (Agnihothrudu, 1968); M. S. (Nanir, 1978; Rokade, 1989; Chimankar, 1993; Jadhav, 1994); Orissa (Ghosh and Dutta, 1962); U. P. (Lodhi, 1934; Thind and Sohi, 1965); W. B. (Thind, 1977).

*Diachea leucopodia* (Bull.) Rost., is close to *D. bulbilosa* (Berk and Br.) Lister. *Diachea leucopodia* (Bull.) Rost. is most common representative of the genus. It is one of the most striking and is readily distinguished from the other species of *Diachea* Fr., by its more or less cylindric sporangia. Those forms with globose sporangia attributed to *D. leucopodia* (Bull.) Rost., are probably belong to other species. According to Farr (1974), this species can be compared with *D. bulbilosa* (Berk and Br.) Lister, in the classification of *Diachea* Fries, this fairly common species is of more than passing intrest, because the lime in the temperate-zone collections is invariably granular, whereas that of tropical material is always aggregated into crystalline nodules. No other consistent morphological differences are evident between these two climate-base categories.

The species is easily recognized by its cylindrical sporangia, white limy stipe and minutely verrucose spores. *D. leucopodia* (Bull.) Rost., is widely distributed in India.

2. **DIACHEA MEGALOSPORA** Thind and Manocha


(PL. XIII FIG. 43)

Fructification sporangiate, stipitate, scattered to gregarious, 0.6 to 1.1 mm tall. Sporangia globose to subglobose, dark brown, umbilicate below, 0.46 to 0.8 mm in
diam. Stipe erect, cylindrical, 0.42 to 0.63 mm long, broad or bulbous at the base, shining, smooth, faint brown to brown, filled with rhomboidal lime. Hypothallus rotate, venulose, non-limy. Peridium single, thin, membranous, faint brown, fugacious above; dehiscence irregular. Capillitium abundant, filamentous, stiff, smooth, sinuate, violaceous brown, dichotomously branched and anastomosed, bases hyaline, tips spiny and hyaline. Columella small, globose or oval, dirty white, with narrow distinct neck, contains rhomboidal white lime. Spore violaceous brown in mass, faint under transmitted light, globose, sparsely and distinctly spiny, 9.5 to 14 μm in diam.


*D. megalospora* is distinguished by its sporangia globose to subglobose, umbilicate below; faint brown to brown stipe; dirty white columella; sparsely and distinctly spiny spores. The outer spore wall possesses prominent, coarse, dark, thin, spine-like warts up to 1 μm long, whereas the inner spore wall is marked by clusters of smaller, paler warts, usually 1 – 2, or more, such clusters being present in one view of the spores; peridium single; capillitium abundant, tips spiny and hyaline; Columella, globose or oval.

The species is very close to *D. thomsii*, from which it is differentiated by its larger spores without clusters of warts, stipe and columella with crystalline lime, sporangia and columella smaller. However, Thind and Manocha (1964), described spores larger, and whether lime is granular or crystalline is not mentioned. Martin and Alexopoulos (1969), mentioned crystalline lime in stipe and columella.

3. **DICHEA SUBSESSILIS** Peck.


*(PL. XIV FIG. 44)*

Fructification sporangiate, short stipitate to subsessile, scattered to gregarious, 0.63 to 1.3 mm in total height. Sporangia globose, dark brown to black, 0.42 to 0.93 mm in diam. Stipe white, cylindrical, broader at the base, smooth, filled with white
lime granules, 0.21 to 0.76 mm long. Hypothallus distinct, rotate, sometimes reticulate, white, limy with rhomboidal lime crystals. Peridium thin, transparent, membranous, iridescent with metallic luster, aeriolate; dehiscence irregular, fugacious above, persistent below, Columella small, an extension of stipe, conic, white, limy, contains white lime granules. Capillitium radiating from the columella and attached to the peridium, filamentous, violaceous brown, paler above, dichotomously branched and anastomosed, marked with rings, dark cup-like or fusiform swellings sometimes with membranous expansions at dichotomy, ends free. Spore-mass black, deep violaceous brown under transmitted light, globose, 8.3 to 12.4 μm in diam., warty or spiny, reticulate or delicately subreticulate.


The species is distinguished by reticulate spores and usually short stipe and columella. It can be compared with *D. radiata* G.Lister and Petch., and *D. bulbilosa* (Berk. & Br.) Lister. However, *D. radiata* G.Lister and Petch., is marked by sporangia globose to subglobose; broad base of the stipe; warted, warts in lines and clusters, 2-3 clusters per hemisphere and *D. bulbilosa* (Berk. & Br.) Lister is marked by globose sporangia, bulbous base of the stipe, and minutely but distinctly and irregularly verrucose spores. Indian collection reported earlier have large sporangia (Lakhanpal & Mukerji, 1981) and slightly smaller spores (Thind, 1977 ; Lakhanpal & Mukerji, 1981).

**4. DICHEA VERRUCOSPORA** Nann.-Brem. & Y. Yamam.


(PL. XIV FIG. 45)
Fructification sporangiate, stipitate, scattered to gregarious, grayish, 0.93 to 1.0 mm in total height. Sporangia globose, with or without umbilicus, grayish, 0.29 to 0.46 mm in long. Stipe cylindric, broader at the bases, smooth, shining, brownish, ochraceous towards the base and darker towards the apex, filled with rhomboidal or nodular lime, 0.68 to 0.76 mm long. Hypothallus, rotate, confluent, calcareous. Peridium thin, membranous, aeriolate, evanescent, persistent towards the base, iridescent with metallic luster ; dehiscence irregular. Columella continuation of stipe, concolorous to stipe, cylindric with obtuse apex, extending up to half of the sporangial cavity, filled with rhomboidal lime. Capillitium abundant, arising from columella, filamentous, stiff, sinuate, dichotomously branched, and anastomosing, blackish brown, paler at both the ends, tips pointed. Spore-mass black, violaceous brown under transmitted light, globose, 11.00 to 14 um in diam., warted, warts with somewhat flattened tips, few warts in close groups.

**COLLECTION EXAMINED:** RRT / 8130, Aug.-2003, Panhala, Dist.- Kolhapur.

On dry leaves of angiospermic plants.

**DISTRIBUTION : INDIA :** M. S. (Chimankar, 1993).

The species is distinguished by its stipitate, globose, with or without umbilicus sporangia; stipe filled with rhomboidal or nodular lime; peridium thin persistent towards the base and iridescent with metallic luster; columella concolorous to stipe, filled with rhomboidal lime; capillitium abundant, tips pointed; spore mass black, warted, warts with somewhat flattened tips, few warts in close group.

*D. verrucospora* Nann.-Brem. & Y. Yaman can be compared with *D. splendens* Peck. *D. verrucospora* Nann.-Brem. & Y. Yaman, fructification scattered to gregarious; hypothallus confluent; columella cylindric with obtuse apex, extending up to half of the sporangia; capillitium blackish brown, paler at both the ends; spores warted, warts with somewhat flattened tips, few warts in close group is compared with *D. splendens* Peck is characterized by fructification densely gregarious; hypothallus often confluent, venulose and netted; columella usually slightly swollen at the apex, extending to the middle of the sporangium; capillitium violaceous brown with paler extremities; spores profusely and coarsely verrucose, warts darker, coarse and prominent.

**SUMMARY AND DISCUSSION**
In the present work, four species of *Diachea* Fr., have been studied for the first time from this region i.e. *D. leucopodia* (Bull.) Rost., *D. megalospora* Thind and Manocha, *D. subsellilis* Peck and *D. verrucospora* Nann. Brem. & Y. Yamam.

The genus show limy stipe and limeless *Lamproderma* like capillitium and peridium. Therefore, it was taxonomically controversial until recently for its placement. Fries (1828), placed it in the 'Stemoniitei'. This was followed by Macbride (1899, 1922). Macbriide and Martin (1934), Martin (1949). Martin & Alexopoulos (1969), Alexopoulos (1973), and Thind (1977). Rostafinski (1874), placed it in the 'Spumariaceae' of the 'Physarales' due to the presence of lime. He was followed by Massee (1825), Schintz (1920), Hagelstein (1944), Farr (1976), Lakhanpal & Mukerji (1981), Martin, Alexopoulos & Farr (1983), but in the family Didymiaceae of the Physarales. According to Blackwell (1973), sporophore development of *D. leucopodia* (Bull.) Rost., is 'Subhypothallic' and hence *Diachea* FR., is misplaced in Stemonitomycetidae. Lister (1925), described three limeless species i.e. *D. cerifera* G. Lister, *D. cylindrica* Bilgram. and *D. caespitosa* (Sturgis) A. & G. Lister. Hagelstein (1944), transferred former to *Elaeomyxa* Hagelst., and recognized later two. but Martin and Alexopoulos (1969), treated later two under *Comatricha* Preuss. Farr (1979), showed that *D. cylindrica* Bilgr. possess limy columella at least in part and thus returned to *Diachea* FR.
DIDERMA Pers.


The genus Diderma Pers., is characterized by the fructification sporangiate, stipitate to sessile, sometimes plasmodiocarpous, rarely pseudoaethalioid. Peridium normally double, or triple, distinct or fused, so as to appear single; outer layer limy, fragile or cartilaginous; inner layer membranous; middle layer when present limy. Outer layer when limy, composed of amorphous lime granules, either loose or compact forming rough or smooth shell. Columella generally present, limy, conspicuous or reduced to thickened base. Capillitium limeless, branched and anastomosed. Spore-mass dark brown or black.


Martin & Alexopoulos (1969), gave an account of 32 species of the genus from the world and mentioned 27 species as 'excluded or doubtful': In Ainsworth and Bisby's Dictionary of The Fungi (2008), mentioned about 75 species from the world.


From the state of maharashtra, Patil & Ranade (1974), described seven species for the first time, of these *D. lyalli* (Massee) Macbr. as a new records for Indian flora. In 1979, Mishra & Ranade illustrated and described four more new
species of the genus i.e. *D. circumsessile* Patil, Mishra & Ranade, *D. lohogadensis* Patil, Mishra & Ranade, *D. marie* Patil, Mishra & Ranade, and *D. punesis* Patil, Mishra & Ranade. Nanir (1978), described four species of the genus from Marathwada. In the present study 14 species of the genus are being described for the first time from the region.

**KEY TO THE STUDIED SPECIES OF THE GENUS DIDERMA** Pers.

1. Fruiting sporangiate

2. Sporangia stipitate

3. Sporangia sessile

3. Fruiting reddish to reddish brown to dark brown, chestnut brown to blackish brown

4. Sporangia funnel or infundibuliform

5. Sporangia so, may be globose or subglobose

6. Peridium single

5. Peridium plainly double

6. Columella absent or merely raised sporangial base

6. Well defined columella present

7. Peridium smooth, spores 14 – 20 µm in diam., bipapillate

7. Peridium crustaceous, spores 11 – 13.5 µm in diam., not papillate

8. Sporangia patelliform with well defined lid

8. Sporangia not patelliform and no well defined lid

9. Sporangia discoid

9. Sporangia globose to subglobose, may be depressed but not discoid

10. Spores conspicuously spiny, with equitorial or compression ridge, 18 – 21 µm in diam., fruiting pseudoaethalloid

10. Not as above

11. Columella present

11. Columella absent

12. Dehiscence circumsessile

12. Dehiscence irregular

---

D. rugosum.

D. hemisphaericum.

D. farrianum.

---

D. punensis.

D. mussooriense.

D. testaceum.

D. cor-rubrum.

D. donkii or testaceum.

D. effusum or platycarpum.

D. donkii.

D. testaceum.
13. Dehiscence stellate

13. Dehiscence not stellate, but irregular, may be floccose

14. Spores banded reticulate reticulum sometimes incomplete

14. Spores not reticulate

15. Spores 8 – 10 µm in diam. warded

15. Spores 11 – 13.5 µm in diam. prominently warded

16. Plasmodiocarp very short, dehiscence circumsessile, lid is demarcated from brownish blackish wall

16. Fructing may be short plasmodiocarps, but not as above dehiscence irregular

17. Columella totally absent

17. Columella present, at least as raised base

18. Spore mass black, capillitium pale brown, columella hemisphaerical

18. Spore mass brown, capillitium hyaline, columella a raised base of fruiting

1. **Diderma cor-rubrum** Macbr.

* N. Am. Slime-moulds, ed. 11 nd, 140, 1922.


( PL. XV FIG. 46)

Fructification sporangiate, sessile or short stipitate, crowded, grayish white with pink violaceous tinge, 0.5 – 0.7 mm tall. Sporangia globose to subglobose, 0.4 – 0.6 mm in diam. Hypothallus confluent, white, limy. Stipe when present, short, flattened, thick, wrinkled, white, limy externally, lime granular, 0.25 – 0.4 mm long, rugose with thick reticulum of ridges. Peridium double, two layer distinct; outer layer thick, crustose, limy, gray white to pink white externally and with vilaceous patches on inner sides; inner layer thin, membranous, transparent, aeriolate, iridescent with violaceous metallic luster, nonlimy; dehiscence irregular. Columella globose, clavate to top shaped, red brown to chocolate brown, rough packed with granular lime, occupying half of the sporangial cavity, more or less pedicillate. Capillitium abundant, radiating form columella and attached to the peridium, dichotomously
branched, rigid, anastomosed, expanded at ramification with membranous perforated expansions, with fusiform swellings at frequent interval giving moniliform appearance, brown, hyaline towards the apex. Spores black in mass, dark reddish brown under transmitted light, globose to subglobose, 11 – 13.5 µm in diam., prominently warted, warts in small curved lines, papillate, along with distinct equatorial ridges.

**COLLECTION EXAMINED :** RRT / 8013, 8036, 8060 Sept.-2003, Panhala, Dist.-Kolhapur. On dry leaves and stem of angiospermic plants.


The species studied in present report is quited similar to Indian populations reported earlier except the spore size. Thind (1977), Lakhanpal (1981), mentioned the spore size 10-12.5 µm., where as present population it is 12-13.5 µm. in diam. Indian population differs from *D. cor-rubrum* Macbr. in lacking cartilaginous outer peridium and limy bars connecting the columella with the peridium (Sensu Thind 1977, Lakhanpal 1981).

*Diderma cor-rubrum* Macbr. can be marked by prominently pitted to wrinkled sporangia surface ; short stipe, simply a prolongation of the well developed hypothallus (both calcareous) ; double peridium ; large reddish brown clavate columella ; pale capillitium and dark, prominently verrucose, large spores. The outer peridium is with reddish brown patches on the inside, except for the characteristic paler-coloured or whitish reticulate lines, along which the sporangia dehisce later on.

*D. cor-rubrum* Macbr., is closely allied with *D. rugosum* (Rex) Macbr. are both species possess a reticulately ridged peridium. Former belongs to the subgenus *Diderma* Pers. and the latter to the subgenus *Leangium* Link.

**2. DIDERMA DEPLANATUM** Fr.

*Syst. Myc.,* 3, 110, 1929.


(PL. XV FIG. 47)

Fructification sporangiate, gregarious, sessile, sometimes short plasmodicarpous, porcelain white. Sporangia globose to slightly depressed globose,
hemispheric, 0.46 – 0.6 mm in diam; plasmodiocarps, small. Hypothallus distinct, white, limy; Peridium double, outer layer thick, smooth, egg shell-like, brittle, limy, lime granular; inner layer papery, distinct, faint brownish to brown, limy; dehiscence irregular form upper portion. Columella is distinct, large, limy, hemispheric or like shape of fruiting, contain rhomboidal lime crystals. Capillitium filamentous radiating from columella, stiff, faint brown, dichotomously branched and anastomosed, attached at both the ends, sometimes with spindle like dark brown swellings. Spore black in mass, violaceous brown under transmitted light, globose, 8 – 10 µm in diam., warded.

**COLLECTION EXAMINED :** RRT / 8077, Sept.-2003, Panhala, Dist.-Kolhapur.

On dry leaf of angiospermic plant.

**DISTRIBUTION : INDIA :** M. P. (Kharat, 2000); M. S. (Patil & Ranade, 1995; Rokade, 1989; Jadhav; 1994); T. N. (Indira, 1975); U. P. (Thind & Sohi, 1956; Thind & Sehgal, 1963).

Earlier reports from India (Thind, 1977), described the species with densely crowded sporangia so as to appearing pseudoaethalioid along with remote inner peridium and abundant capillitium. ‘An a typical’ forms accompanied with sporangiate from is reported by (Thind & Sehgal, 1963), from U. P.

The species is characterized by white, gregarious to crowded fructification varying from pulvinate sporangia to curved, anulate plasmodiocarp and columella represented by thickened raised base. *D. deplanatum* Fries, is close to *D. niveum* (Rost) Macbr. However, later possesses large columella and subplasmodiocarpous habit is rare. It is also close to *D. chondrioderma* (de Bary & Rost.) G. Lister, in fruiting but also differs in delicate capillitium and smaller spores.

3. **DIDERMA DONKII** Nann.-Brem.


(PL. XV FIG. 48)

Fructification sessile, sporangiate, often associated with few short plasmodiocarp, scattered, pale yellowish brown to white. Sporangia depressed, discoid, 0.4 – 0.6 mm in diam, concave above, pulvinate with dark brown shiny wrinkled base. Plasmodiocarps simple, depressed and concave above and wrinkled towards the dark brown base, 1.1 – 1.5 mm long, pale yellow or chalky white. Hypothallus distinct,
white, limy with granular lime. Peridium double; outer layer of granular lime, thick, brittle, pale yellow; inner layer thin, membranous, ash gray; dehiscence circumsessile, lower part persistent as a saucer shaped structure. Columella represented by raised base, rough, pale yellow, limy with granular lime. Capillitium abundant, filamentous, smooth, elastic, dichotomously branched anastomosed, with perforated membranous expansion at the dichotomy, small perforations towards the apices, hyaline throughout, tips are attached to peridium. Spore brown in mass, violaceous brown under transmitted light, globose, 7 – 11 µm in diam., warty, warts are in clusters and in lines.


DISTRIBUTION : INDIA : M. S.

The species is characterized by depressed pulvinate sporangia, associated with small simple plasmodiocarp with dark shiny brown peridium towards the base; capillitium with perforated membranous expansion at the diachotomy; small perforations towards apices conspicuously warted spores.

The population studied in the present work is similar to type description given by Nannenga-Bremekamp (1973). However, it differs in its depressed sporangia associated with small flat pulvinate plasmodiocarpous habit, dark shiny brown peridium towards base of the fruiting, capillitium with membranous expansion and conspicuous warted spores.

The species looks like D. spumaroide (Fries), but differs from it in mostly distinct peridial layers and in the shape and colour of sporangia. It differs from D. globosum in its shape and colour but similar in spore character. The species is being reported for the first time from Indian flora.

4. DIDERMA EFFUSUM (Schw.) Morgan


(PL. XVI FIG. 49)

Fructification primarily plasmodiocarpous mixed with few sessile sporangia, gregarious to scattered, chalky white or snow white. Plasmodiocarps short simple to branched, sometimes reticulate, few annulate, depressed or flattened dorsiventrally,
effused, spreading upto 10.6 – 12.3 mm in diam., strands 0.55 – 0.85 mm wide. Sporangia sessile, depressed globose to discoid, pulvinate, 0.51 – 0.76 mm in diam. Hypothallus inconspicuous, rarely beyond the colony, thin, white, limy. Peridium double, both layer remote, often closed; outer layer thick, white to snow white, smooth, egg shell-like, fragile, lime granular, granules 1.4 – 3.4 µm in diam.; inner layer thin, cinereous, membranous, transperant. Dehiscence irregular. Columella absent or represented by thickened, ochraceous to pale reddish limy base. Capillitium profuse, radiating from the base and attached to inner peridium, threads thin, delicate, hyaline, slender, branched and sparsely anastomosed, membranous expansions towards the base. Spores dark brown in mass, violaceous brown under transmitted light, globose, 8.0 – 11.0 µm in diam., minutely and uniformly warted, warts in faint clusters.


**DISTRIBUTION : INDIA**: A. P. (Agnihothrudu, 1956); Assam (Agnihothrudu, 1959); Delhi (Lakhanpal & Mukerji, 1981); H. P (Lakhanpal, 1973); M.S. (Patil & Ranade, 1974; Nanir et al., 1993); T. N. (Indira, 1968); U. P. (Thind & Sohi, 1956); W. B. (Bruhl & Gupta, 1927; Lodhi, 1934).

The species is marked by densely gregarious to crowded, effused, white fructification, frequently arranged in reticulate pattern in to large patches, peridium double, delicate hyaline capillitium and minutely verrucose spores. *D. effusum* (Schw.) Morgan, can be compared with *D. globosum* Pers. *D. hemisphaericum* (Bull.) Hernem, and *D. platycarpum* Nann.-Brem. In *D. globosum* Pers., capillitium is flexuous with irregular expansion near the base and conspicuous clavate columella. In *D. hemisphaericum* (Bull.) Hornem, sporangia are stipitate wrinkled and umbellicate below. In *D. platycarpum* Nann.-Brem., fruiting is typically plasmodiocarpous, broadly effused, branched or netted, and spores are warted and arranged in clusters.

Microscopically *D. effusum* Link and sessile from *D. hemisphaericum* (Bull.) Hernem, are very alike too ‘ in small and pale spores and slender capillitium which is more or less flexuous ‘. According to Nanneng-Bremekamp (1958) sessile from of *D. hemisphaericum* (Bull.) Hernem, and *D. effusum* (Schw.) Morgan can be separated on the basis of the size of lime granules. ‘ In *D. effusum* (Schw.) Morgan, granule size is
very small while in *D. hemisphericum* (Bull.) Hernem, size of the granules is up to 4 mm in diam.

5. **Diderma Farrianum** Nanir & Rokade sp. nov.  

*(PL. XVI FIG. 50)*

Fructification sessile sporangiate, compactly clustered laterally in to pseudoaethaloid structure, spreading 4.2 – 21.3 µm in diam., creamy white or pinkish white. Sporangia discoid flat, angular due to mutual compression often with central depression above and broad umbilicus below, surface smooth, 0.55 – 0.68 mm in diam., and 0.11 – 0.57 mm tall. Hypothallus distinct, common to a colony, confluent, branched, white or pinkish, limy strands extends upwards in the base of the sporangia. Peridium double; outer layer chalky or pinkish white, smooth, thick, tough layer of lime granules; inner layer thin, membranous, transperant, grayish white, iridescent, inner surface brown, shining, nonlimy; dehiscence circumsessile, separating the upper part, basal part persistent as a disc with brown base. Columella is raised thicked base of sporangium. Capillitium scanty to abundant, radiating from the base and attached to the inner peridium, filamentous, pale brown, hyaline towards the ends, dichotomously branched and anastomosed, with membranous expansion with perforations, filaments rough, marked with small warts, sometimes with dark swellings and rings. Spore black in mass, dark violet brown under transmitted light, globose, 18.0 – 20.8 µm in diam., apiculate, paler on one side, prominently spiny, spine straight, unequal in length, sometimes with compression ridges.


The present species is characterized by: (1) sporangia compactly aggregated laterally forming pseudoaethaloid structure. (2) Sporangia discoid on membranous stalk-like weak extension of reticulate hypothallus. (3) Columella is raised thicked base of sporangium. (4) Capillitium with membranous expansion at dichotomy. (5) Outer peridium smooth, tough, creamy pinkish white. (6) Spores large, 13-15 µm in diam., conspicuously spiny, spines upto 2-5 µm.

The species is quite distinct by itself. However, apparently it resembles with *D. effusum* (Schw.) Morgan, but later can be distinguished by pulvinate sporangia,
dark purple spore mass, minutely warded small spores (7-9 µm) with faint clusters of large warts.

6. **DIDERMA HEMISPHAERICUM** (Bull.) Hernem.

*Neus Mag. Bot.* 1, 13, 1829.


(PL. XVI FIG. 51)

Fructification stipitate sporangiate, chalky white, creamy white, pink white, scattered to gregarious, 0.55 – 1.5 mm tall. Sporangid discoid, flat with central dimple above, broadly umbilicate below, sometimes two sporangia are fused, 0.55 – 1.5 mm in diam. Stipe thick, stout, cylindrical, vertically rugose, ridges continue on lower surface of sporangium, base of stipe appears as fringe-like, calcareous, white or creamy, 0.34 – 1.1 mm long. Hypothallus rotate, small ventral, sometimes reticulate, thin, white, limy, contains rhomboidal lime crystals. Peridium double, outer layer of lime granules of 1 – 5.0 µm in diam., forming crust, white or pinkish, thick, fragile, smooth or rough; dehiscence irregularly in plasmodicarps and by circumsessile along the margin in the sporangiate form; inner layer cinereous, thin, delicate, membranous, dehiscence irregularly. Columella absent or represented by raised, white to pale brown, limy base. Capillitium profuse, attached to the peridium, thin, delicate, hyaline, slender, branched, sparsely anastomosed, with few cross bars, smooth, rarely with brown swellings. Spores deep brown to black in mass, violet brown under transmitted light, globose, 7.0 – 9.5 µm in diam., minutely warded, warts arranged in clusters.


Very typical and widely distributed species, easily recognized by its flat, discoid sporangia and circumsessile dehiscence of outer fragile limy layer of peridium. The plasmodiocarps are difficult to distinguish from *Diderma platycarpum* Nann.-Brem., and *D. effusum* (Schw.) Morgan. It is only possible to recognize on the basis of size of lime granules in the peridium (sensu Nann.-Brem.), In *D. hemisphaericum* (Schw.) Morgan, the size of lime granules are variable, whereas in the rest, the size is more or less uniform and another character is the thickness of the fruiting i.e. *D. platycarpum* Nann.-Brem. it is very thin without columella or any raised base.

*D. hemisphericum* (Schw.) Morgan, can be compared with *D. indicum* Thind & Sehgal. *D. hemisphericum* (Schw.) Morgan is characterised by strongly depressed, discoid, lenticular or orbicular, white sporangia, umbilicate below, seated on stout, rugose, white, calcareous, short stipe. *D. indicum* Thind & Sehgal, is marked by its heaped white fructification with violaceous or pinkish hue at the top; crustose, shell-like single peridium, the prominent and areolate columella; the violaceous capillitial threads prominently marked by fusoid swellings; and the globose or ovoid, irregular, inconspicuously verrucose spores.

7. **DIDERMA LOHOGADENSIS** Patil, Ranade & Mishra


(PL. XVII FIG. 52)

Fructification sporangiate, stipitate, scattered to gregarious, erect, reddish to chestnut brown to blackish brown, 1.1 – 2.0 mm tall. Sporangia infundibuliform, reddish brown to chestnut brown to blackish brown, 0.42 – 1.1 mm long, 1.1 – 1.4 mm in diam. Stipe thick, cylindrical, shining, broader at the base, stout, erect, rugose towards upperside, yellowish brown to whitish towards the base, reddish brown towards the apex, filled with white lime nodules, 0.85 – 1.3 mm long, 0.29 – 0.42 mm broad. Hypothallus rotate, white to ochraceous, shining with membranous strands. Peridium triple, outer thick, cartilaginous, limy, lime granular, smooth, brownish orange, adhered to middle layer; middle layer thick, whitish orange to whitish, rough, limy towards the periphery; inner layer thin, remote, membranous, grayish white with irregular red brown patches; sometimes outer two layers separate as a cup, inner layer persists. Capillitium abundant, filamentous, slender, branched, sparsely anastomosed,
rigid, brown, attached to the both ends, threads 1.3 – 2.7 µm in diam., filaments smooth, brown with expanded and perforated hyaline ends. Columella absent. Spore dark brown to black in mass, deep reddish brown to pinkish under transmitted light, globose to subglobose, 10 – 15 µm in diam., paler on one hemisphere, minutely and uniformly warded or spinulose, warts unequal in length, shorter at paler side, arranged in small lines.

**COLLECTION EXAMINED :** RRT/ 8002, 8029, 8051, 8078, Aut.-2003, Panhala, Dist.-Kolhapur. On dry leaves and twig of angiospermic plants.


It is very distinct species of the myxomycetes. The typical infundibuliform, chest-nut brown sporangia of this species can be detected even in the field. This alone is sufficient diagnostic feature to differentiate this species from the known species of *Diderma* Pers. Besides, other features of this species are-cartilaginous, triple peridium and large spores of (10 – 15 µm). In the type description the sporangia and spores are smaller (9.5 – 12 µm in diam.). The species can be characterized by its quite unique shape of sporangium. To date the species is known from the Maharashtra only.

8. **DIDERMA MUSSOORIENSE**  Thind & Manocha


( PL. XVII FIG. 53)

Fructification sporangiate, sessile, densely gregarious in colony. Sporangia dull whitish to whitish brown, wide mouthed cuplike, pateliform with preformed lid, 0.25 – 0.38 mm in total height and 0.42 – 0.68 mm in wide. Hypothallus, common to colony, sometimes extends beyond the colony, white, limy. Peridium double, two layers distinct towards the upper region and fused towards the base ; outer layer thick, white to fawn coloured, limy, forming smooth limy shell-like crust, lime granules 2-3 µm in diam. ; inner layer ash gray, inner surface purple brown to reddish brown, limeless, thin, membranous ; dehiscence circumsessile by preformed lid, lid white, flat, smooth, reflexed out after dehiscence, basal portion persistent as a cup. Columella hemispheric subglobose to clavate, small, less than half of the sporangial
cavity, white to pale reddish brown, rough, limy, filled with small rhomboidal lime crystals. Capillitium profuse, radiating from columella and attached to inner peridium and lid, filamentous, filaments stiff, slender, wavy, branched, anastomosed, with membranous cross bars towards the base appearing as perforations, sometimes with swellings, tips pointed, violaceous brown, paler at the both ends. Spores-mass dark brown to blackish, violaceous brown under transmitted light, globose, 9.5 – 11 µm in diam., minutely and uniformly warted, warts is small curved lines forming lax reticulation, with 2 – 3 compression ridges, papillate with very faint equatorial ridge.

**COLLECTION EXAMINED:** RRT / 8010, 8019, 8058, 8075, 8076, 8120, Sept.-2003, Panhala, Dist.-Kolhapur. On dry leaves of angiospermic plants.

**DISTRIBUTION : INDIA :** U. P. (Thind & Manocha, 1964) ; M. P. (Kharat, 2000) ; M. S. (Chimankar, 1993 ; Jadhav, 1994).

Very striking and distinct species marked by its peltiform sporangia with distinct lid separating as a whole, after dehiscence peridium persists as a shallow cup. As compared to the type description present population has small fruiting and larger spores.

**9. DIDERMA PLATYCARPUM** Nann.-Brem.


(PL. XVIII FIG. 54)

Fructification sessile, simple to branched plasmodiocarpous, white, scattered, associated with few sessile sporangia. Plasmodiocarps short or long, depressed, dorsoventrally flattened, reduced to discoid sporangiate form. Plasmodiocarps 1.2 – 11.9 mm long, 0.46 – 0.72 mm wide. Hypothallus inconspicuous, thin, white, limy. Peridium double, outer layer, white and more or less smooth, compact crust of lime granules of about 1.0 – 3.1 um in diameter, brittle, breaks irregularly leaving inner layer intact ; inner layer grayish white, thin, membranous ; dehiscence irregular. Columella absent. Capillitium profuse, radiating from the base, thin, delicate, more or less elastic, sparsely branched and anastomosing and with hyaline membranous expansion at the base, smooth, rarely with few spindle like swelling. Spores blackish brown in mass, pale violaceous brown under transmitted light, globose, 7.0 – 9 µm in diam., warted, with faint clusters of warts.

DISTRIBUTION: INDIA: Delhi (Lakhanpal & Mukherji, 1981); Gujrat (Salunkhe, 1995); M. S. (Nanir, 1978; Rokade, 1989; Chimankar, 1993; Jadhav, 1994); M. P. (Kharat, 2000).

*D. platycarpum* Nann.-Brem. is characterized by two close peridial layer, a grayish-white columella represented by merely the raised base of the sporangium and, prominently warted spores. The capillitium appears profusely branched and anastomosed due to overlapping of the threads in mounts.

*D. platycarpum* Nann.-Brem., can be compared with *D. effusum* (Schw.) Morgan. Later is marked by densely gregarious to crowded, effused, white primarily plasmodiocarp often arranged in a reticulate pattern into large patches; double peridium; light brown columella-like raised base of fructification; delicate hyaline capillitium and minutely, verrucose spores. There are also faint clusters of warts on the spores. Fructification are sometimes fused into a flat, expanded pseudoaethalium.

Nannenga-Bremekamp (1966), described var. platycarpum and var. berkeleyanum, former for the type and later for more reddish fruiting, having tubules which penetrate the plasmodiocarps as in case of *Didymium difforme* var. *rependum* G. Lister, and prominently warted smaller spores of 6-7 um in diam. The populations studied in the present work probably belongs to var. *berkeleyanum* Nann.-Brem. But differs from it in having larger spores and fruiting without tubules. On the contrarary var. *platycarpum* Nann.-Brem., has bigger and darker spores. In these characters the population seems to be between these two varieties.

10. **DIDERMA PUNENSIS** Patil, Ranade & Mishra


(PL. XVIII FIG. 55)

Fructification sporangiate, stipitate, gregarious, milky white, 0.7 – 1.00 mm tall. Sporangia globose, umbilicate above, slightly reflexed down, 0.5 – 0.65 mm wide. Stipe cylindric, erect, broader at the base, more or less smooth, slightly rugose, ochraceous white, base swollen, packed with ochraceous white lime granules, 0.45 – 0.7 mm long. Hypothallus rotate, membranous transperant, limeless, sprinkled with lime nodules. Peridium double, appearing single; outer limy layer smooth, egg-shell
like, with or without faint hexagonal line of dehiscence on upper region; inner layer thin, fused compactly. Dehiscence along the lines of dehiscence, upper portion cracks and flakes away showing irregular petalloid nature, persistent below as a disc. Columella small, hemispheric or pulvinate, smooth, ochraceous white, packed with nodular limes. Capillitium scanty, filamentous, delicate, hyaline or faint brown, rarely branched and anastomosed, with spindle like swellings. Spore-mass black, dark brown under transmitted light, almond shaped, 14 – 21 µm in diam., smooth, bipapillate, with two ridges placed at right angles.


**DISTRIBUTION : INDIA:** M. S. (Mishra & Ranade, 1979); M. P. (Kharat, 2000); M. S. (Rokade, 1989).

Mishra and Ranade (1979) described species with spore size 12.5 – 13.5 µm in diam.; spore are encircled by a ridges; peridium with hexagonal lines of dehiscence; capillitium abundant, dark brown; stipe white; and hypothallus inconspicuous. In the specimen studied in this work, spores are 13.8 – 20.8 µm diam., bipapillate, encircled by two ridges; hypothallus is conspicuous and rotate, capillitium scanty. These characters shows marked differences from the type description. However, it seems that type description seems to be incomplete as illustration of spores show encircling second ridges. It might have slipped during their observation. Colour shade of the stipe, capillitium and spores may be due to the environmental changes. In other major deciding characters, except spores size, populations studied is quite fit in the *D. punensis* Patil, Ranade & Mishra.

*D. punensis* Patil, Ranade & Mishra can be compared with *D. rugosum* (Rex) Macbr. However, later is marked by rugose, globose, white sporangia; dark subulate, rugose stipe; the peridium breaking into polyhedral fragments along the reticulate ridges at the time of dehiscence, large, clavate, rugose, whitish columella; and minutely verrucose spores.

11. **DIDERMA ROANENSE** (Rex) Macbr.

*N. Am. Slime-Moulds*, p. 104, 1899

(PL. XVIII FIG. 56)
Fructification sporangiate, short stipitate, subsessile to sessile, scattered to gregarious, stipitate sporangia 1.2 – 1.5 mm in total height. Sporangia globose to subglobose, umbilicate below, dark brown to reddish brown, areolate, 0.35 – 0.85 mm in diam. Stipe short, cylindric, dark brown, limeless, longitudinally rugose, shining, 0.63 – 0.85 mm long. Hypothallus rotate, small, concolorous with stipe. Peridium double, distinct, outer layer thick, cartilaginous, smooth, polished, marked by irregular pale lines of dehiscence, giving a characteristics mosaic appearance polished brown externally, white internally, remote from the inner layer, dehiscence by stellate lobes which spread radially or along the lines of dehiscence; inner layer membranous, cinerous, limy; Columella subglobose to hemispherical, occupying one-half of the sporangial cavity, calcareous, brown to cream coloured, rough. Capillitium abundant, delicate, purplish brown, slender, sparsely branched and anastomosed, flexuous, sometimes with small nodular thickening. Spore black in mass, purplish brown under transmitted light, globose, 8.5 – 11 µm in diam., minutely but distinctly verrucose.


**DISTRIBUTION:** INDIA: H. P. (Lakhanpal, 1974).

*D. roanense* (Rex) Macbr. is characterized by globose or subglobose, umbilicate sporangia; peridium double; outer layer cartilaginous is marked by paler lines of dehiscence; dehiscence stellate manner; columella globose to subglobose to hemispherical, brown to cream colour; capillitium consists of sparsely branched and anastomosed; spore minutely but distinctly verrucose.

The species was described for the first time from India by Lakhanpal (1974), collected from H. P. at or above an altitude of 2000 m. Present report is the second report of its kind from Indian flora. It is being described for the first time from Maharashtra. As compared to the earlier reported Indian population, the studied populations have smaller spores and taller fruitings.

12. **DIDERMA RUGOSUM** (Rex) Macbr.

*N. Am. Slime-Moulds*, 105. 1899.

Fructification sporangiate, stipitate, scattered to gregarious, white to cinereous, 0.7 – 1.1 mm tall. Sporangia globose to subglobose, hemispheric, centrally depressed, white or cinererous, 0.46 – 0.89 mm in diam. Stipe cylindric, erect or bent, broader at the base, longitudinally rugose, 0.3 – 0.7 mm long. Hypothallus inconspicuous, when present, it is as a narrow rim or small, membranous, brown disc. Peridium single, thick, white, cartilaginous, prominently and reticulately ridged or wrinkled, ridges marking the lines of dehiscence; dehiscence irregular, mostly along the peridial ridges in to polygonal fragment. Columella prominent, massive, clavate, subglobose, calcareous, white or pale ochraceous, wrinkled or rugose, nearly reaching the middle of the sporangial cavity. Capillitium abundant, delicate, slender, radiating from the columella and tips attached to the peridium sparingly branching and anastomosing, pinkish brown to yellowish brown, hyaline or paler at the apices. Spores black in mass, yellowish brown or violet brown under transmitted light, globose, 8.3 – 13.8 µm in diam., minutely verrucose.

**COLLECTION EXAMINED:** RRT / 8014, 8062, 8064, 8089, Aug.-2004, Pachagani, Dist.- Satara. On the bark of angiospermic tree.

**DISTRIBUTION:** INDIA: M. S. (Nanir, 1978); T. N. (Agnihothrudu, 1954); W. Bengal (Thind & Sehgal, 1958).

The species is characterized by rugose, globose, white sporangia; dark subulate, rugose stipe; the peridium breaking into polygonal fragments along the reticulate ridges of peridium; large, clavate, rugose, whitish columella and minutely verrucose spores. Apparantly it looks like *D. dargilingense* Thind & Sehgal. However later is quite different which, possesses pulvinate, sessile, bright brown sporangia having irregular dehiscence, peridium not breaking into platelets.

*D. rugosum* (Rex) Macbr. can be compared with *D. punensis* Patil, Ranade & Mishra. However, later is characterized by larger spores of 13.8 – 20.8 µm diam., which are bipapillate and, encircled by two ridges; hypothallus is conspicuous and rotate and capillitium is scanty.

13. **DIDERMA SUB-DICTYOSPERMUM** (Rost.) Lister


Fructification sessile sporangiate, crowded forming colony on a common hypothallus white to chalky white. Sporangia globose, subglobose to oval, on broad base, 1.4 – 1.5 x 0.85 – 1.3 mm in diam., laterally compressed due to mutual compression. Hypothallus profuse, extend beyond the colony, thick, wrinkled, white, limy. Peridium double, both layers compactly adhered; outer layer thick, white, limy, crustose, surface smooth, fragile, breaking into patches, lime granules 3 – 4 µm in diam; inner layer thin, membranous, hyaline, transparent, nonlimy; dehiscence irregularly, mostly from upper side, upper part fuscose, basal part persistent. Columella cylindric or clavate, reaching up to half of the sporangial cavity, white, limy. Capillitium abundant, filamentous, brown, flexuous, branching and anastomosing, often with dark swellings, pale at apices. Spore-mass blackish brown, deep violet brown under transmitted light, globose, 10 – 16.5 µm in diam., banded reticulate, reticulation incomplete, bands 2-3 µm in length.

**COLLECTION EXAMINED:** RRT / 8042, Sept.-2003, Panhala, Dist.-Kolhapur. On dry leaves of angiospermic plants.

**DISTRIBUTION : INDIA :** Gujrat (Salunkhe, 1995) ; H. P. (Thind and Lakhanpal, 1968 ; Lakhanpal, 1974) ; M. P. (Kharat, 2000) ; M. S. (Chimankar, 1993 ; Jadhav, 1994).

The species is characterized by white sporangia clustered on profusely developed white limy hypothallus, limy columella and larger (11 – 13 µm diam.) subreticulate spores.

The population studied in the present report have larger spore size as compared to Indian populations reported by Thind (1977). The species was known only from the H. P. It is being reported for the third time from the Maharashtra.

14. **DIDERMA TESTACEUM** (Schrad.) Pers.


**Fructification sporangiate, sessile, white, scattered. Sporangia discoid, flattened to pulvinate, umbilicate below, depressed in middle on upper sides, usually circular in outline, 0.38 – 0.76 diam. Hypothallus inconspicuous. Peridium double ;**

(PL. XIX FIG. 58)

(PL. XX FIG. 59)
outer layer of lime, smooth, porcelain-like, thick, easily falling away; inner layer, thin, membranous, rugose, pale brown; dehiscence irregular; columella – a raised convex orange brown base rough. Capillitium abundant, delicate, slender, sparsely branched, with few cross bars at the base, pale brown. Spore-mass black, violet brown under transmitted light, globose, 7.0 – 11.0 µm in diam., minutely warty.


**DISTRIBUTION**: INDIA: H. P. (Thind and Lakhanpal, 1965); Karnataka (Indira, 1968); M. S. (Patil & Ranade, 1974); M. P. (Kharat, 2000).

The species is characterized by discoid, flattened crowded sporangia, columella as raised orange brown base, and minutely warty spores.

*D. testaceum* (Schrad.) Pers. can be compared with *D. darjeelingense* Thind and Sehgal. Later possesses single peridium, and spores are larger, as globose to ovoid and distinctly verrucose.

**SUMMARY AND DISCUSSION**

The genus *Diderma* Pers., represented by about 75 species from the world. From India, the genus is represented by about 30 species. In the present work, the genus is studied with 14 species. All are collected for the first time from the region.

Of the described species, *D. niveum* (Rost.) Macbr. is an addition to the list of Indian myxomycetes and *D. donkii* Nann.-Brem. is being described from the second time from Indian flora. *D. alpium* Meylan, *D. radiatum* (L.) Morgan are the addition to the list of myxomycetes of Maharashtra and *D. globossum* Pers., *D. indicum* Thind and Sehgal, *D. rugosum* (Rex.) Macbr., are being described for the second time from Maharashtra.

The genus is differentiated from its allied genus *Didymium* Schrad., in its nature of peridial lime. It is granular in *Diderma* Pers. and crystalline in *Didymium* Schrad. The genus *Diderma* Pers., is recognized by its plainly two layered peridium; outer crustaceous or fragile and calcareous of granular lime. But this definition does not accommodate cartilaginous peridium of *Leangium* Link., In general *Leangium* Link., is treated as a synonym of *Diderma* Pers. However, due to distinctness *Leangium* Link., is treated as a subgenus of *Diderma* Pers.

There is no unanimity about the citation of type species. According to Martin and Alexopoulos (1969), Persoon erected the genus *Diderma* in 1794, and described
four species i.e. *D. contortum*, *D. defforme*, *D. floriforme*, and *D. globosum*. Of these, first one is of doubtful identity. Second is a *Didydium* Schrad. in the present sense. *D. floriforme*, must be the type of *Leangium* Link …… leaving only *D. globosum* as the type of *Diderma*. Hagelstein (1944), Martin (1949), Thind (1977), cited *Sphaerocarpus floriformis* Bull. (1791), [= *Diderma floriforme* (Bull) Pers. (1794)] as the type species. In support of his selection of type species, Thind (1977), stated that, 'Persoon erected the genus *Diderma* to stress the presence of two peridial walls in the species. This character continued to be the chief diagnostic feature of the genus…….'

It seems Persoon did not mention the type species. Both i.e. *D. floriforme* (Bull.) Pers. and *D. globosum* Pers. were described in his original publication of 1794. Former based on *Sphaerocarpus floriformis* Bull. (1791.). The genus *Leangium* Link., was erected in 1809 i.e. after the erection of *Diderma* Pers. The genus, *Leangium* Link., is cited as a synonym of *Diderma* Pers., in most of the Monographs (Hagelstein, 1944 ; Martin & Alexopoulos, 1969; Farr, 1976; Thind, 1977; Lakhanpal & Mukerji, 1981; Martin Alexopoulos & Farr, 1983). According to the Martin and Alexopoulos (1969), ' *Leangium* Link., was …. recognized as a genus and was later …..as subgenus for the species with cartilaginous peridium. As a genus, it is certainly as distinct from *Diderma* Pers…… as are *Leocarpus* Link and *Craterium* Trent. ….. ' Lakhanpal and Mukerji (1981), accepted *Leangium* Link., as a subgenus. To add a little to support the treatment of Lakhanpal and Mukerji (i.c.), the genera *Didymium* Schrad., *Lepidoderma* Bary and *Lepidodermopsis* Hohnel, are separated on single character only. If *Leangium* Link, is treated as a distinct genus, *Diderma* Pers. will be more homogenous. In that circumstances there will be no alternative for the type species other than the *Diderma globosum* Pers.
The genus *Didymium* Schrad., is characterized by the sporangia stipitate to sessile, or plasmodiocarpous. Peridium membranous, covered with usually stellate lime crystals, which are either loosely scattered or compacted to form a crust or smooth layer. Columella well developed or absent, or merely raised or thickened sporangial base. Capillitium branched and anastomosed, non-limy, with or without dark swellings. Spore-mass black.

The genus *Didymium* was erected by Schrader, in 1797. *Didymium farinaceum* Schrad., is accepted as the type species. Schrader, in his original publication described the genus with eight species. Of these *Didymium tigrinum* Schrad., is the type species of *Lepidoderma* de Bary (1877). *Didymium parietinum* Schrad., is an ascomycetes (Martin & Alexopoulos 1969). *Didymium floriforme* (Bull.) Schrad., *D. stellare* Schrad., *D. testaceum* Schrad., *D. candidum* Schrad., are synonyms of well defined species of *Diderma* Pers. (Hagelstein, 1944; Martin & Alexopoulos 1969; Farr, 1976; Thind, 1977; Lakhanpal & Mukerji, 1981). *Didymium complanatum* Schrad., is also belongs to *Diderma* Pers. (Martin & Alexopoulos, 1969). *Didymium farinaceum* Schrad., is the species having all the characters of the genus and thus represented as the type species.

Since the erection of the genus, several species were described and reported from different parts of the world by many workers e.g. Link (1815), Gary (1821), Fries (1818, 1829), Schweinritz (1832), Wallorth (1833), Robenhorst (1944), de Bary (1861), Berkeley & Broome (1850, 1873), Berkeley & Curtis (1868, 1873), Fuckel (1870, 1872), Rostafinski (1874), Peck (1879), Raunkiaer (1886), Massee (1873, 1889, 1892), Torrend (1908), Sturgis (1913, 1917), Jahn (1919), Buchet (1920), Macbride (1899, 1922), Meylan (1908, 1929, 1935), Yamashiro (1936), Martin & Brooks (1938), G. Lister (1923, 1925, 1931, 1943), Hagelstein (1927, 1944), Wedlen (1954), Martin, Thind & Rehill (1959), Martin, Lodhi & Khan (1961), Brooks & Kowalski (1966), Nannenga-Bremekamp (1958, 1968, 1972), Harkonen & Koponen (1978), Farr (1979), Farr, Eliasson & Dumont (1979), Ortega & Calonge (1979), Whitney (1979), Blackwell & Gilbertson (1980), Eliasson & Lundqvist (1980), Henney & Alexopoulos (1980), Whitney & Olive (1983), Nannenga-Bremekamp & Lado (1985), Keller, H. W., and J. D. Schoknecht. (1985), Nannenga-Bremekamp, N. E. &

Martin & Alexopoulos (1969), accepted and described 30 species and listed 38 species as 'excluded or doubtful' and also appended 12 species of the genus from the world. About 75 species of the genus, are mentioned in Ainsworth & Bisby's 'Dictionary of The Fungi' (2008).

From India the genus was reported for the first time by G. Lister (1924), described D. anellus, Morg. and D. nigripes (Link) Fr. var Xantopus (Ditm.) A. Lister, from West Bengal. (Later is treated as a synonym of D. iridis (Ditm Fr.). Later on, Bruhl & Gupta (1927), described one species from Orissa ; Lodhi (1934), described three species, one from Darjeeling and two from Mussoorie. Agnihothrudu (1956, 1959), reported five species from Assam and Karnataka. Thind et al (1956, 1958, 1959, 1963, 1964, 1968, 1969), in the series of papers, described sixteen species of the genus from east-west of Himalayas. Two species were described by Ghosh & Dutta (1962), from West Bengal. Singh & Pushpavathy (1965), reported three species from Delhi. Indira (1968, 1975), described nine species of the genus from Tamil Nadu. Lakhanpal (1973), Lakhanpal & Kowalski (1973), Lakhanpal & Mukerji (1976, 1978, 1979), studied the genus extensively and described seventeen species from H.P. and Delhi, of these seven species were new to science. Sekhon (1979), reported one species from Chandigarh.

Thind (1977), described the genus with sixteen species. Lakhanpal & Mukerji (1981), illustrated and described twenty seven species of the genus from India.

From Maharashtra state, the genus remained unreported until Nanir (1978), who described nine species for the first time from the region of the Marathwada, Rokade (1989) who described twenty species of the genus for the first time from the region of Jalgaon and Dhulia, Chimankar (1993) who described twenty species of the genus for the first time from the region of East Vidarbha and Jadhav (1994) who described twenty one species of the genus for the first time from the region of North Eastern ranges of Western Ghat. In the present work the genus is being described with fourteen species.
# KEY TO THE STUDIED SPECIES OF THE GENUS DIDYMIDUM

1. Fruiting plasmodiocarpus

1.  Fruiting sporangiate

2.  Columella absent. Fruiting annulate

2.  Columella present along with the length of fruiting plasmodiocarps compressed laterally

3.  Peridium double, when more than two sporangia covered in common peridium

3.  Peridium single

4.  Fruiting sessile

4.  Fruiting stipitate

5.  Sporangia discoid pulvinate, peridium crustose, spores papillate with compression ridges, often with equatorial ridge

5.  Sporangia globose, peridium corrugated, spores not so may be with compression ridges

6.  Columella absent

6.  Columella present

7.  Stipe, columella and peridium dark; columella pedicillate

7.  Not so above

8.  Stipe non-limy

8.  Stipe limy

9.  Stipe long subulate often nodding

9.  Stipe more or less cylindric

10.  Sporangia discoid lenticulate with upper umbilicus along with broad umbilicate below

10.  Sporangia globose with deep umbilicus below

11.  Peridium hyaline, columella ochor white about one-third of sporangial cavity. Capillitium profuse with occasional dark thickening and membranous expansion, stipe often longer than sporangial diam.

11.  Peridium ash grey, columella pale yellowish brown about half of the sporangial cavity capillitium scanty, delicate stipe almost equal to sporangial diam.

12.  Stipe weak, seems to be extension hypothallus

---

\[ D. \text{anellus.} \]

\[ D. \text{flexuosum.} \]

\[ D. \text{crustaceum.} \]

\[ D. \text{nigripes.} \]

\[ D. \text{clavus.} \]

\[ D. \text{muscorum.} \]

\[ D. \text{chrysosporum.} \]

\[ D. \text{minus.} \]
12. Stipe distinct and well defined

13. Spores papillate with compression ridges and often with equatorial ridge

14. Columella brown

15. Hypothallus scanty, peridium breaking into flakes, fruiting separate distinct

16. Spores with clusters of warts

17. Sporangial lime deposition corrugated, columella globose to subglobose or hemisphaeric, hypothallus conspicuous and venulose

18. Spores not as above, warts conspicuously, warts often in lines

19. Columella white or ochraceous

20. Hypothallus often branched, fruiting often coriombus group

21. Spores not with clusters of warts, warts may be in lines

22. Sporangial lime deposition not corrugated, columella discoid, hypothallus indistinct

1. **DIDYMIUM ANELLUS** Morgan


   (PL. XXI FIG. 60)

   Fructification white, whitish gray, plasmodicarpous mixed with few sessile sporangia, scattered. Plasmodiocarps short to long, simple or branched, annulate or flat, centrally depressed, 1.0 – 2.1 mm long 0.38 – 0.51 mm wide, 0.21 – 0.29 mm thick. Sporangia pulvinate, discoid, bowl like, depressed, 0.34 – 0.51 mm in diam. Hypothallus indistinct. Peridium thin, single, membranous, hyaline, covered with white, stellate, loosely or densely deposited lime crystals, iridescent when lime is scanty; dehiscence irregular or circumsessile along the margin, basal part persistent. Columella absent or represented by thickened, slightly raised base. Capillitium profuse, radiating from base and attached to peridium, thin, filamentous, slightly flexuous, branching and anastomosing, with many cross bars forming network.
towards periphery, marked with few calciform swellings, violaceous brown, paler at both the ends. Spore mass dark brown, violaceous brown under transmitted light, globose, 9.7 – 12.4 µm in diam., minutely and uniformly warded, warts in small clusters.


This species is characterized by the small, flattened or depressed sporangia and annulate plasmodiocarps, circumsessile dehiscence. The populations described in the present work possesses plasmodiocarps and are similar to Indian populations described earlier.

*D. anellus* Morgan, is close to *D. dubium* Rost. *D. anellus* Morgan is characterized by predominantly plasmodiocarpous, white or whitish grey sessile fructification on a constricted base, slightly elastic capillitium, smaller, lighter-coloured and minutely warded spores, columella absent or represented merely by the slightly raised brown base; besides its spores are slightly smaller. *D. dubium* Rost., is differentiated by sessile sporangiate to plasmodiocarpous, effused white fructification on a broad base; strongly elastic capillitium; strongly verrucose spores; prominent, convex, columella.

2. **DIDYMIUM CLAVUS** (Alb. & Schw.) Rab.  
(PL. XXI FIG. 61)  
Fructification sporangiate, stipitate, white, 0.68 – 0.97 mm in total height. Sporangia flat, discoid, umbilicate above, 0.3 – 0.55 mm in diam. lower umbilicus shallow and broad with brown to black, nonlimy, broad basal disc. Stipe short, stout, straight or bent, cylindric, broad at the base, tapering towards the apex, vertically rugose, merged in the basal disc in the form of veins, dark brown, opaque, incorporated with refuse matter, nonlimy, 0.38 – 0.80 mm long. Hypothallus rotate or discoid, dark brown or concolorous to stipe, smooth, thin, contain refuse matter,
nonlimy. Peridium single, thin, membranous, iridescent, pale brown, covered with densely clumped, stellate, white lime crystals; lime crystals remain attached to peridium after dehiscence; dehiscence irregular, upper part floccose and lower portion remains attached as thick basal disc. Columella absent or represented by thickened basal disc, contains rhomboidal lime crystals. Capillitium profuse, radiating from base and attached to the peridium, filamentous, thin, delicate, somewhat flexuous, pale brown, hyaline at both the ends, brached and anastomosed, with cross bars, surface rough. Spore black in mass, pale violaceous under transmitted light, globose, 5.5 – 8.3 um in diam., minutely warty, warts in clusters.

**COLLECTION EXAMINED:** RRT / 8301, 8294, 8224, Sept.-2003, Panhala, Dist.-Kolhapur. On dry leaf angiospermic plants.


It is very striking species, seems to be widely distributed. The species can be characterized by its discoid sporangia with upper umbilicus, nonlimy basal disc, short, thick, stout stipe, minutely warty spores with cluster of warts. *Didymium clavus* (Alb. & Schw.) Rab. is close to *D. dehlianum* Lakhanpal & Mukerji. However later is distinguished by its small globose sporangia, small prominent columella, bright violaceous capillitial threads and warty spores with distinct cluster of warts.

### 3. **DIDYMIUM CRUSTACEUM** Fr.

*Syst. Myc.* 3, 121, 1829.


(PL. XXI FIG. 62)

Fructifications sporangiate, on weak stalk or sessile, white, gregarious or in small groups, 2-3 sporangia may fuse to form pseudoplasmodiocarps with limy layer, 0.76 to 0.93 mm in height. Sporangia globose or much compressed from above, umbilicate below, surface rough, 0.46 to 1.1 mm in diam. Stipe when present small, weak, limy, white, rugose, lime crystals non-stellate. Hypothallus inconspicuous, branched in clustered sporangia. Peridium double; inner layer membranous, faint
yellow, covered by thick crust of stellate lime crystals forming smooth, fragile distinct outer layer. Dehiscence floccose, basal part persistent. Capillitium scanty, rigid, hyaline, wavy towards the tips, dichotomously branched and rarely anastomosed with spindle shaped dark swelling, often with web-like expansions at junctions. Columella small, somewhat discoid, limy, yellowish brown. Spore-mass black, brown under transmitted light, globose, 9.7 to 12.4 μm in diam., warty, warts in curved or straight lines.

**COLLECTION EXAMINED:** RRT/ 8529, July-2005, Malsiras, Dist.-Solapur. On dry leaf of angiospermic plants.


The species is easily distinguished when crust of crystalline lime is well developed covering a cluster of sporangia. In the absence of common limy layer, the diagnostic features of the species are peridium double, floccose inner layer, rigid capillitium with fusiform swellings, hypothallus strand like and weak stalk, and when outer crust falls away, sporangia appear grayish black, smaller, umbilicate below, surface rough, spores black in mass with warts in curved or straight lines.

_D. crustaceum_ Fr. is characterized by its fructification sporangiate on weak stalk or sessile, gregarious or small groups ; sporangia globose ; peridium double, faint yellow covered by thick crust of stellate lime crystals ; capillitium scanty ; spore warty. _D. crustaceum_ Fr. is compared with _D. dubium_ Rost. However _D. dubium_ Rost. is marked by fructification primarily plasmodiocarpus, solitary to closely gregarious ; sporangia pulvinate ; peridium single, purplish, covered by more or less covered with a floccose or compact or occasionally squamose, crust of minute stellate, rod-like or nodular lime crystals ; capillitium abundant ; spore densely verrucose.

4. **DIDYMIUM CHRYSOSPORUM** Lakhanpal & Mukerji


(PL. XXII FIG. 63)

Fructification sporangiate, stipitate, scattered, erect, rarely nodding, white, 1.2 – 1.5 mm tall. Sporangia globose, subglobose to hemispheric, 0.4 – 0.7 mm in
diam., umbilicate below. Stipe thick, stout, cylindric, broader at the base, vertically rugose, dark brown to yellowish brown, opaque, filled with refuse matter towards the base, reddish brown and translucent towards the apex, 0.68 – 0.89 mm long, nonlimy. Hypothallus small, rotate, thin, membranous, dark brown, smooth, nonlimy. Peridium single, thin, membranous, hyaline, covered with white stellate lime crystals; dehiscence irregular, upper part floccose, basal part persistent. Columella globose or hemispheric, less than half of the sporangial cavity, white or ochraceous, limy, filled with small rhomboidal lime crystals. Capillitium abundant, radiating from columella and attached to the peridium, filamentous, tubular, branched and anastomosing, with dark spherical or fusiform thickenings, brown, paler at both the ends. Spores dark brown to black in mass, violaceous brown under transmitted light, globose, 8.3 – 9.7 µm in diam., minutely warted, warts in clusters.

**COLLECTION EXAMINED:** RRT / 8256, Sept.-2004, Radhanagari, Dist.- Kolhapur. On dry angiospermic leaf.

**DISTRIBUTION : INDIA** : Delhi (Lakhanpal & Mukerji, 1978) ; Gujrat (Salunkhe, 1995) ; M. P. (Kharat, 2000) ; M. S. (Rokade, 1989 ; Chimankar, 1993 ; Jadhav, 1994).

The distinguishing features of the species are: (1) Peridium is hyaline and floccose (2) Columella is well developed and (3) Prominently warted spores with distinct clusters of warts. The species can be compared with *D. lenticulare* Thind and Lakhanpal for its hyaline peridium and prominently warted spores, but it differs from latter in having smaller stipe, smaller spores and well developed columella.

**5. DIDYMIUM FLEXUOSUM** Yamashiro


**(PL. XXII FIG. 64)**

Fructification plasmodiocarpous, intermixed with sessile sporangia, scattered to gregarious, cinerious white to grayish white. Plasmodiocarps simple to branched, laterally compressed, 3.7 – 4.2 mm long, 0.25 – 0.29 mm thick, 0.4 – 0.8 mm in height. Sporangia globose, obovate, dome shaped, baciliform, vermiform, on restricted base, allantoid, 0.38 – 0.51 mm in diam. Hypothallus profuse, massive below the fruiting, reticulate, heavily deposited with large rhomboidal lime crystals.
Peridium single, thin, membranous, pale brown, transparent, iridescent, areolate, densely covered with stellate lime crystals forming distinct scaly layer; dehiscence irregular or longitudinal from above. Columella long, wall like, running along the whole length of plasmodiocarp, pale brown to white, limy, contains rhomboidal lime crystals. Capillitium abundant, arising from columella and attached to the peridium, branched and anastomosed; threads slender, tubular, pinkish brown, darker at junction, with brown globular, or fusiform swellings, few calciform swellings, tips paler or hyaline attached to spore like vesicles bearing broken reticulation. Spore black in mass, violaceous brown under transmitted light, globose to subglobose, 12.4 – 16.6 µm in diam., coarsely warty, warts long spine like, upto 1.5 µm long, forming complete or incomplete reticulation.


**DISTRIBUTION**: INDIA: Gujrat (Salunkhe, 1995); H. P. (Lakhanpal, 1973); T. N. (Indira, 1975).

*D. flexuosum* Yamashiro, is characterized by laterally compressed plasmodiocarpous fruiting; long wall like, limy columella; dense capillitium; globose, subreticulate spores of 12 – 16.0 µm in diam., intermixed with spores like vesicles bearing broken reticulation.

It can be compared with *D. serpula* Fries, both show plasmodiocarpous habit and spore like vesicles attached with capillitium. However, *D. serpula* can be differentiated from the former by the absence of columella and smaller, minutely warted spores without reticulation. In fruiting and spore character *D. flexuosum* Yamashiro, is close to *D. tubi-crystallinum* Nann.-Brem. & Critchfield. However, later is distinguished by the presence of angular lime crystals (not stellate) on peridium, and capillitium with large swellings filled with crystalline lime agglomerations.

---

6. **DIDYMIUM FLOCCOSUM** Martin, Thind & Rehill


(PL. XXII FIG. 65)
Fructification sporangiate, stipitate, scattered, white, 0.63 – 1.2 mm in total height. Sporangia globose, slightly depressed above, 0.3 – 0.6 mm in diam., narrow umbilicus below. Stipe thick, stout, erect, cylindric, broader at the base, tapering towards the apex, shining smooth, orange or ochraceous brown, packed with rhomboidal lime crystals, opaque, 0.38 – 0.85 mm long. Hypothallus concolorous to stipe, rotate or discoid, smooth, nonlimy, contains refuse matter. Peridium single, thick, membranous, dark brown or orange, wrinkled, forming a reticulation of paler lines, covered over with white stellate lime crystals which remains attached to peridial flake after dehiscence which are dark brown on inner surface; dehiscence along the ridges, breaking the peridium into plates, upper part floccose, basal portion persistent as a collar or small irregular cup. Columella large, globose, clavate, or top shaped, dark brown, rough, limy, filled with lime nodules. Capillitium profuse, radiating from columella and attached to peridium, filamentous, brown, paler at extremeties, thin, more or less flexuous, dichotomously branched and anastomosing with cross bars and bearing nodular, elongated and cup-like dark swellings. Spore black in mass, violaceous brown under transmitted light, globose, 9.7–12.4 µm in diam., strongly warty or verrucose, warts often arranged in clusters and lines forming lax reticulation. COLLECTION EXAMINED: RRT / 8053, 8237, 8258, 8262, 8267, 8268, 8280, 8283, 8284, 8285, 8287, 8004, Sept.-2003, Pnhala, Dist.- Kolhapur; 8599, Aug.-2005, Sukrachari, Dist.-Sangli. On dry leaves of angiospermic plant.


The species can be distinguished by its umbilicate, white sporangia, yellowish or yellowish brown limy stipe, prominent rough, dark, limy columella, floccose peridium breaking into flakes and verrucose, subreticulate spores.

*D. floccosum* Martin, Thind & Rehill, resembles with *D. intermedium* Schroet, but in latter sporangia are borne on common stalk in the form of corymbose cluster on limy venulose hypothallus. *D. floccosum* Martin, Thind & Rehill appears like *D. leoninum* Berk. & Br. (= *Lepidodermopsis leonina*). However cartilaginous peridium is quite distinct in later.
7. **DIDYMIUM INTERMEDIUM** Schroet


(PL. XXIII FIG. 66)

Fructification sporangiate, stipitate, scattered, 0.8 – 1.3 mm tall. Sporangia globose, subglobose or depressed globose, umbilicate below, white or grayish white, 0.34 – 0.55 mm in diam. Stipe long, erect, pale brown, opaque, thick, cylindric, contain rhomboidal lime crystals, sometimes externally sprinkled lime, thicker towards lower portion, often breaks at the point where it is thicker and limy shining nodules are exposed, 0.68 – 1.0 mm long. Hypothallus distinct, often common to more than one sporangia, rotate, blackish brown, membranous, nonlimy or limy. Peridium single, thin, membranous, transperant, colourless or pale brown, white lime crystals dusted or agglutinated; dehiscence irregular, upper part floccose, lower part persistent. Capillitium abundant, somewhat elastic, slender, filaments dichotomously branched and anastomosed, faint brown, often brown membranous expansions between dichotomy and the bases are present, often with dark swellings, sometimes granular outgrowth towards the lower part cross bars at the bases, ends paler. Columella hemispheric, discoid, white or yellowish brown, in fused sporangia deformed or plate like, yellowish or creamy, contain rhomboidal lime crystals. Spore-mass black, blackish brown under transmitted light, globose, 9.7 – 13.8 µm in diam., prominently warted or spiny, spines long on one side, often in lines, sometimes papillate with faint equitorial ridge.


**DISTRIBUTION:** **INDIA**: Gujrat (Salunkhe, 1995); Delhi (Lakhanpal & Mukerji, 1978); M. P. (Kharat, 2000); M. S. (Rokade, 1989; Jadhav, 1994); T. N. (Indira, 1968).

The species is said to be rare (Martin & Alexopoulos, 1969, Farr, 1976). From India it was reported in culture (Indira, 1968). The species is marked by its umbilicate, somewhat lobed sporangia with the tendency of forming clusters on common hypothallus which is often branched, stellate lime crystals on the peridium and non-stellate lime in the stalk. The population studied possess somewhat larger
sporangia as compared to the Indian population observed by Lakhanpal & Mukerji (1981).

Didymium intermedium Schroet, can be compared with D. fluccosum Martin, Thind and Rehill. However D. fluccosum Martin, Thind and Rehill, the dark ochraceous, calcareous stipes; the rather small, very dark, strongly verrucose spores with the suggestion of a partial reticulation due to the lines of closely spaced warts and the arrangements of the crystals on the peridium in small clusters tending to break away as small flakes in dehiscence are the chief diagnostic characters of D. fluccosum.

8. DIDYMIIUM MINUS (Lister) Morgan


(PL. XXIII FIG. 67)

Fructification sporangiate, stipitate, scattered, white to grayish white, 0.51 – 1.4 mm tall. Sporangia depressed globose with deep umbilicus below, 0.25 – 0.85 mm long, 0.38 – 0.42 mm in diam. Stipe, cylindric, broader at base and narrow towards the apex, vertically rugose, yellow brown, darker toward the lower side, opaque, filled with refuse matter, nonlimy, 0.29 to 0.63 mm long. Hypothallus concolorous to base of the stipe, rotate, sometimes branched, contains refuse matter, nonlimy, sometimes sprinkled with lime crystals. Peridium single, thin, membranous, pale yellowish brown, densely covered by white, stellate lime crystals, forming rough crust; dehiscence irregular, upper part floccose, basal portion persistent. Columella globose to depressed globose, white to ochraceous, rough, contains white lime crystals. Capillitium radiating from columella and attached to the peridium, abundant, filamentous, pale brown or violaceous brown, paler at both the ends, branched and anastomosed, marked with few spherical or elongated calciform vesicles and dark thickenings. Spore-mass dark brown, violaceous brown under transmitted light, globose, 6.9 – 9.7 µm in diam., minutely warted, warts in small lines and clusters.


DISTRIBUTION: INDIA: Delhi (Lakhanpal & Mukerji, 1981); Gujrat (Salunkhe, 1994); M. S. (Nanir, 1978, Rokade, 1989; Chimankar, 1993; Jadhav, 1994); Orissa
D. minus (Liste) Morgan, is characterized by depressed-globose, white sporangia, umbilicate below, dark limeless stipe, prominent ochraceous hemispheric columella and distinctly verrucose spores, 7.0 – 10 µm in diameter.

The species is very close to D. melanosporum (Pers.) Macbr., and often was treated as a variety of it (Hagelstein, 1944). From later it is distinguished by its smaller sporangia, slender capillitium, paler and smaller spores. It is close to D. nigripes (Link) Fr., from which it is differentiated by deeply umbilicate sporangia with slender and opaque stipe and columella. Indian population reported earlier possess slightly smaller fruitings. Spores size described by Indira (1968), is too small for the species. Population studied in the present work has slightly smaller fruiting and spores.

9. DIDYMIUM MUSCORUM  Lakhan. & Mukerji


( PL. XXIII FIG. 68)

Fructification sporangiate, short stipitate to sessile, white, scattered, gregarious to clusters, sometimes more than two sporangia fused together. Sporangia globose to subglobose, deeply and narrow umbilicate below, 0.34 – 0.42 mm tall, 0.29 – 0.80 mm in diam. Stipe when present, short, completely embedded in the umbilicus of sporangium, weak, slender, vertically rugose, white to yellowish white, dusted with rhomboidal lime crystals. Hypothallus rotate, thin, white, smooth or venulose, limy with rhomboidal lime deposition. Peridium single, thin, membranous, hyaline, densely covered with white, stellate lime crystals forming thick, corrugated crust ; dehiscence irregular, upper half floccose, basal half persistent as a irregular, small shallow cup. Columella globose to, hemispheric or discoid, white or pale yellowish, less than half of the sporangial cavity, limy, filled with rhomboidal lime crystals. Capillitium radiating from columella and attached to peridium, abundant, filamentous, thin, hyaline or pale brownish then paler at both the ends, dichotomously branched, sparsely anastomosed, with membranous expansions near dichotomy, threads bearing elongated or spindle shaped calciform vesicles as well as some dark spherical or
spindle like thickening, rarely with dark rings. Spore black in mass, deep violaceous brown under transmitted light, globose, 9.7 – 12.4 µm in diam., strongly warted, warts in small lines and clusters.


*D. muscorum* Lakhan. & Muker., is close to *D. karstensii* Nann.-Brem., and *D. squamulosum* (Alb. & Schw.) Fr. *D. karstensii* is differentiated by its double layer of peridium, prominently warted spores with one or more equatorial and compression ridges forming lax reticulation. *D. squamulosum* (Alb. & Schw.) Fries, possesses minutely warted spores of 8 – 11 µm in diam., hyaline or pallid capillitium and conspicuous venulose white hypothallus. *D. muscorum* Lakhan. & Mukerji, is characterized by its violet brown spores of 11 – 12.5 µm in diam., strongly warted forming prominent clusters and lines of warts, well developed columella ; peridium single, limy, corrugated and stipe if present short, weak, prominently rugose, limy, embeded in the deep umbilicus of sporangium.

10. **DIDYMIUM NIGRIPES** (Link) Fries


**(PL. XXIV FIG. 69)**

Fructification sporangiate, stipitate, scattered, white, 0.8 – 1.1 mm tall. Sporangia globose, subglobose, with narrow and deep umbilicus below, 0.3 – 0.5, mm in diam. Stipe short, cylindric, broader at the base, longitudinally rugose, dark brown to blackish brown, opaque, contains refuse matter, nonlimy, 0.50 – 0.85 mm long. Hypothallus rotate conspicuous, dark brown to blackish brown , venulose, thin, nonlimy. Peridium single, thin, membranous, dark brown, covered with white lime crystals which remained attached to the peridium ; dehiscence irregular, upper part floccose, basal part persistent. Columella globose, obovate or clavate, with short neck, dark brown to black brown, limy, reaching upto centre of the sporangial cavity. Capillitium radiating from columella, filamentous, slightly flexuous, branched and
anastomosed, dark brown, paler at both the ends with fusaroid or spherical swellings and cross bars near dichotomy. Spores black in mass, reddish brown under transmitted light, globose, 7.0 – 8.5 µm in diam., warded, warts in faint clusters and small lines.


**DISTRIBUTION : INDIA :** Assam (Agnihothrudu, 1959) ; Delhi (Singh & Pushpavathy, 1965) ; Gujrat (Salunkhe, 1995) ; H. P. (Lakhanpal & Mukerji, 1981) ; Karnataka (Indira, 1968) ; M. P. (Kharat, 2000) ; M. S. (Nanir, 1978 ; Rokade, 1989 ; Chimankar, 1993 ; Jadhav, 1994) ; T. N. (Agnihothrudu, 1956) ; U. P. (Thind & Sohi, 1956) ; W. B. (Lodhi, 1934) ; (Lister, 1924 ; described var. *xanthopus* (Ditm.) Lister, from W. B., is now treated as distinct species, *Didymium iridis* (Ditm.) Fr.).

*D. nigripes* (Link) Friesis distinguished by its dark stipe, columella and peridium, minutely warted spores with clusters of warts. The population studied is smaller in size.

*D. nigripes* (Link.) Fries its diagnosed by its white, globose sporangia umbilicate below, dark peridium ; dark, long stipe, dark prominent columella and minutely verrucose spores, 7 – 10 µm in diameter. It is close to *D. minus* (Lister) Morgan, but differs from it in having globose sporangia, only slightly umbilicate below, and much longer stipe which is light-coloured and translucent above and darker columella. The spore characters are similar in both the species. The peridium, likewise, is similar in both.

11. **DIDYMIUM SIMLENSIS** Lakhan. & Muker.


*(PL. XXIV FIG. 70)*

Fructification sporangiate, stipitate, scattered to gregarious, grayish white, 0.5 to 0.8 mm tall. Sporangia globose, hemispheric to depressed globose, umbilicate below, 0.4 to 0.5 mm in diam. Stipe long, cylindrical, thick, broader at the base, narrow above, filled with rhomboidal lime crystals, yellowish white, 0.4 to 0.6 mm long, vertically rugose. Hypothallus rotate, milky white, venulose, limy. Peridium single, membranous, hyaline, covered with stellate lime crystals ; dehiscence
irregular, upper part floccose, persistent below as a disc. Columella prominent, discoid to hemispheric, orange, rough, contain rhomboidal lime crystals. Capillitium profuse, radiating from columella, dichotomously branched, anastomosed, threads flexuous, with few brown thickenings, pale violaceous brown to subhyaline, tips paler. Spore-mass black, violaceous brown under transmitted light, globose, 8.3 to 11.1 µm in diam., prominently warty, warts in lines forming subreticulations.


The species is characterized by hemispheric to depressed globose sporangia ; stipe cylindric, thick ; hypothallus venulose ; peridium single ; columella prominent, discoid ; capillitium threads flexuous, tips paler ; spores prominently warty, warts in lines forming subreticulations.

The species is closely related to *D. intermedium* Schroet., in having lime duplex in peridium and stalk, strongly warty, subreticulate spores. However distinguished from it by the presence of white, limy, rotate, hypothallus, scattered sporangia and flattened well developed columella. It is also close to *D. squamulosum* (Alb. & Schw.) Fr., but differs it in having duplex lime, smaller columella and strongly warty, subreticulate spores.

12. **DIDYMIUM SQUAMULOSUM** (Alb. & Schw.) Fries


(PL. XXIV FIG. 71)

Fructification sporangiate, stipitate, scattered to gregarious, white to grayish white, 0.38 – 1.1 mm tall. Sporangia globose, subglobose to hemispheric, deeply umbilicate below, 0.25 – 0.6 mm in diam. Stipe white to creamy white, cylindric, erect, vertically rugose, often lime externally, 0.25 – 0.85 mm long. Hypothallus small, rotate, thin, white, limy, venulose sometimes. Peridium single, thin, membranous, hyaline, iridescent, covered with white stellate lime crystals agglutinated to form thick corrugated layer ; dehiscence irregular, upper part floccose, basal part remain persistent. Columella globose, hemispheric, flattened, discoid, white
to brownish, limy, filled with rhomboidal lime crystals, reaching up to the centre of the sporangial cavity. Capillitium abundant, radiating from columella and attached to peridium, thin, delicate, filamentous, dichotomously branched and anastomosed, violaceous brown, paler at both the ends, marked with some calciform hyaline vesicles and dark spherical or elongated swellings along with few membranous expansions at dichotomy. Spore mass black, deep violaceous brown under transmitted light, globose, 7 – 10 µm in diam., strongly warted or verrucose, warts in clusters and lines.


The species is characterized by depressed globose, white, umbilicate, sporangia; short, stout, rugose, limy stipe; small, rotate, venulose, limy hypothallus; globose or hemispheric columella; and verrucose spores. D. squamulosum (Alb. & Schw.) Fries is closely allied to D. intermedium Schroet, which, however, possesses a prominent, branching hypothallus, giving rise to clusters of sporangia, two types of crystals, and spiny, subreticulate spores. It is also close to D. muscorum Lakhan. and Mukerji is differentiated in its rotate, thin, smooth or venulose hypothallus; sometimes more than two sporangia fused together; stipe vertically rugose; peridium stellate lime crystals forming thick corrugated crust; capillitium hyaline or pale brown; columella globose to hemispheric; spores strongly warted, warts in small lines and clusters and D. thindii Rokade & Nanir, sp. nov. is distinguished by its hypothallus rotate, venulose or smooth when isolated, branched, stranded and raised between sporangia; scattered sporangia; stipe longitudinally rugose; peridium with lime crystals deposited forming uniform rough surface layer; capillitium dar brown;
13. **DIDYMIUM THINDII** Nanir & Rokade sp. nov.  

*(PL. XXV FIG. 72)*

Sporangia short stipitate to subsessile appearing almost sessile, scattered to gregarious, 0.35 – 0.6 mm in total height, white to grayish white, depressed globose, 0.4 – 0.45 mm in diam., deeply umbilicate below, often upper surface flat with depression above. Stipe when present small, weak, erect, or slanting, hallow longitudinally rugose, often embedded in the umbilicus, dusted with lime crystals, white or yellowish white, not distinct from hypothallus, appearing as an extension of hypothallus when later is branched and stranded. Hypothallus rotate, venulose or smooth when isolated, branched, stranded and raised between sporangia, limy. Peridium single, floccose towards upper half, lower portion persistent, thin, membranous, transperant, faint brown to colourless, lime deposited crystals forming rough surface layer. Capillitium abundant, radiating from columella and attached to peridium, filamentous, dichotomously branched and sparsely anastomosed, somewhat flexible, dark brown, tips expanded like funnel, base flattened, membranous or cross bars towards first dichotomy, bud like outgrowth on the entire surface are frequent, vesicular swellings of different shapes with or without inclusion of lime are often present towards the lower region. Columella prominent, flat, discoid, white to turbid or yellowish white, enclosing, rhomboidal lime crystals. Spore mass black, pinkish brown under transmitted light, globose to subglobose, 8.3 – 11.1 µm in diam., often with papillae, warded, warts unequal in length, sparsely and unevenly distributed forming clusters and line of warts.

**COLLECTION EXAMINED:** RRT / 8238, Sept.-2003, Panhala, Dist.-Kolhapur.

On dry angiospermic leaves.

**DISTRIBUTION : INDIA :** M. S. (Rokade, 1989 ; Jadhave, 1995).

*D. thindii* Rokade and Nanir, sp. nov., is distinguished by : 1) depressed globose or discoid sporangia with upper depression, narrow stipe and deep umbilicus below, 2) lighter, more or less rugose weak short stipe, embedded in narrow umbilicus, 3) discoid and lighter columella contain rhomboidal lime crystals, 4) capillitium with cross bars at the bases and tips flattened, 5) peridium floccose...
towards the upper half, 6) spores often papillate, 10-13 µm in diam., prominently warted with clusters and lines of warts.

*Didymium thindii* Rokade and Nanir, sp. nov. is close to *D. floccosum* Martin, Thind & Rehill, in the nature of floccose peridium, limy stipe, indistinct hypothallus and spore marks, but differentiated by its shorter fruiting and smaller sporangia, lighter stipe and columella, larger spores. The species also shows some resemblances with *D. squamulosum* (Alb. & Schw.) Fr., *D. muscorum* Lakhan. & Muker and *D. simlensis* Lakhan. & Muker. From *D. sqamulosum* (Alb. & Schw.) Fries, *D. thindii* Rokade and Nanir, sp. nov. is differentiated in its smaller and week stipe, lime deposition on peridium, half floccose peridium, swellings of capillitium threads, lime in columella and larger spores. *D. muscorum* Lakhan. & Muker is differentiated by its frequent sessile habit, globose sporangia, corrugated lime deposition, iridescent peridium, truncate or clavate columella. *D. simlensis* Lakhan. & Muker. is segregated in its slightly umbilicate sporangia, columella as a thickened sporangial base, smaller spores, stout and narrow stipe.

14. **DIDYMIUM VERRUCOSPORUM** Welden


(PL. XXV FIG. 73)

Fructification sporangiate, stipitate, scattered to gregarious, nodding, white to grayish white, 0.76 – 1.5 mm tall. Sporangia globose, subglobose to hemispheric, with narrow umbilicus below 0.34 – 0.80 mm in diam. Stipe long, subulate, mostly nodding, vertically rugose, dark brown at the base, reddish brown or orange brown, transperant towards the apex, nonlimy, broader at the base, narrow towards the apex, 0.55 – 1.1 mm long. Hypothallus rotate, dark brown, thin membranous, nonlimy, may contain refuse matter. Peridium single, thin, membranous, hyaline, densely covered with white stellate lime crystals, forming compact rough crust; dehiscence irregular, upper part floccose, basal part persistent. Columella globose or hemispheric, white, limy, filled with rhomboidal lime nodules, reaching near the centre of the sporangial cavity. Capillitium radiating from columella and attached to the peridium, thin, delicate, filamentous, yellowish brown, hyaline at both the ends, dichotomously branched and anastomosed, frequently bears dark nodular and elongated thickenings.
Spore black in mass, violaceous brown under transmitted light, globose, 6.9 – 9.7 \( \mu \text{m} \) in diam., prominently warted, warts in clusters and lines.


**DISTRIBUTION:** INDIA : Delhi & H. P. (Lakhanpal, 1973) ; M. P. (Kharat, 2000); Gujrat (Salunkhe, 1995) ; M. S. (Nanir, 1978) ; Rokade, 1989 ; Chimankar, 1993 ; Jadhav, 1994).

*D. verrucosporum* Welden is the member of *D. nigripes* (Link) Fries complex. It is differentiated in its pure white columella and delicate colourless peridium. From *D. iridis* (Ditm.) Fr. it is marked by darker and strongly warted spores with cluster and lines of warts. The species can be characterized by its nodding sporangia, long, slender subulate stipe, darker towards the base, yellow brown or violaceous capillitium bearing swellings and distinctly warted spores with clusters and lines of warts. Lakhanpal (1973) described the species for the first time from India, in which he did not mention the lines of warts on spore.

**SUMMARY AND DISCUSSION**

In the present work, the genus, *Didymium* Schrad., is studied with fourteen species. However, *D. chrysospermum* Lakhan. & Muker. *D. dehlianum* Lakhan. & Muker. and *D. muscorum* Lakhan. & Muker. are collected for the fifth time since their erection of the species. Where as *D. difforme* (Pers.) Gray., *D. verrucosporum* Welden, *D. flexuosum* Yamashir, *D. vaccinum* (Dir. & Mont.) Buchet, *D. intermedium* Schroet., are being collected for the fourth time from Indian flora. The genus *Didymium* Schrad., is one of the largest genus of the Myxomycetes represented by well defined about 75 species from the world. In the current concept, *Didymium* Schrad., is distinguished from its allied genera, *Diderma* Pers., *Lepidodermopsis* Hohnel, and *Lepidoderma* de Bary, in the nature of lime and peridium. In *Didymium* Schrad., the lime depotsition is crystalline and peridium membranous. In *Diderma* Pers., lime is granular, Peridium may be membranous or cartilaginous (in subgenus Leangium). The genus *Lepidodermopsis* Hohnel, which is generally treated as a
subgenus of *Didymium* Schrad., has crystalline lime and cartilaginous peridium marked by lines of dehiscence. Where as the peridium in the genus *Lepidoderma* de Bary, may be cartilaginous, subcartilaginous or membranous, but covered by crystalline lime scales.

Farr (1974,1976), described the validity of *Lepidodermopsis* Hohnel and suggested that there is a meager cause for treating the subgenus *Lepidodermopsis* Hohnel. However Lakhanpal (1978), gave more stress cartilaginous nature of peridium and amended *Lepidodermopsis* Hohnel as a distinct genus from *Didymium* Schrad. Farr (1982), while discussing the validity of the genus *Squamuloderma* Kowal., she has not accepted the genus *Squamuloderma* Kowal., and merged it with *Didymium* and recommended that even *Lepidoderma* de Bary, should be united with *Didymium*. It is felt that diagnostic features are quite distinct to maintain *Squamuloderma* Kowal., *Lepidoderma* de Bary, *Lepidodermopsis* Hohnel, and *Didymium* Schrad., as distinct taxa, as 'Badhamia-Physarum'. group is maintained with 'physaroid' or 'Badhamoid' capillitium respectively. Similarly segregation of taxa in Triachiales are on single distinct and constant character only.

Nannenga-Bremkamp (1972), while delimiting the stipitate species of *Didymium* Schrad., concluded that *D. pertusa* Berm, is a distinct species. It had been treated as a synonym of *D. iridis* (Ditm.) Fr., and *D. nigripes* variety *Xantopus* A. Lister, by earlier worker. She also separated *D. microsporum* Rost. from *D. squamulosum* (Alb. & Schw.) Rost. *D. eximium* Peck., had been treated as a variety of *D. nigripes* by G. Lister (1925) ; and as a synonym of *D. megalosporum* Burk. & Curt. by Martin & Alexopoulos (1969), Thind (1977), Farr (1976), Lakhanpal & Mukerji (1981), It was treated as a distinct species by Hagelstein (1944).

Among all species of ' *Didymium nigripes* complex ' and ' *Squamulosum* complex ' have become most difficult for the segregation of the species from their respective complexes. Gaitner and Collins (1984), examined different isolates of *D. iridis* (Ditmar) Fries, *D. nigripes* and *D.ovoideum* by SEM for spores ornamentation, capillitium and lime crystal morphology. They found no distinction in these characteristics at intraspecific level among heterothallic and non-heterothallic isolates of *D. iridis* (Ditmar) Fries. However interspecific comparision showed that *D. iridis* (Ditmar) Fries, have connate verrucae forming crude non continuous reticulum on the spore wall. This tendency was not prominent in other two species. Further more *D. iridis* (Ditmar) Fries, possessed both stellate and encrusted botryodial lime on
peridium. This exceptional characteristics either not shown or rarely suggested in other two species. Capillitial morphology could not be used to distinguish in those taxa and peridial lime was too similar to be used in distinguishing these three closely related taxa.
The genus *Lepidoderma* de Bary is characterized by sporangiate to plasmodiocarpous frutifications. Peridium cartilaginous to thick membranous covered with crystalline lime scale, these may be united into a continuous crust forming distinct layer. Capillitium typically *Didymium* Schrad. like or may be expanded at nodal region forming vesicular swelling enclosing lime crystals.

The genus *Lepidoderma*, was erected by de Bary, in 1873. It was based on the type species *Didymium tigrinum* Schrad. (1797). The formal transfer of *Didymium tigrinum* to *Lepidoderma* de Bary was made by Rostafinski in Fuckel's Jahrbucher (1873), as *Lepidoderma tigrinum* (Schrad.) Rost. (Kowalski : 1971).

Since the erection of the genus, very few species were reported. Rostafinski (1874), added two more species i.e. *L. chailletii* Rost. and transferred *Reticularia carestianum* Rab. (1892), as *Lepidoderma carestianum* (Rab.) Rost. in 1892, Massee enlarged the concept of the genus and included the species of *Didymium* that have scale like lime on peridium, neglecting capillitial characters. It was not followed by the subsequent workers. Fries (1906), transferred *Didymium granuliferum* Phill. as *Lepidoderma granuliferum* (Phill.) Fries. Thus raising the number of the species in the genus to four.

Lister (1911), treated *L. chilletii* Rost. and *L. granuliferum* (Phill.) as varieties of *L. carestianum* (Rab.) Rost. In (1925), she *L. chilletii* as a distinct species but retained *L. granuliferum* as a variety of *L. carestianum* (Rost.). Macbride & Martin (1934), treated all four species as distinct taxa (cf. Kowalski : 1971). Hagelstein (1944), followed Lister's treatment. Martin (1949) recognized four distinct species of the genus. Kowalski (1967), described *L. crustaceum* Kowal. as a new species from north California. Martin and Alexopoulos (1969), accepted all five species of the genus. In 1971, Kowalski treated the genus at monographic level; and added two more species i.e. *L. didermoides* Kowal and *L. aggregatum* Kowal; collected from Washington. He treated *L. chailletii* (Reb.) Rost as a synonym of *L. carestianum* and Lister's variety *L. cerestianum* var. *granuliferum* (Phill.), Lister, as a distinct species i.e. *L. granuliferum* (Phill) Fries.

Thus the total number of taxa in the genus was six, (Martin & Alexopoulos : 1969). And until more material is collected showing smooth spores of the size 6.9-7.2
µm in diameter, *Lepidoderma mandschurica* Skvortzaw, is to be treated in abeyence (Martin & Alexopoulos : 1969 ; Kowalski ; 1971).

In India, the genus remained unreported until Thind & Monocha (1957), Who described *L. tigrinum* (Schrad.) Rost. from Mussoorie Hills. Lakhanpal (1973), reported it from Manali & Kulu. Since then there is no report of the genus till Nanir and Rokade (1985), who described six new species of the genus from Maharashtra. entitated new to science. In the present study three species are being described.

**KEY TO THE STUDIED SPECIES OF GENUS THE LEPIDODERMA de Bary**

1. Spores with distinct equitorial and compression ridge      -----      *L. nannengae*.

1. Spores without such ridge    -----    2.

2. Fruiting stipitate sporangiate, columella well defined, spores 8 – 11 µm in diam.    -----    *L. thindii*.

2. Fruiting sessile sporangiate to plasmodiocarpous; columella absent ; spores
  11 – 14 µm in diam.    -----    3.

3. Peridium single; spores minutely but uniformly warted    -----    *L. effusum*.

3. Peridium double; spores almost smooth    -----    *L. carestianum*.

1. **LEPIDODERMA CARESTIANUM** Rost.

Rost. Mon., 188, 1875

*(PL. XXVI FIG. 74)*

Fructification sessile, sporangiate to plasmodiocarpous, porcelain white. Sporangia small, discoid, effused, 0.34 – 0.97 mm in diam. Plasmodiocarps flat, effused, short, simple, 1.3 – 3.4 mm long, 0.42 – 0.76 mm wide. Hypothallus indistinct. Peridium double, distinct ; outer layer thick, porcelain white, smooth, shining consists of closely compacted lime scale of stellate lime crystals, closely adhered ; inner layer thick, membranous, pale brown, iridescent, nonlimy. Dehiscence from upper part, mostly with both layer, intact leaving inner part as a shallow tray. Columella none. Capillitium scanty, stiff, pale brown, sparsely branched and anastomosed, with many irregular calciform vesicles attached to peridium. Spore-mass black, purple brown under transmitted light, globose, 10 – 14 um in diam., apiculate, lighter and thin walled on one hemisphere, almost smooth. **COLLECTION EXAMINED** : RRT/ 8299, Aug.-2004, Pachagani, Dist.-Satara. On dry and decaying leaves and stem of angiospermic plant.
The species is characterized by fructification sessile, sporangia discoid, effused; double distinct peridium; columella none; scanty capillitium with calciform vesicles, spores black in mass with apiculate, lighter and thin walled on one hemisphere, almost smooth.

*L.carestianum* (Rost.) can be compared with *L.effusum* Rokade & Nanir, sp.nov. However, *L.effusum* Rokade & Nanir, sp.nov. is characterized by the fructification grayish white with effused plasmodiocaps and hypothallus inconspicuous; peridium single; dehiscence mostly from upper part, sometimes floccose; more or less stiff and dichotomously branched capillitium; absence of columella with spore minutely and uniformly warded, 10 -14 um in diam.

The species is being described for the first time from Indian flora.

2. **LEPIDODERMA EFFUSUM** Rokade & Nanir, sp.nov

*(PL. XXVI FIG. 75)*

Fructification sessile, sporangiate to plasmodiocarpous, grayish white, scattered. Sporangia discoid, flat, pulvinate, effused, 0.46 – 0.97 um in diam. Plasmodiocarps simple, short, small, flat pulvinate, effused, depressed, 0.93 – 4.7 mm long, 0.42 – 0.80 mm wide and 0.17 -0.21 mm tall. Hypothallus inconspicuous. Peridium single, layer thick, membranous, yellowish, brownish to violaceous brown; covered by limy scales of stellate crystals compactly forming uniform crust, firmly adhered to peridium; lime scales strong, pearly white. dehiscence irregular, sometimes floccose, mostly from upper part, lower part persist as shallow tray or bowl. columella none. Capillitium abundant, radiating from the base, attached to capillitium, more or less stiff, dichotomy branched and anastomosed, filaments, broader and rough, slender above with occasional dark, globose or fusiform swellings, some filaments show multiple branching with calciform expanded bases. Spore-mass black, brown to violaceous brown under transmitted light, globose to oval, 10 – 14 um in diam., minutely and uniformly warded.


**DISTRIBUTION : INDIA** : Gujrat (Salunkhe, 1995) ; M. P. (Kharat, 2000) ; M. S. (Rokade, 1989 ; Chimankar, 1993 ; Jadhav, 1994).
L. effusum Rokade & Nanir, sp.nov. is characterized by sporangiate to plasmodiocaps fructification, discoid, effused sporangia; hypothallus inconspicuous; peridium single; dehiscence mostly from upper part, sometimes floccose; more or less stiff capillitium; spore minutely and uniformly warty.

L. effusum Rokade & Nanir, sp.nov. species can be compared with L. granuliferum (Phill.) Fr. and L. carestinianum (Rost.). However L. granuliferum (Phill.) Fr., is distinguished by double peridium of which outer layer is cartilaginous to subcartilaginous; capillitium an intricate net, swollen nodes like large vesicle filled with lime nodules, tips funnel-like; spores minutely spinulose, 15 – 18 um in diam. L. carestinianum (Rost.) is differentiated by its fructification sessile, sporangia discoid, effused; double distinct peridium; columella none; scanty capillitium with calciform vesicles, spores black in mass with apiculate, lighter and thin walled on one hemisphere, almost smooth with 10 – 14 um in diam.

3. LEPIDODERMA NANNENGAEE sp. nov.

(PL. XXVII FIG. 76)

Fructification sessile to very short stipitate sporangiate, scattered to gregarious, white. Sporangia depressed globose to discoid, pulvinate on restricted base, sometimes with upper depression, 0.3 – 0.7 mm in diam. Hypothallus inconspicuous. Stipe when present is short, flat, weak, seems to be an extension of hypothallus, limeless. Peridium double, both layer distinct; outer layer white, consists of compactly stellate lime crystals agglutinating into scales, there are forming continuous smooth egg shell like layer breaking into scales; inner layer thin, membranous, iridescent, transparent, violaceous brown, nonlimy; dehiscence irregular, basal part may persist as shallow cup. Columella none or represented by a thickened raised base of sporangium. Capillitium sparse, stiff, sparsely branched, radiating from the base and attached to peridium, sparsely anastomosed with several membranous expansions towards base, filaments thick, rigid, violaceous or faint brown, smooth or with small nodular thickenings, and often tips expanded, web-like. Spore black in mass, dark violet brown under transmitted light, globose, 11–14 um in diam., with distinct equatorial ridges and compression ridges forming lax reticulation, distinctly and closely warty, warts may form lines.
On dry leaf and stem.


*L. nannengae* sp. nov. is characterized by fructification sessile to very short stipitate, sporangia depressed globose to discoid; hypothallus inconspicuous; peridium is double, inner layer violaceous brown; dehiscence irregular; columella none; capillitium sparse, stiff; spores distinctly and closely warted, warts may forms lines.

From the known species of the *Lepidoderma, L. nannengae* sp. nov. apparently looks like *L. aggregatum* Kowal., in its external texture. But later differs from the former in its buff lime scales; well developed columella occupying one third of the sporangial cavity; spores purple brown, sparsely spinulose, without equatorial ridges. In spore characters it may be compared with *L. indicum* Nanir and Rokade. But later is primarily depressed, discoid, scales are like cane sugar crystals, peridium single, capillitium with nodular thickenings, spores conspicuously warted, longer warts to one hemisphere.

4. *LEPIDODERMA THINDII* Nanir & Rokade sp.nov.

(PL. XXVII FIG. 77)

Fructification sporangiate, stipitate, scattered, white, 0.7 – 0.8 mm in total height. Sporangia globose to depressed globose, deeply umbilicate below, 0.34 – 0.42 mm long, 0.46 – 0.51 mm in diam. Stipe short, thick, stout, erect or bent, vertically rugose, cylindric, broad, dark brown at the base, tapering and yellowish upwards, incorporated with refuse matter, frosted with white lime nodules, 0.42 – 0.46 mm long, 0.12 – 0.17 mm in wide. Hypothallus concolorous to stipe, rotate, thin, nonlimy, contains refuse matter. Peridium single, thick, membranous, pale brown, transparent, covered with white, shining, lime scales of 10 – 19 µm in diam. ; dehiscence irregular, upper part floccose, basal part persistent as cup. Columella globose, hemispheric or clavate, white, filled with white lime nodules, less than half of the sporangial cavity. Capillitium radiating from columella and attached to peridium, filamentous, thin, tubular, hyaline, dichotomously branched and anastomosed, with many calciform vesicles at regular intervals, dark violaceous, and in frequently with cross bars. Spores dark brown in mass, violaceous brown under
transmitted light, globose, 8.3 – 11.1 µm in diam., minutely spinulose, spines in small lines.


**DISTRIBUTION : INDIA**: M. S. (Rokade, 1989; Chimankar, 1993).

The species is characterized by small globose or depressed globose stipitate sporangia; short cylindric stipe, frosted with lime nodules, dark brown towards the base and paler above; peridium with lime scales, hyaline and tubular capillitium with many calciform swellings; and minutely warted or spinulose spores.

*L. thindii* is close to *L. marathwadense* Rokade & Nanir, but latter is quite distinct in its bipappillate spores with equatorial line, dichotomously branched capillitium with limeless expansions at the nodal region. Stipitate form of *L. carestianum* (Rab.) Rost. have variable fruitings bearing large lime scales (50 – 60 µm in diam.) and have bigger spores (13 – 15 µm in diam.). *L.cristaceum* Kowal., have obovate sporangia in loose clusters with double peridium, lacking columella and are spores 11 – 13 µm in diam.

**SUMMARY AND DISCUSSION**

Kowalski (1971) stated that the genus is alpine and rare one. This concept might have developed because of the previous few reports of the genus were from high latitudinal coniferous forest and from high altitudes. This is probably because, Myxomycetes as whole have been studied mostly from alpine and coniferous forest.

Mostly *Lepidoderma* have been described from 3500 to 6700 fts high altitude. The present study have been carried out between 1000 to 3000 fts altitudes, that too from tropical hot climate. It suggests that an extensive explorations are needed from the plains of tropical hot regions before commenting on its distribution and occurance.

Rokade (1989), described six species of *Lepidoderma* i.e. from plains and tropical hot climate. *L. effusum* sp. nov., *L. indicum* sp. nov., *L. kowalskii* sp. nov., *L. marathwadense* sp. nov., *L. nannengae* sp. nov. and *L. thindii* sp. nov. as new to science. This suggests that an extensive explorations are badly needed from the plains of tropical hot regions before commentings on its distribution.

The genus *Lepidoderma* de Bary, is closely related to *Didymium* Schrad. The main difference between these two genera is the nature of the lime on peridium i.e. it
is stellate crystalline in *Didymium* Schrad. and large crystalline scales or plates in *Lepidoderma* de Bary. Separation of *Lepidoderma* de Bary from *Didymium* Schrad. is exactly similar to that of separation between *Diderma* Pers., and *Didymium* Schrad. on the basis of the nature of the peridial lime i.e. granular in former and crystalline in later. Hence, suggestion of Farr (1981), for the possibility to merge *Lepidoderma* de Bary with *Didymium* Schrad. seems to be unjustifiable. It is felt that such merging would bring diverse taxa together. In case of such view the recognition of several genera of Myxomycetes would be superfluous. For example *Diderma* Pers., is separated from *Didymium* Schrad. on the basis only granular lime on peridium. *Physarum* Pers., and *Badhamia* Berk., are maintained on the basis of capillitial lime nodes only. Limeless internodes are present in former and limy tubular network in latter, with several intergradations. *Craterium* Trent., is simply segregated on the character of cartilaginous peridium from *Physarum* Pers. Similar situation is there in the genera of *Trichiales* i.e. *Prototrichia* Rost., *Hemitrichia* Rost., and *Metatrichia* Ing, which are separated from each other on a single but natural demarketing taxonomic character. Hence, the treatment of Martin & Alexopoulos (1969), and of Kowalski (1971), is followed for the genus.

In the present study four species of *Lepidoderma* i.e. *L. carestianum* Rost., *L. effusum* Rokade & Nanir, sp. nov., *L. nannengae* sp. nov. and *L. thindii* sp. nov. have been described.
**LEPIDODERMOPSIS** Hohnel.

*Sitz.-ber. Akad. wein.*, **118**, 438, 1909 ;


The genus is characterized by the fructification stipitate to sessile, sporangiate to plasmodiocarpous. Peridium cartilaginous, glossy brown, to chestnut brown, marked by pale lines of dehiscence. Columella if present orange or brown. Capillitium branching and anastomosing, dark brown, often bearing nodular thickenings. Spore-mass violaceous gray, or deep violaceous brown. Stalk stout, yellow, orange yellow or deep reddish.

Originally, Hohnel erected the genus *Lepidodermopsis* in 1909, for the species *Didymium leoninum* Berk. and Br., as it was neither fit into *Didymium* because of its cartilaginous peridium, nor into the *Lepidoderma* due to the lack of lime scales. Thus described the only species *Lepidodermopsis leonina* (Berk. & Br.) Hohnel. The genus remained monotypic until Lakhanpal (1978), who described second species of the genus *L. martini* Lakhan., and also emended the diagnosis of the genus.

From India the genus remained unreported until. Thind & Rehill (1958), who described as *Didymium leoninum* Berk & Br. from Mussoorie Hills. Lakhanpal (1978), reported the genus for second time from Indian flora, who described two species i.e. *Lepidodermopsis leonina* (Berk. & Br.) Hohnel and *L. Martinii* Lakhanpal, collected from H.P. Both these reports based on the collection from Himalayas. Two species being described in the present study are collected from the tropical deciduous forest. These are presented below.

**KEY TO SPECIES STUDIED OF LEPIDODERMOPSIS**

1. Stipe limeless, spore 1.0-10.5 µm, warted warts in lines forming subreticulation, apiculate with compression ridges, paler and thinner to one hemisphere.

    -------

    *L. martin.*

1. Stipe limy, spore 7.5-9 um in diam. warted minutely uniform in colour and wall thickness, compression ridges absent

    -------

    *L. leonina.*

1. **LEPIDODERMOPSIS LEONINA** (Berk. & Br.) Hohnel


Fructification sporangiate, stipitate, rarely sessile, scattered to gregarious, pearly white to ochraceous white, sometimes two sporangia fused, 0.72 – 1.6 mm tall. Sporangia globose, umbilicate below, 0.35 – 1.1 mm in diam. Stipe thick, stout, cylindrical, broader at the base, vertically rugose, deep orange to reddish brown, spongy, opaque, merged in the hypothallus in the form of thick veins, sprinkled with white to yellowish orange stellate lime crystals, 0.35 – 0.95 mm long. Hypothallus prominent, more or less rotate, venulose, orange brown, spongy, densely covered with yellowish or ochre white, stellate lime crystals. Peridium thick, single, cartilaginous, dark brown, shining, aeriolate, marked with raised pale brown ridges of dehiscence forming reticulum, heavily covered with white, yellowish or pearly white, large, stellate, shining lime crystals compactly arranged forming a layer which crumbles down easily and remain more or less intact at the base of sporangium; dehiscence irregular along the ridges, upper part floccose, lower part remains persistent as a small shallow cup. Columella globose, dome shaped, clavate, pedicillate reaching upto half of the sporangial cavity, filled with rhomboidal lime crystals. Capillitium radiating from columella and attached to peridium, profuse, filamentous, stiff, wavy, dichotomously branched and anastomosed with few membranous expansion at point of branching along with cup shaped and dark spherical swellings, violaceous brown, paler at the both ends, tips pointed. Spores black in mass, violaceous brown under transmitted light, globose, 8.5 – 10 µm in diam., uniformly warted or spinulose, warts arranged in small curved lines.


**DISTRIBUTION : INDIA :** Gujrat (Salunkhe, 1995); H. P. (Lakhanpal and Mukerji, 1978); M. P. (Kharat, 2000); M. S. (Rokade, 1989; Chimankar, 1993; Jadhav, 1994); U. P. (Thind and Rehill, 1958).

*Lepidodermopsis martini* Lakhanpal is close to *L. leoninea* (Berk. & Br.) Hohnel. However former is differentiated in its larger, limeless and fluted stipe; nonlimy hypothallus; peridium and capillitium ochraceous brown; larger and strongly warted spores, which are papillate with thinner and paler on one side. Earlier worker
(Hagelstein, 1944; Martin & Alexopoulos, 1969; Farr, 1976; Thind, 1977) treated *L. leonina* under *Didymium* as a *D. leoninum*. The species is distinguished by its robust fruiting, cartilaginous shining peridium with, large spiny crystals breaks into more or less uniform polygonal platelets; columella stipitate and shining.

2. **LEPIDODERMOPSIS MARTINII** Lakhanpal

*L. martinii* species is characterized by scattered nature of fruiting; presence of cartilaginous peridium marked by yellow lines of dehiscence together with white lime crystals on the peridium; ochraceous brown hemispheric columella; larger apiculate spores with compression ridges, however spore wall on one side and warts in subreticulate arrangements.


(*PL. XXVIII FIG. 79*)

Fructification sporangiate, stipitate, scattered to gregarious, snow white to white, 0.63 – 1.7 mm tall. Sporangia globose, 0.38 – 1.0 mm x 0.34 – 0.97 mm in diam. Hypothallus distinct, rotate, brown, thin, membranous, nonlimy. Stipe cylindrical, stout, broader at the base, vertically rugose, dark reddish brown, nonlimy, shining, 0.29 – 1.1 mm long. Peridium single, thick, cartilaginous, areolate, iridescent, showing reticulation of thin paler ridges, covered with stellate lime crystals, falling readily as a clump; dehiscence along the ridges, breaking into platelets, basal part persistent. Columella globose, hemispheric, orange brown, rough, contains stellate lime crystals. Capillitium profuse, radiating from columella and attached to the peridium, filamentous; filament thick, stiff, faint brown to orange brown, dichotomously branched and anastomosed. Spore-mass black, violaceosus brown under transmitted light, globose, 10 – 11.1 µm in diam., warted, warts arranged in lines forming subreticulation, apiculate with compression ridges, paler and with thinner wall on one hemispheric.


**DISTRIBUTION :** INDIA : Gujrat (Salunkhe, 1995) ; H. P. (Lakhanpal, 1978) ; M. S. (Rokade, 1989 ; Jadhav, 1994) ; M. P. (Kharat, 2000).

*L. martini* Lakhanpal species is characterized by scattered nature of fruiting; presence of cartilaginous peridium marked by yellow lines of dehiscence together with white lime crystals on the peridium; ochraceous brown hemispheric columella; larger apiculate spores with compression ridges, however spore wall on one side and warts in subreticulate arrangements.
Population described in the present work differs from type description in its more or less cylindric stipe; stiff capillitium, with many calcified vesicles.

*L. martinii* Lakhanpal can be compared with *L. leonina* Lakhanpal. However, later is marked by the sporangiate fruiting, the peridium and capillitium are ochraceous brown, though the latter bears numerous black swellings at places; the stipe is long, non-calcarious, fluited and deep reddish brown, the hypothallus is membranous and non-calcarious, the spores are larger and more prominently warted.

**SUMMARY AND DISCUSSION**

In the present work the genus *Lepidodermopsis* Hohnel, is described with two species i.e. *L. leonina* (Berk. and Br.) Hohnel and *L. martini* Lakhanpal.

The genus seems to be rare and restricted in its distribution. According to Thind (1977), (While describing *Didymium, leoninum*), it appears to be strictly Asian. But recently Farr (1976), described one collection of *L. leonina* (as *D. leoninum*) from Jamaica, represented the first report from Western Hemisphere.

The genus *Lepidodermopsis* Hohnel, *Didymium* Schrad. and *Lepidoderma* de Bary are close to each other, *Didymium* Schrad. is recognized by membranous peridium and the stellate crystalline lime on peridium. *Lepidodermopsis* Hohnel, is marked by cartilaginous peridium (and floccose nature) and stellate crystalline lime deposition. Whereas, the *Lepidoderma* de Bary, is distinguished by its limy stellate scales or plates on peridium and peridium is generally thick and membranous. Lister (1925), treated the genus as a subgenus of *Didymium* Schrad. Later workers followed the treatment with some reservation and ambiguity. Farr (1974), commented that "there is meager cause for retaining the subgenus *Lepidodermopsis* ", and in 1976, suggested to treat it as a subgenus of *Didymium* Schrad. According to Martin & Alexopoulos (1969) the " Cartilaginous peridium is unique in *Didymium* ….untill further information is available, it may remain in *Didymium* as subgenus ……". However Lakhanpal (1978), reinstated and emended the diagnosis of the genus and added second species and widened the concept of the genus.

Cartilaginous nature of the peridium in *Lepidodermopsis* Hohnel, is justifiable to maintain and segregate it from *Didymium* Schrad., as *Criterium* Trent. from *Physarum* Pers. The generic segregation on single but stable and distinct characters in Myxomycetes are not rare to maintain the homogenesity of the genera. Separation of *Diderma* Pers. and *Didymium* Schrad. on granular and crystalline peridial lime
respectively is a good example. Taxa from Trichiales are maintained on single character only. To bring out homogenesity, separation of *Lepidodermopsis* Hohnel, and *Lepidoderma* de Bary, from *Didymium* Schrad., and *Leanigium* Link from *Diderma* Pers., is justifiable and practicable.
The genus *Physarina* Hoehn, is characterized by the stipitate or sessile sporangia with numerous, limy peg-like protuberances projecting from the surface of cartilaginous peridium; stout and rigid short stipe; pale, subglobose, limy and conspicuous columella. Capillitium composed of limeless, violaceous brown, branched and anastomosed threads; Spore-mass black, brownish violaceous or dark violaceous under transmitted light, nearly smooth to strongly warted.

The genus was erected by Hoehnel in 1909 with the type species *Physarina echinocephala* Hoehn. The genus was monotypic until Thind and Monocha (1964), who described *P. echinospora* Thind and Manocha, from India. It is represented by only two species from the world. Nannenga-Bremekamp and Yamamoto (1986) described *P. albosclabra* Nann-Brem. and Yamamoto as a new species.

Until Thind & Monocha (1964), the genus was unreported from Indian flora, who described the genus with new species i.e. *P. echinospora* Thind & Monocha, from U. P. Nanir (1985), described the genus with two species from the region of Marathwada for the first time. In the present work, the genus is described with a single species.

1. **PHYSARINA ECHINOSPORA** Thind & Manocha


*(PL. XXVIII, FIG. 80)*

Fructification sporangiate, stipitate to sub sessile, scattered curdy white, 0.34 to 0.85 mm in total height. Sporangia globose, umbilicate below, 0.32 to 0.72 mm long, 0.38 to 0.89 mm in diameter. Stipe short, stout, cylindrical, creamy white, limy, filled with granular lime, vertically rugose, 0.12 to 0.42 mm long, 0.17 to 0.34 mm thick. Hypothallus concolorous to stipe, small, rotate, limy or nonlimy. Peridium single, impregnated with lime granules, brittle, covered with equisized limy pegs placed equidistantly; pegs creamy white, cylindrical with obtuse apex, 0.8 to 0.12 mm long, 0.4 to 0.8 mm thick, basal regions of pegs are marked by pentagonal or hexagonal lines forming reticulation on the surface of peridium, sometimes lines are inconspicuous; dehiscence along the ridges, upper part separate, basal part remain
persistent. Columella globose, subglobose or clavate, white reddish brown to pinkish, limy, filled with white lime granules, reaching up to half of the sporangial cavity. Capillitium abundant, radiating from columella and attached to the peridium, filamentous, stiff, branched, anastomosing, with many large membranous expansion and cross bars at dichotomy along with dark spindle shaped or cup like swelling, reddish or violaceous brown, paler or hyaline at the extremities. Spore black in mass, deep violaceous brown under transmitted light, globose to oval, 9.7 to 13.8 μm in diam. with pale equatorial ridge, prominently spiny, spines scattered or dense.


**DISTRIBUTION:** INDIA: Gujrat (Salunkhe, 1995); M. S. (Nanir, 1985; Chimankar, 1993; Jadhav, 1994); M. P. (Kharat, 2000); U. P. (Thind and Manocha, 1964).

In the type description, equatorial ridge is not mentioned. However this character has been established throughout the cultural study (Alexopoulos & Blackwell, 1968). Populations observed in this work show equatorial ridge as consistent character.

**SUMMARY AND DISCUSSION**

The genus is presented with a single species i.e. *P. echinospora* Thind and Manocha. The species seems to be rare. After its erection, it was reported from Mexico only (Alexopoulos & Backwell, 1968). In India since its erection it was collected by Nanir (1985), Chimankar (1993), Jadhav (1994), from Maharashtra, Salunkhe (1995) from Gujrat and by Kharat (2000) from M. P.

G. Lister (1925), noted the genus very close to *Diderma* Pers. and suggested that it might be well included in it, perhaps as subgenus. Alexopoulos & Blackwell (1968), discussed the taxonomy of the genus and retained it as a distinct one. According to Martin & Alexopoulos (1969), Martin, Alexopoulos & Farr (1976), 'two known species are so strikingly different in external appearance from any *Diderma* species that the maintenance of the genus is well justified ....' Nannenga-Bremekamp & Yamamota (1986) described *Physarina alboscabra* as a new species. Thus the genus is represented by three species from the world.