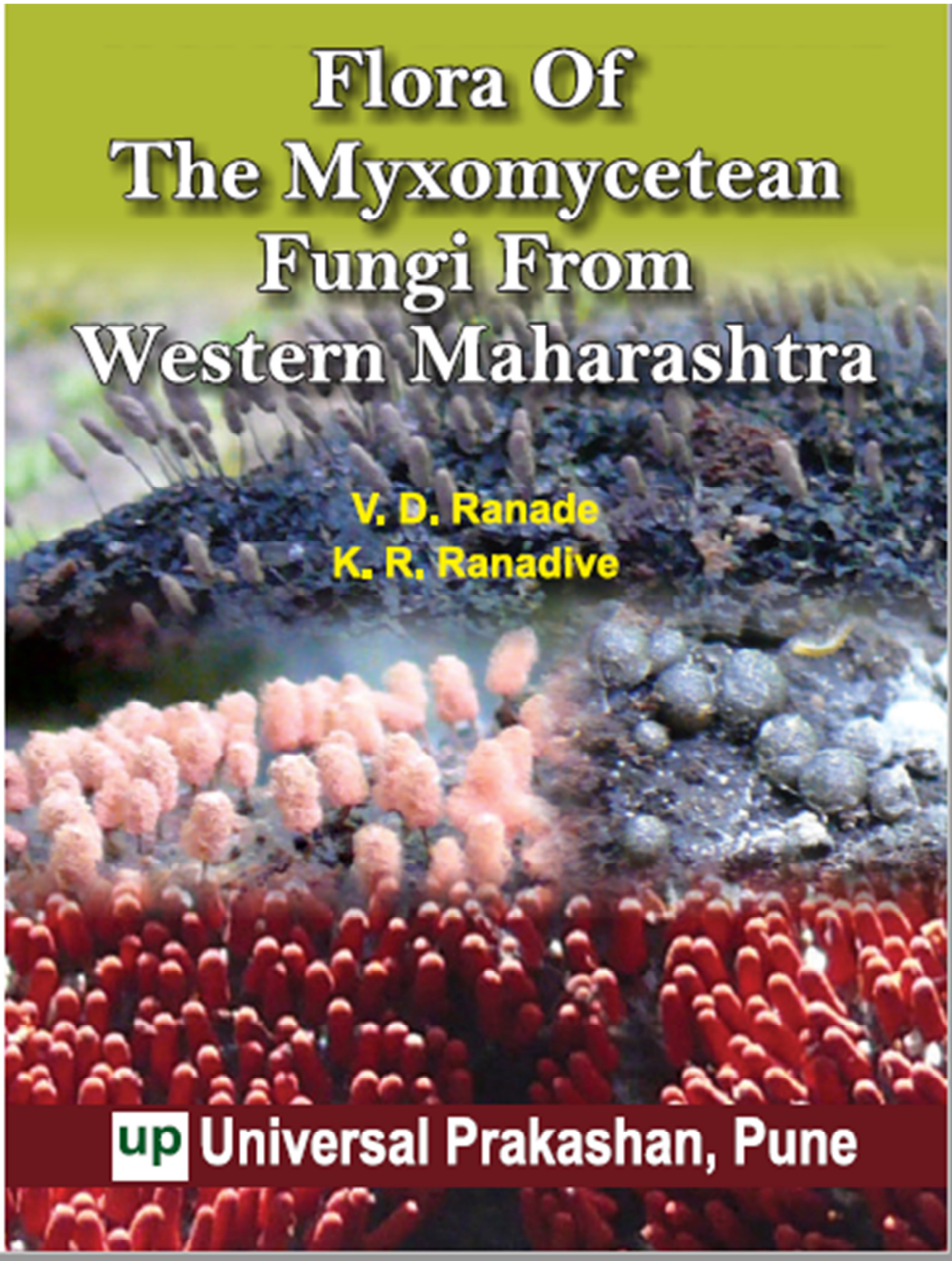
Flora Of The Myxomycetean Fungi From Western Maharashtra

V. D. Ranade
K. R. Ranadive



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Authors: **I] Dr. Vijay Damodar Ranade**
Department of Botany,
Abasaheb Garware College, Karve Road, Pune-411004
vijay.ranade1950@gmail.com

II] Dr.Kiran Ramchandra Ranadive
Assistant Professor,
Waghire College, Saswad, Tal-Purandar,
Maharashtra, India.
ranadive.kiran@gmail.com, www.fungifromindia.com

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CONTENTS

INTRODUCTION

The state of Maharashtra is the third largest state in India, both in area and population. It forms a major part of western India, extending over an area of 306345 sq. kms and is almost within the limits of Deccan trap. The state comprises three natural divisions: narrow coastal low land of konkan, the sahyadri ranges and the Deccan plateau. The state is divided into three regions viz. Western Maharashtra, Marathwada and Vidarbha. The western Maharashtra has a shape like that of a narrow, oblique leaf blade and is traversed by Sahyadri ranges, more or less parallel to west coast and divide it in narrow coastal strip to the west, "Konkan" and to the east "Desh or Deccan plateau". Both the regions are connected by routes and paths, locally called "Ghats". The major among them are Bhor and Kumbharli, the other are Bor, Amboli, Phonda to mention some. These ghats are at elevations between 770-1540 metres above mean sea level. The western Maharashtra, especially the ghat region, is very rich in variety of plant materials and is of great interest to Plant geographers and Taxonomists. Many workers like Dalzell and Gibson (1861); Blatter (1909) and Mahabale (1966) have pointed out that the western Maharashtra region is not only rich in Angiosperms, but also in Algae, Bryophytes and Pteridophytes. From endless reports of many genera and species of Fungi (Kamat et al, 1971), it can be seen that Fungi also abound in Western Maharashtra with other plant groups. Until recent years large numbers of Fungi belonging to various groups have been reported. The first consolidated report of Fungi of Maharashtra (old Bombay Presidency), was published by Uppal, Patel and Kamat (1935) and was supplemented by Patel, Kamat and Bhide (1948). The latest list of "Fungi of Maharashtra" has been published by Kamat et al (1971).

In spite of the good work done on taxonomy of various groups of Fungi, few ecological groups like predaceous fungi, entomogenous fungi, Myxomycetes seen to be poorly attended. There are only a few isolated reports of Myxomycetes from Maharashtra. Therefore, it appears that this group of organisms remained more or less neglected inspite of its abundance in this area.

Myxomycetes are characterized by an assimilative phase in the form of a free living, multinucleate, amoeboid, acellular mass of protoplasm the "Plasmodium" and a propagative phase consisting of mass of spores enclosed in simple or complex spore cases alongwith a system of netted, branched threads, the "Capillitium".

The typical fruitings of Myxomycetes show i) **hypothallus**, ii) **stipe** (may be present or

absent) and iii) **fruiting body** or **sporocarp**.

Hypothallus: It is a membranous, horney, spongy or calcareous stratum on which sporophores are usually seated. It is deposited by plasmodium at the time of sporulation. It may be abundant or scanty to almost absent.

Stipe: The sporocarp (actual fruiting body) may be stalked or sessile, when stipe (stalk) is present, it is usually cylindrical, subulate and in a few cases hair like. It may be calcareous or non-calcareous. It is hollow or filled with strand like material (e.g. Stemonitales) or stuffed with granular material or spore like cells (e.g. Trichiales). Sometimes stipe is nothing but an extension of hypothallus. The characteristics of stipe and its length are important taxonomic features.

Actual fruiting body or sporocarp: It typically occurs in the following three distinguishable forms.

Sporangia: From single plasmodium one to many sporangia are simultaneously developed. They may be sessile (Fig. no. 8) or stalked (Fig. no. 1) and have characteristic size, shape and colour. They show various shape like globose (Fig. no. 1, Pl. fig. 66), depressed globose (Fig.no. 3), reniform (Fig.no. 2, Pl. fig. 53), cylindrical (Fig. no. 4, Pl. fig. 77), hemispherical (Fig.no. 5, Pl. fig. 87), cupulate (Fig. no. 6, Pl. fig. 49) and thimble shaped (Fig. no. 7, Pl. fig. 46).

Plasmodiocarps: A typical plasmodiocarp (Fig. no. 12, Pl. fig. 42) is like a sessile sporangium but more or less elongated and forms a net over the substratum, retaining to a certain extent the habit of the plasmodium. The variety of shapes of plamodiocarps occur in nature, varying form sporangium like spheres to a net work of tubules.

Aethalia: - An aethalium is a fairly large and massive structure formed by conversion of entire plasmodium into a single fruiting body (Fig. nos. 10, 11; Pl. figs. 33, 47). Sometimes sporangia are very compactly arranged and entire body appears as an aethalium. However, the sporangia are clearly distinguishable at or close to the maturity. Such a fruiting is called pseudoaethalium (Fig. no. 9, Pl. fig. 44).

The sporocarps (except for *Ceratiomyxa* Schroet.) are covered by delicate or tough, early evanescent (Fig. nos. 22, 47 -50) or persistent wall, the “peridium” which is made up of single , double or triple layers that are closely appressed or widely separated. It may be calcareous (Fig. no. 102), non-calcareous (Fig. no. 95) or cartilaginous (Fig. no. 110). The configuration of line on the peridium is also an important taxonomic character. The fruiting body or sporocarp on maturity dehisces to liberate the spores. The dehiscence of peridium may be either irregular (Fig.no. 13; Pl. figs. 1, 67), along preformed lines (Fig. no. 20, Pl. fig. 4), by longitudinal slits (Pl. no. 21, Pl. fig. 29), along apical sutures (Fig. no. 14, Pl. fig. 5), circumscissile(Fig. nos. 15, 16; Pl. fig. 3), cup and lid like (Fig. no. 18, Pl.

fig. 2), stellate(Fig. no. 19, Pl. fig. 6), into petaloid lobes (Fig. no. 17) or sometimes the peridium is evanescent leaving the net behind (Fig. no. 22, Pl. fig. 7). Inside the peridium are enclosed spores alongwith system of threads, the “capillitium”. The capillitium may be elastic (Fig. no. 47) or non-elastic (Fig. no. 84) and shows variety of ornamentations such as smooth (Fig.no.23, Pl.fig.no.10), spirals (Fig.no.26, 27, Pl.fig.13), spirals with spines (Fig.no.25, Pl.fig.14), warty (Fig.no.24, Pl.fig. 11), half rings (Fig.no. 28, Pl.fig. 15), complete rings (Fig.no.29, Pl. fig.16) etc. The capillitium may be calcareous (Fig.no. 30, 31) or non-calcareous (fig.no. 23, Pl. fig.10).It may be attached to the peridium or columella or both.

A pseudocapillitium (Fig.no. 32, Pl. fig. 17), as it typically occurs in aethalia, usually represents the empty strands of plasmodium from which the protoplasm has been evacuated before the spore formation. It shows wrinkles as well as transverse folds (Fig.no. 42, Pl. fig.17).The capillitium plays an important role in the liberation of spores. The presence or absence of capillitium is also an important taxonomic character.The asexual reproductive bodies i.e. the spores are borne externally (in *Ceratiomyxa* Schroet. Fig.no, 39 B, Pl. fig. 26) on individual stalks “spicules” or inside the fructification. Spores are thick walled, uninucleate and haploid structures in compact or loose clusters or are free. They are generally globose (Fig.no. 35, Pl. fig. 22) to subglobose, elliptic (Fig.no. 33, Pl. fig.25), oval, walnut like (Fig.no. 38, Pl. fig.19) etc. The spore wall shows variety of ornamentation like smooth (Fig.no.33, Pl. fig. 19), warty (Fig.no. 34, Pl. fig. 20), spiny (Fig.no. 35, Pl. fig.21), incompletely reticulate (Fig.no. 36, Pl. fig.22), reticulate (Fig.no. 37, Pl. fig. 24), with ridges (Pl. fig.23), with encircling ridges (Fig.no. 38, Pl. fig. 19, 21) to mention some.The colour of the spores in mass, is the key character in taxonomy of Myxomycetes while the characters like shape, size and ornamentation of spores are used in distinguishing the species.

Alongwith the spores and the capillitium, a structure which is generally a continuation of stipe into the sporocarp, called “columella”, (Fig.no. 106, Pl. fig.8) may be present. It may differ in its colour and nature. Like columella, pseudocolumella (Fig.no. 89, Pl. fig.9) may also be present. The nature and shape of columella and pseducolumella are important characters used in taxonomy of Myxomycetes.The spores on germination give rise to swarm cells or myxomycetes which fuse in pairs to form a free living, amoeboid, acellular mass, the “plasmodium”. Plasmodium may be hyaline, red, yellow, violet, black with many intermediate shades. Three main types of plasmodia are recognized: microscopic “protoplasmodium”, the flat transparent “aphanoplasmodium” and thick, gelatinous, granular “phaneroplasmodium” (Pl.fig.27,

Alexopoulos 1962). The type of plasmodium is another important taxonomic feature (Alexopoulos 1969).

The members of the group are widely distributed and occur wherever conditions promote the growth of vegetation. They are preferably moisture and shade loving and are abundant in forest lands on dead, decaying wood, litter, dead leaves, organic matter and also in the soil (Thom and Raper 1930, Krezmieniewska 1929, Warcup 1950).Some species also occur on bark and a few in open spaces. The present work is confined to the Myxomycetes collected from different localities in western Maharashtra (Map no, 2).The localities visited were Amboli, Bhimashankar, Kanakeshwar, Karjat, Katraj, Khandala, Kolwan, Lohogad, Mahabaleshwar, Matheran, Panchgani, Pashan, Pune, Purandhar, Sinhgad, vani hills, Vavoshi and Vithalwadi. During this survey 81 species of Myxomycetes belonging to 23 genera are collected, studied and described. The species are described in the alphabetical order. Since, not much work has been done on this group in Maharashtra; the study of Myxomycetes is undertaken. It is more or less a pioneering work in this part of the country.

MATERIAL AND METHODS

The slime-moulds normally appear in moist areas during wet seasons and as such they usually appear on the onset of monsoon in this part of the country. Hence, most of the collections have been made during rainy season or just after rains, during July to January or so. Few localities form western Maharashtra as mentioned in the text (page no. 6) were selected for the collections. These localities were visited at least 3 to 4 times or even more every year during the tenure of the research work. The slime-molds were collected on dead, fallen decaying leaves, stem pieces, wood, bark, litter, organic matter such as dung humus rich soils etc. from the forest and also in the neighourhood of the cultivated areas having fairly thick vegetation. It was noticed that these forms grow on any plant material and show very little or no preference for particular substratum. Most of the forms were collected on dead organic matter with few exceptions e.g. *Stemonitis herbatica* Peck and *Physarum cinereum* (Batsch) Pers. Which were collected on green, herbaceous plants.

The specimens were collected in card-board or plastic boxes and brought to the laboratory. They were examined by usual laboratory methods. They were observed first under dissecting binocular microscope (Bosch and Lamb, Germany) and were picked up for further studies. Before their actual mounting on the slide, their characteristic feature such as colour, size, nature of the fruiting body, dehiscence etc. were carefully observed and recorded. The colours were checked with Methuen Hand book of colours (Kornerup and Wanscher, 1967) to have standardized notation of colour of fruiting body, spore and capillitium. Many times, leaf litters, debries, bark, rotten logs were collected in the fields and brought to the laboratory for moist chamber cultures. The materials were soaked overnight in sterile distilled water and placed on moist filter paper. These studies could help in observing the development of the slime-moulds. Slides were prepared by picking or scraping off the material from the substratum. For simple microscopic examination materials were treated with absolute

alcohol, followed by 2- 3% KOH for causing plumpness of the inner parts. KOH was then blotted out. A drop of 8% glycerine was added as a mounting medium and temporary slides were prepared. These slides helped in observing the nature of the lime on peridium, size and shape of the lime knots and spores etc. In the similar manner, semipermanent slides were prepared by using Amann's medium instead of glycerine.

Formula of Amann's medium:

Phenol	-	20 gms
Lactic acid	-	20 gms
Glycerine	-	40 ml
Water	-	20 ml

Slides were gently heated before they were sealed by sealing wax. It was also found convenient and helpful to prepare permanent slides of some of the forms for the study of the capillitium, columella etc. Materials were passed through alcohol grades, alcohol-xylol grades, xylol and finally mounted in Canada-balsm (e.g. members of stemonitales pl.fig. 113-117). All the above preparations helped in identifying various genera and species of myxomycetes. Habit sketches were made by using dissecting binocular microscope and camera lucida drawings were made with the help of "Erma"camera lucida, at the stage level, using 3.5x, 5x, 10x, 40x and 100x objectives and 3.5x, 5x, 5x, 10x and 15x eyepieces. Choice of the combination of eyepiece and objectives lenses was according to the size of the specimen. Careful measurements were taken by using 6x Ernst-Leitz wetzler occular and 10x, 40x, and 100x objectives, which enabled in preparing the detailed morphological description of each specimen. Photomicrographs of the slides of some of the forms were taken by using "Ernst- Leitz Wetzler" unit of photomicrography. Photomicrographs of some species were also taken by zoom camera (MA IV b Leitz wetzler Co., Germany) to have more realistic views.Identification of these organisms and their early reports for India and Maharashtra, were confirmed with the help of following literature. Lister G. (1925), Lodhi (1934), Mundkur (1938), Butler and Bisby (1960), Vasudeva (1962), Mathur (1954), Tilak and Rao (1968), Martin and Alexopoulos (1969), Kamat et al (1971), Ainsworth and Susman (1973), Mukerji and Juneja (1974), Nannenga-Bremekamp (1974) and Sorbhoy et al (1975). The specimens are glued on the cards and are placed in card-board boxes of 9 x 5 x 3 cms size. Specimens are deposited in the Botany Department, University of Poona, Pune- 411 007.

SUMMARY AND CONCLUSIONS

Myxomycetes as such is a universally distributed group of organisms and are abundant in this part of the Country. Inspite of their abundance, scanty systematic work has been done in this state. Hence the present investigation is being undertaken.The present investigation deals with the Myxomycetes occurring mainly in the western parts of Maharashtra. They were collected on various substrata such as dead leaves, wood, bark, dung, etc. mainly during monsoon and immediately after the rains. In the present work 23 genera and 81 species are being described. of the total number of species collected and described, 6 are new taxa, few are new records for India and many of them are new reports from Maharashtra.

1. Establishment of new taxa – The following species have been described as new taxa.

Licea sinhgadensis Patil, Ranade and Mishra

Physarum sumatii sp. nov, Patil and Ranade
Physarum thindii sp. nov. Patil and Ranade
Diachea khandalensis sp. nov. Patil and Ranade
Diderma lohogadensis sp. nov. Patil and Ranade
Diderma punensis sp. nov. Patil, Ranade and Mishra

2. New reports from India – Following species are being reported for the first time from the Country.

Licea marginata
Physarum
decipiens
P. megalosporum
P. mortonii
Physarina echinocephala
Diderma alpinum
D. crustaceum
D. lyallii
Didymium perforatum
D. serpula

3. New records for Maharashtra – All of the species described in the present work, except Ceratiomyxa *fruticulosa*, *Arcyria cinerea*, *Hemitrichia serpula* and *Physarum pusillium* are new records for the Maharashtra state.
4. Myxomycetes are ubiquitous and occur everywhere where the conditions on Earth's surface promote the growth of the vegetation. However, some of the Myxomycetes appear to be confined to tropics or temperate zones. e.g. *Physarum nicaraguense* and *P. javanicum* are more or less confined to tropics. *Hemitrichia clavata* is reported to restricted to temperate regions only, however, the same has been collected in this region of the Country i.e. in tropics. Similarly species of *Diderma* Pers. Collected at Pune has provisionally been assigned to *D. alpinum*, however, this species is generally reported to occur at the alpine type of regions.
5. The distribution of Myxomycetes at different altitudes and under different climatic conditions, in this state has been discussed.
6. The study of co-relation of distribution of Myxomycetes and their substrata was undertaken. It was found that the Physarales more commonly inhabit leaves and litter while Stemonitales and Trichiales on twig or wood. However, it was observed that no definite substrate relationship is indicated by members of the other orders. At times it was also observed that sometimes more than one species of Myxomycetes inhabit the same substrate and forming a so called Myxomycetes community.
7. So far, Myxomycetes have more or less been neglected in this state. A very few reports of these fungi have been reported from Maharashtra. In the present investigation extensive collections of Myxomycetes were made. Their taxonomy and distribution are studied. As such this is more or less a pioneering work in this state as far as Myxomycetes are concerned.

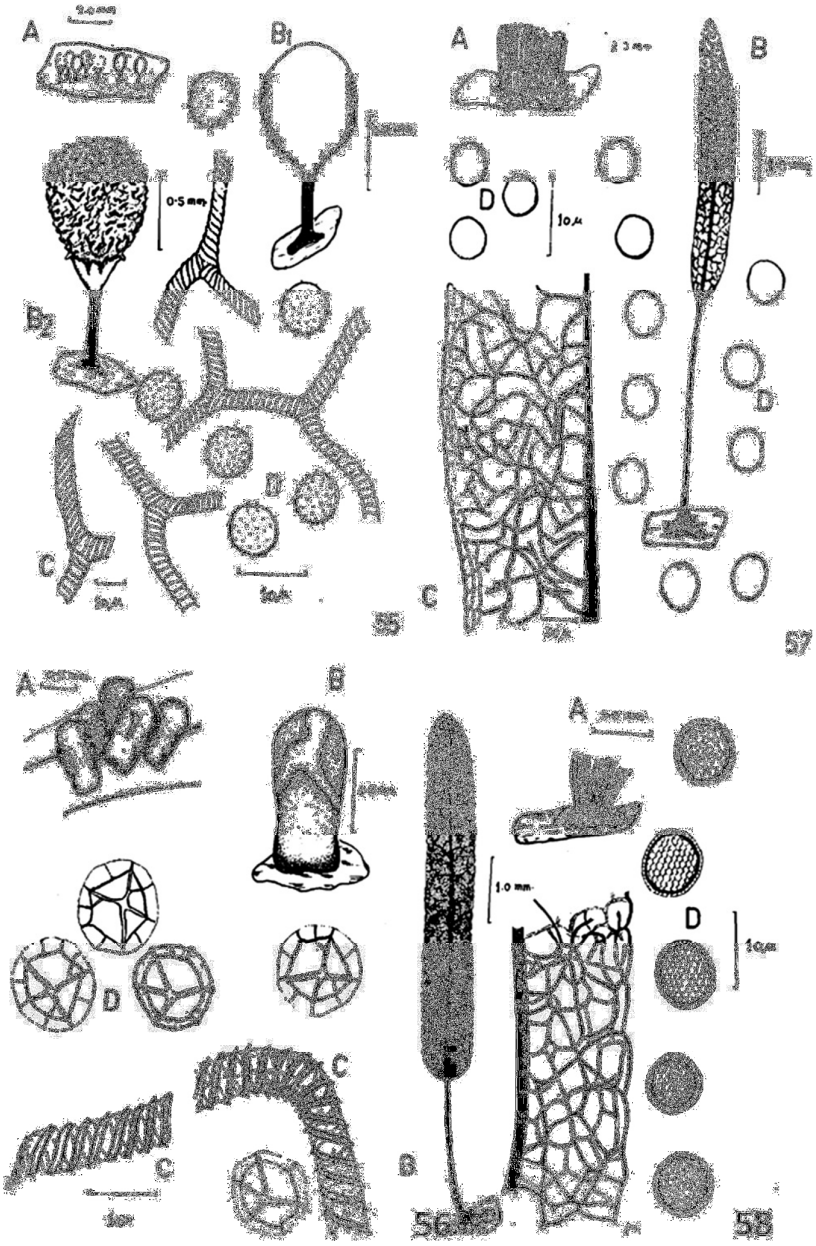
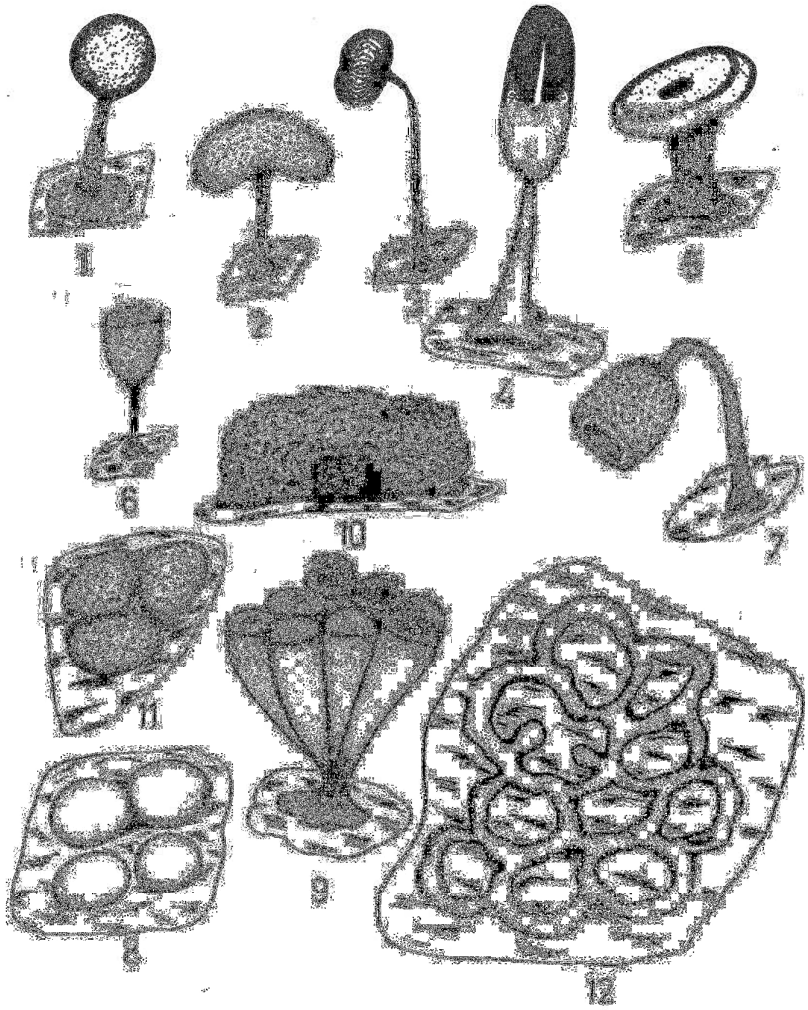


Fig. no. 55. *Hemitrichia calyculata* (Speg.) Farr. Habit, B_1. Single sporangium, B_2.Dehisced sporangium with elastic capillitium, C. Capillitium with smooth spirals, D. Spores. **Fig. no. 56.** *Trichia favoginea* (Batsch) Pers. Habit, B. Single sporangium with irregular dehiscence, C. Spiny elaters, D. Ridged Spores**. Fig. no. 57.** *Stemonitis axifera* (Bull.) Macbr. Habit, B. Single sporangium, C. Part of the sporangium showing the capillitial arrangement on columella, D. Spores. **Fig. no. 58.** *Stemonitis fusc*a Roth. Habit, B. Single sporangium, C. Part of the sporangium showing the capillitial arrangement on columella, D. Reticulate spores.



TYPES OF FRUCTIFICATIONS Fig.No. 1. Stipitate, globose sporangium-*Physarum leucopus.*2. Stipitate, reniform sporangium-*Physarum compressum.* 3. Stipitate, depressed-globose sporangium- *Dictydium cancellatum.* 4. Stipitate, cylindrical sporangium- *Diachea leucopodia*. 5. Stipitate, hemispherical sporangium-*Diderma hemisphaericum.*6. Stipitate, cupulate sporangium- *craterium leucocephalum.*7. Stipitate, thimble like sporangium-*Physarella oblonga.*8. Sessile sporangium- *Diderma testaceum* 9. Short stipitate, pseudoaethalium- *Metatrichia vesparium.*10. Aethalloid frutification- *Fuligo cinerea.*11. Aethalloid frutification- *Lycogala epidendrum.*12. Plasmodiocarpous fructification- *Hemitrichia serpula.*

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