

# INVESTIGATION ON THE FUNGAL FLORA OF NORTH BENGAL

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## INTRODUCTION

Survey of fungal flora of any area is a very interesting and informative aspect of research. This is a basic need for any kind of planning of mycological and plant pathological research or similar such work. The Northern part of West Bengal is characterized by climatic variation and richness of vegetation. The climatic and vegetational peculiarities of this area are very attractive to undertake a fascinating topic of research like : Survey of fungal flora of North Bengal, which when completed will be a positive contribution to Science. Review of literature indicates that the study of fungi of North Bengal was initiated far back in 1842 for the first time by J. F. C. Montagne, who worked on Polystictus nilgheriensis Mont. Subsequently many workers worked on the different groups of fungi of this area. Names of some these workers and their major area of work are given below.

During the period from 1856 to 1884, M. J. Berkeley (1856) worked on Azarius exaltatus Berk., A. silvaticus Schaeff., Armanitopsis berkeleyi (Hook. f.) Sacc., A. ericifera (Berk.) Sacc., A. regalis (Berk.) Sacc., Armillaria adelaha Berk., A. dichynella Berk., A. duplicata Berk., A. horrens Berk., A. multicolor Berk., A. omatians Berk., Boletus delphinus Berk., B. ustalis Berk., B. amdensis Berk., Pulgaria chalybea (Berk. in Herb.) Cooke and Masses, Calocera sphaerobasis Berk., Clitocybe inconspua Berk., Collybia antityna Berk., C. comatodora Berk., C. napinea Hook. f. in

Berk., G. napararceus Berk., G. raphaninus Berk., C. rhodella  
Berk., C. stellaticia Berk., G. undarhunda Berk., C. ustinas  
Berk., C. valutinæ (Curt.) Fr., Georinus somatus Fr., C.  
hookeri Berk., C. vallerius Berk., Dactylops amoenensis Berk.,  
D. atropoides Fr., Daldinia verrucosa (Schw.) Ces. and Not.,  
Entoloma cystosodum Berk., E. solisth Hook. f., Egidia  
hirsaciformis Berk., Favolus tenerrius Berk., Fistulina  
henatica Fr. Flamula chrysoconca Berk., E. macrophala (Berk.)  
Sacc., Romes adamantinus (Berk.) Sacc., E. igniaris (L.) Fr.,  
E. senex Sacc and Mont., Galera turkhilli Massae., G. tenera  
(Schaeff.) Fr., Harnepia cochleata Fr., H. delicata (Fr.) Bres.,  
Hypolema castinophyllum Berk., Hydnum coralloides Scop., H.  
silvum Berk., Hypocrella semiannulata (Berk.) Sacc., Lycogonias  
elongatum Berk., Marasmius consocius Berk., Merulius lignosus  
Berk., Mycena bicrenata Berk., Mycena xanthophylla Berk.,  
Mauzeria sericea Berk., Otidea daricciensis (Berk.) Sacc.,  
Panus conchatus Fr., Pezillus chrysitia Berk., Pezillus olivaceus  
HOOK. f., P. sulphureus Berk., Peziza aurantia Pers., Pholiota  
aurivella (Batsch) Fr., Pluteus palumbinus Berk., Polyporus  
crenoricolor Berk., P. crepus (Pers.) Fr., P. digitalis Berk.,  
Polystictus elongatus Berk., P. lignoides Mont., P.  
algherensis Mont., Polystroma grossum (Berk.) Boedijn.,  
Psathyra calvescens Berk., Rhizina zonata Berk., Aneura  
amatica Fr., Stereumhirsutum (Willd.) Fr., Schizophyllum commune

Fr., Tremella protensa Berk., Trematos colliculosa Berk.,  
Uovaria thwaitesii Hook. f., Xerotus cantharelloides Berk.,  
Xylaria tabacina (Klckx.) Berk., Medothia macrotia (Berk.) Sacc.;  
and F. Currey (1874) on Hexagonia Kurzii Currey, Peziza nurentia  
Pers., Xylaria tabacina (Klckx.) Berk., Fomes melanogorus Mont.

From 1886 to 1891, A. Barclay (1890, 1891) worked on  
Aecidium mori Barclay, Puccinostele clarkiana (Barclay) Diet.,  
Puccinia nitida Barclay, Colosporium campanulae (Pers.) Lev.;  
M. C. Cooke (1891) on Bulgaria chalybia (Berk. in Herb) Cooke  
and Massae. Where as from 1898 to 1912, G. Massae (1898) studied  
Hydnium coralloides Scop., Galera burkhillii (Massae). Workers who  
worked on the different genera and species of fungi during the  
period from 1899 to 1926 are : P. Dietel (1899) on Puccinostele  
clarkiana (Barclay) Diet.; P. Hennings (1901) on Lycomorpha  
elongatum Berk., Polyporus americanus Berk., Stereum hirsutum  
(Willd.) Fr., S. purpureum Pers.; H. P. Sydow (1902-1924) on  
Puccinia congesta Berk. and Br., Uredo ranunculus Syd.; G. Watt  
and H. H. Mann (1903) on Hectria cinnabarina (Tode) Fr.; P. Dietel  
(1904) on Puccinostele clarkiana (Barclay) Diet.; C. G. Lloyd  
(1904-1919) on Fomes sanex Hess and Mont., Ganoderma lucidum  
(Leyes) Karst., Polyporus gilvus Schw., P. saccharibilia Berk.,  
Polystictus elongatus Berk., P. lignoides Mont., P. tabacinus  
Mont., Stereum hirsutum (Willd.) Fr.; H. P. Sydow and E. J. Butler  
(1906) on Acanthostoma wattii (Syd. and Butler), Aecidium mori  
Barclay., Asterina indica Syd., Chaetothyrium javanicum (Zimm.)

Boschn., Colosporium campanulae (Pers.) Lev., Myriangium  
duriae Mont. and Berk., Neotria cinnabarina (Tode) Fr.,  
Rhacidium sylvaticum Syd., Rytisma acerinum (Pers.) Fr.,  
Sphaerella rosigena Ellis. and Everh., Xylaria tabacina (Kieckz)  
Berk., Uromyces congoлинаe Cooke., U. setariae-italicae (Diet.)  
Yoshino Ustilago aperta Syd. and Butler; H. H. Mann (1906) on  
Exobasidium vexans Massae; H. H. Banker (1906) on Steccherinum  
rhos (Schw.) Banker; P. Dietel (1906) on Aecidium gori Barclay;  
and H. P. Sydow and E. J. Butler (1907) on Aecidium gori  
Barclay., Puccinia inavati Syd., P. solmsii P. Henn.; P. Dietel  
(1907-1910) on Puccinostele clarkiana (Barclay) Diet.; W. McInae  
(1910) on Exobasidium vexans Massae; F. Theissen (1911) on Peziza  
senex Nees and Mont., Stereum hirsutum (Willd.) Fr.; H. and P.  
Sydow and E. J. Butler (1912) on Aecidium nycei Syd., A.  
vancouveriae Cooke., Colosporium campanulae (Pers.) Lev.,  
Exobasidium vexans Massae., E. nioridia P. Henn., E. indica  
Syd. and Butler., Puccinia gracillata Syd. and Butler., P.  
nevadense Syd., Puccinostele clarkiana (Barclay) Diet., Uredo  
dioscoreae Cooke.; F. Theissen (1912) on Acanthostoma wittii  
(Syd. and Butler)., Melanconium ranjani Mitra, A. K.; F.  
Theissen (1913) on Asterina indica Syd., Peziza senex Nees. and  
Mont., Lloydella bicolor (Pers.) Noel and Lits., Polystictus  
tabacinus Mont.; C. G. Lloyd (1915) on Polyporus hookeri Lloyd.,  
Polystictus nilgherionensis Mont.; H. and P. Sydow and E. J.  
Butler (1916) on Colletotrichum clorodendri Diet., Dinemasporium

hispidulum (Schrad.) Sacc., Robillarda sessilis Sacc., Santaria  
rosea Desm., S. tabacina Diet.; T. Patch (1917) on Myriophyllum  
duriaci Mont. and Berk.; C. G. Lloyd (1917-1919) on Madia  
vernicens (Schw.) Ges. and deNot.; A. C. Tunstall (1918) on  
Hectria cinnabarina (Tode) Fr.; S. J. Butler (1918) on  
Exobasidium vexans Maseoe., Ustilina zonata (Lev.) Sacc.,  
Uromyces setariae-italicae (diot) Yoshino; A. C. Tunstall (1918)  
on Ustilina zonata (Lev.) Sacc.; C. G. Lloyd (1923) on Xylaria  
tabacina (Kickx) Berk.; G. Bresadola (1920) on Hirneola cochleata  
Fr., H. delicata (Fr.) Bres., Laschia intestinalis (Berk.) Bres.;  
S. N. Bose (1922) Trametes cincta Dose; A. C. Tunstall and S. N.  
Bose (1922) on Exobasidium vexans Maseoe., E. oleridis P. Henn.,  
E. indicum Syd. and Butler; A. C. Tunstall (1922) on Ustilina  
zonata (Lev.) Sacc., A. C. Tunstall (1923) on Hectria cinnabarina  
(Tode) Fr.; W. A. Merrill (1924) on Sternum hirsutum (Willd.) Fr.;  
A. C. Tunstall (1925) on Exobasidium vexans Maseoe., Hectria  
cinnabarina (Tode) Fr.; T. Patch (1925) on Hydnum alvum Berk.;  
(1925).

From (1926 to 1933) A. C. Tunstall (1927) on Exobasidium  
vexans Maseoe.; P. Dietel (1928) on Puccinostate clarkiana  
(Barclay) Diet.; A. Hafiz Khan (1928) on Colensoarium canosculum  
(Pers.) Le'v.; A. C. Tunstall (1928) on Hectria cinnabarina (Tode)  
Fr.; S. N. Bose (1919 - 1928) on Fomes adamentinus (Berk.) Sacc.,  
E. durns (Jungh.) Cunn., E. fastuosus Le'v., E. lignosus (Klotzsch),  
E. melanoporus Mont., E. senex Nees and Mont., Ganoderma lucidum  
(Leyss) Karst., G. subternatum Merrill., Hexagonia Kurzii Currey.,

H. sulcata Berk., Polyporus circinatus Fr., P. gilvus Schw.,  
P. hookeri Lloyd., P. radiatus (Sow.) Fr., P. secerotibilia  
Berk., Polystictus lichenoides Mont., P. nilahariensis Mont.,  
P. tabacinus Mont., S. J. Butler and G. A. Bisby (1931) on  
Chaetothyrium javanicum (Zimm.) Boedijn., Dianortha (Chorostate)  
toxicola Sacc. and Syd., Fomes fastuosus Le'v., Ganoderma  
annulare (Lloyd) Boedijn., Leucogasterius excoriatus (Schaeff.  
ex Fr.) Singer., Leucites unicolor (Fr.) Cunn., Hymenospora  
thwaitesii (Berk. and Br.) Syd., Polyporus asaricus Berk.,  
Polystictus elongatus Berk., Hymenospora gigantea Berk. and Curt.;  
H. Sydow and J. H. Mitter (1935) on Carcospora chenopodii Pres.,  
Colosporium xanthoxyli Diet. and Syd., Puccinia congesta Berk.  
and Br.; K. B. Boedijn (1934) on Podostroma grossum (Berk.)  
Boedijn.; S. R. Bose (1934) on Fomes albamarginatus (Le'v.)  
Cooke., P. olivicola Fe., P. tricolor (Murrill) Bres., Polyporus  
cuticularis (Bull.) Fr.; H. Mitra (1935) on Gophalosporium spp.;  
S. R. Bose (1937) on Polyporus cuticularis (Bull.) Fr.; B. B.  
Mundkur (1938) on Chaetothyrium javanicum (Zimm.) Boedijn.; H.  
Sydow (1938) on Hatitaga nealensis Liro.; B. B. Mundkur (1939)  
on Schaeletheca ciliabraga Munk.

During the period from 1942 to 1958, F. J. Seaver 1942  
worked on Hymenospora gigantea Berk. and Curt.; B. B. Mundkur and K.F.  
Kneswalia (1942) on Pestalotia elasticola P. Henn.; A. K. Mitra  
(1943 & 1944) on Melanospora ranianii Mitra, A. K.; B. B.  
Mundkur and H. J. Thirumalachar (1946) collected and studied  
Hymenospora thwaitesii (Berk. and Br.); S. R. Bose (1946) on

Fomes durus (Jungh.) Cunn., Polyporus circinatus Fr., P. radiatus (Sow.) Fr., Strobilomyces kalimpongensis Bose; S. N. Banerjee (1947) on Polyporus agaricus Berk., Polystictus elongatus Berk.; G. C. DaCosta and B. B. Mundkur (1948) on Phyllosticta pirina Sacc.; M. S. Pavgi and B. B. Mundkur (1948) on Ustilago maydis (D.C.) Corda, U. aperta Syd. and Butler., U. rabenhorstiana Kuehn.; T. C. Roy (1948) on Nyssonosora thwaitesii (Berk. and Br.) Syd., Penicillium expansum Link., P. italicum Wehmer.; K. B. Raper and C. Thom (1949) on Penicillium expansum Link., P. italicum Wehmer; B. L. Chona and R. L. Munjal (1950) on Myriangium duriaei Mont. and Berk.; G. H. Cunningham (1950) on Fomes durus (Jungh.) Cunn., Lenzites unicolor (Fr.) Cunn.; B. B. Mundkur and M. J. Thirumalachar (1952) on Spaceolotheca dinebrae Mundk., Ustilago maydis (D.C.) Corda., U. nepalensis Liro., U. aperta Syd. and Butler., U. rabenhorstiana Kuehn., U. tuberculiformis Syd.; K. Ramkrishnan and T. S. Ramkrishnan and C. V. Subramanian (1952) on Leucoagaricus exoriatus (Schaeff. ex Fr.) Singer., Stereogloeocystidium spadicium (Fr.) Rick.; K. Bagchi (1953) on Xylaria hvooxylon f. tropica.; S.K. Roy (1953) on Daedalea subsulcata Berk. & Br.; K. Bagchi and Y. N. Puri and B. K. Bakshi (1954) on Fomes pinicola Fr., F. Senex Nees and Mont.; Y. N. Puri (1955) on Fomes pinicola Fr., F. senex Nees and Mont.; B. L. Chona and R. L. Munjal and J. N. Kapoor (1956) on Phyllosticta sterculicola Trav.; and on (1957) on Septoria cestri (Mont.) Sacc.; V. Agnihotrudu and G. C. S. Barua (1957) on Kutikalakesonsis macalpineae Agnihotrudu and

Barua.; A. C. Lacy (1953) on Discoaria tanzaniae Lacy.

Mention may be made of the workers who worked on the fungal flora of this area during 1959 to 1967, they are : A. L. Munjal and B. L. Chona and J. N. Kapoor (1959) worked on Ascochyta rhei Sll. and Fr.; A. L. Munjal and J. N. Kapoor (1960) on Cochliobolus heterostrophus Drechsler; and on (1961) on Hyalopsoza polytrichii (Pers.) Nagl.; J. N. Kapoor and A. S. Gill (1961) on Mycochaerell minimaenata Cooke, Kapoor and Gill.; P. N. Rao (1962) on Sarcospora cruciferarum Sll. and Sv.; M. N. Payak and D. P. Misra (1963) Zuccinia coronata var. avena Erikss.; K. S. Thind and Karnail Singh Waraich (1964) on Rhizis rapanda Pers.; U. P. Singh and M. S. Pavgi (1965) on Stictis bangalensis Singh and Pavgi; H. C. Dubo and K. S. Bilgrami (1966) on Roestelia pedocerei Dennis; M. S. Hane, K. K. Payak and B. L. Kenfro (1966) on Phaeochaeria maydia (P. Henn) Hane, Payak and Kenfro; S. K. Banerjee (1966) on Gidium sp.; K. S. Thind and S. S. Sattan (1967) on Clavaria inaequalata Wein., Clavulinopsis minata (B) Corner., Deflexule subsimplex (P. Henn) Corner; S. B. Chattopadhyay and S. K. Sengupta (1967) on Eusarium solani (Mont.) App. and Wall; J. N. Kapoor and A. L. Munjal (1967) on Heliola rubicella Hansf.; A. N. Ghosh, H. C. Pathak and I. Tewari (1967) on Gutierrezella radicata (Rehm. ex Fr.) Singer.

Again during the period from 1968 to 1981, A. K. Kar and K. P. Pal (1968) worked on Ascochelus lignatilis A. and S., Ascochaeta striatus Thind, Cash and Singh, Chaetmania coarctata (Cooke) Boud, C. stercorea (Pers. ex Fr.), C. theleboloides

(Alb. & Schw. ex Fr.) Boud., Tricothema nelletieri (C. & Cr.) Boud.; S. M. Reddy (1969) on Anicopora montanoi Sacc., Valsaria cinnabarinum (Cda.) Srinke. & Benth.; A. K. Kar and M. Mondal (1969) on Cercospora amoni Kar & Mondal, C. hardsyrensis Kar & Mondal, C. dichlitorae Kar & Mondal, C. divalliae Kar & Mondal, C. johnsonii Kar & Mondal, C. tillacorseae Kar & Mondal; K. S. Thind and Harnek Singh (1969) on Helotium himalayens Thind & Singh, Lambertella cryptomariae Thind & Singh, Eustroemia avinistonia Thind & Singh; K. S. Thind and S. S. Rattan (1970) on Eustroemia indica Thind & Singh; K. S. Thind and Harnek Singh (1970) on Corynetes atrocerasus (Batsch & Fr.) Dur., Gudonia luras (Peck) Sacc., Geoglossum affine (Dur.) Sacc. & Trav., Microglossum longisporum Dur., Seriaria clavida var. longispora Meins., Spathularia clavida var. longispora Meins., Trichoglossum farlowii (Cke.) Dur.; A. K. Kar and M. K. Maity (1970) Melanoceraeus sanchalii Kar & Maity, Valsaria cryptomariae Kar & Maity; A. K. Kar and M. Mondal (1970) on Cercospora wedeliae Kar & Mondal; A. K. Kar and K. P. Pal (1970) on Eibhriopsis hrugli Kar & Pal, C. cerasa Kar and Pal, Dasyscypha nudica var. minor Dennis, D. oblonga-elliptica Kar and Pal, Lachnellula himalayensis Kar and Pal, Cookeina sulcipes (Berk.) Kuntze, G. tricholoma (Mont.) Kuntze, Helvella elastica Bull. ex St. Aman, H. apicatum Lo'v.; and on Boltoniopsis arvalina (Karst. Sacc. & Syd.), Bulgaria inquinans (Pers. ex Hook.) Fr., Dasyscypha fuscans (Pers. ex Fr.) Rehm., Verotinia spiraeicola Dennis; and on Wynnea macrotis

(Berk.) Berk.; A. K. Kar and M. K. Maity (1970) on Asterina claviflora Kar and Maity, A. drimycarai Kar and Maity, A. iamholanae Kar and Maity, A. mysinae Kar and Maity, A. zanthoxyli Yamamoto, Aulographum maculata Berk. and Br., Cylindrosporium leucosceptri Keissler, Sarcinella prunicola Pavgi and Singh, Soridium indicum Pavgi and Singh.; and on (1970) on Asterocystis caasaridia Kar and Maity, Gnomonia appendiculata Kar and Maity; M. S. Pavgi and U. P. Singh (1970) on Annelomyces anisualis Ces., Aulographum maculata Berk. & Br., Cercospora pulchella T. S. & Sankrishnan, E. Withanae, H. and P. Sydow, E. oxycalyi Pavgi and Singh, Cylindrosporium leucosceptri Keissler, Pestalotiopsis palmigii Pavgi and Singh., Sarcinella prunicola Pavgi, Soridium indicum Pavgi and Singh; A. K. Kar and M. K. Maity (1971) on Appendiculella heveniae Kar and Maity, Asteridiella meliosmae Kar and Maity, A. phiana var. major Kar and Maity, A. pentanterygii Kar and Maity; Lrenopsis tenuissima var. major Kar and Maity, and on (1971) on Hypoxylen bovei var. microsporum Miller, H. magalosporus Speg., H. rutilum Tul., and on (1971) on Edaccioidea anarctica P. Henn and Shival., Phyllochorella micheliae Syd., Phyllochora leae-elatae Kar and Maity; K. S. Thind and Harnek Singh (1971) on Belonopsis baghusae Thind and Singh, Hymenascyphus subcomplicatus Thind and Singh; K. S. Thind and K. S. Waraitch (1971) on Plecteria himalayensis Thind and Waraitch; and on (1971) on Lamprospora lebata (Berk. & Curt.) Seaver, Scutellinia hadiobaria (Berk. ex Cooke) Kuntz.; D. K. Purohit (1971) on Pestalotia

acruinea Stey.; H. P. Srivastava (1971) on Gelasinospora  
ratisspora Cain., Lentosantheurulia trifolii (Aostr.) Petr.;  
A. K. Kar and M. K. Maity (1972) on Appendiculella calostroma  
(Desm.) V. Hohn., Armatella litsea (P. Henn.) Theins. Syd.,  
Iranopsis crotonis (Ster. Tchon.) Stev.; J. L. Shreemali (1972)  
on Ascochyta cyathulae Chena and Mujal; S. Singh and P. S.  
Pandey (1972) on Melanconidius irama Singh and Pande.; T. A.  
Nagraj and Kendrick Bryce (1972) on Urophondarsocia indica Syd.;  
B. B. Dewan and A. K. Kar (1974) on Coleosporium blattae Diet.,  
Trichoglossum farlowii (Cooke) Durand; A. K. Kar and B. B. Dewan  
(1975) on Aleuria aurantia (Fries) Fuckel, Gaeoglossum fallax  
Durand, G. schagrabulum Shrenck Wallr., Neottiola vivida  
(Nylander) Dennis; and on (1975) on Peziza carae (Cooke) Boudier,  
P. gilva Boudier; K. S. Thind and K. S. Haraitch (1975) on  
Rondiera narvispora; A. K. Kar and B. B. Dewan (1975) on Peziza  
domicelliana Cooke., P. echinospora Karst.; A. K. Kar and H. C.  
Chakraborty (1977) on Sphaerosporella brunnea (Alb. and Schue.  
ex Fr.) Svranc Kub., Sarcoscypha coccinea (Scop. ex Fr.) Lamb.,  
Sdytidhysterium rufulum (Spreng.) Speg., Chlorosplenium  
aeruginum (Berk.) Sac.; A. K. Kar and S. K. Gupta (1978) on  
different species of Xylaria; A. K. Kar and S. N. Ghosh (1973)  
on different species of Helicium; A. K. Kar and B. B. Dewan (1973)  
on Coleosporium campanulae (Pers.) Lev., E. myriactidis Syd.,  
E. plectranthi Barclay, Phragmidium octolocularis Barclay, Ruccinia  
arundinariae Schw., R. caricis (Schum.) Robert., R. collattiana  
Barclay., R. fagopyri Barclay., R. menthae Pers., R. punctata  
Link., R. rosapholiata Maire et Sacc., R. rososae Barclay, R.

urticae Barclay, Drooycea annandiculatus (Pers.) Unger, U. fabae (Pers.) de Bary, U. trifolii (Otedw. f.) Lev.; K. S. Waraitch (1980) on different species of Ascobolus and Cheilmania; A. K. Kar and S. K. Gupta (1980) on different species of Phyllachora; A. K. Kar and H. S. Mahapatra (1981) on different species of Collatetrichum.

From the above literature review it reveals that there is ample scope to work on the fungal flora of North Bengal. As such the present work entitled : <sup>Investigation on the</sup> ~~Survey of~~ fungal flora of North Bengal was taken up in 1972.

## COLLECTION AND PRESERVATION OF SPECIMENS

With a view to study the fungal flora in their natural habitat and to collect them for detailed study in the laboratory, frequent field trips were undertaken throughout the year in different parts of North Bengal during 1972 to 1981. The areas of field study and collection included districts of Jalpaiguri, Malda, Cooch-Bihar, Darjeeling (including Siliguri at an altitude ranging from 23-1,000 ft.; hills of Kalimpong, Kurseong and Darjeeling at an altitude ranging from 3,000 - 8,000 ft.). The fungi mainly belonging to the Discomycetes, Pyrenomycetes and Uredinales and Deuteromycetes were collected following standard techniques after taking field notes. During collections in the field, a 10 X handlens and a sharp knife were very useful for finding out the fungi in natural habitat and preliminary examination of the lesions in the infected leaves.

In the collection spot, the specimens were collected and examined by handlens. The specimens were then collected in brown paper bags and also cellophan bags, on which field notes such as : locality, date of collection, habitat, texture, external features and colour were recorded. Some of the specimens collected were preserved dry and others in liquid. For dry preservation, the specimens were placed in a drying oven at 50°C for three to four hours for three days in case of fleshy Discomycetes. Specimens of leaf-inhabiting fungi were dried by the usual pressing method used for Phanerogamic

specimens and placed in herbarium packets. Thoroughly dried specimens were treated with Paradichlorobenzene to prevent destruction by insects. As to wet preservation, specimens were preserved in liquid made out of 40 percent formalin with 5 percent glycerin in 1 : 1 ratio.

All specimens collected were labelled as DGC  
(Darjeeling Government College herbarium, Darjeeling).

## MATERIAL AND METHODS

The collected specimens were at first examined in the laboratory with dissecting microscope at 10 - 20 X. In case of discomycetous fungi, the colour of the disc and excipulum, stipe and hairs were recorded. Behaviour of different fungi on leaves and other vegetative parts was studied both from fresh and preserved specimens.

Details of fruit bodies were studied from crushmounts of fresh specimens in water and from free hand sections stained in lactophenol cotton blue. They were also studied from serial microtome sections by fixing in FAA for 12 hours followed by dehydration in alcohol grades and xylene series, embedded in paraffin wax, and sectioning at 10 - 20  $\mu$ . The microtome sections were stained in lactophenol cotton blue.

The dried specimens were treated with 2% KOH for about five minutes and then washed in water. After this treatment the specimens were softened and then sectioned with a good razor blade. The sections were stained in lactophenol cotton blue, mounted in lactophenol and covered with coverglass and ringed with paraffin wax.

In case of fungi belonging to the Meliolaceae at first a good colony was selected, one drop of colloidal acetone was placed upon the colony. After drying it was removed. Its removal from the leaf usually brought the whole of the surface mycelium intact within it. The whole thing was then placed into

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lactophenol, covered with coverglass and ringed with paraffin and was ready for examination.

For special examination of discomycetous fungi, fresh specimens were crushed in Melzer's reagent (consisting of 0.5 gm iodine, 1.5 gm Potassium iodine, 20 gms of chloral hydrate and 20 ml. distilled water), covered with coverglass and examined. This reagent gives a blue stain either the entire wall of the ascus or tip of the ascus. Response to iodine of ascus and hymenium was also worked out separately.

Ascospore ornamentations were studied using technique laid down by Le Gal (1947) and Korf (1952).

KOH-Phloxine staining and Sudan III staining techniques were applied for the study of spore septation and for study of the nature of oil globules.

All microscopic examinations were made with compound Microscope of varying magnification range.

Photography was done with Reichert Camera by using blue filter. Photography of small size specimens was done with reflected light.

## EVALUATION OF TAXONOMIC CHARACTERS

Following are some of the important structures which are used for the taxonomic treatment of the members of the Discomycetes, Pyrenomycetes, Uredinales and Deuteromycetes. The structures that are described here are based on the genera that have been described in this work.

Ascus - It is a sac-like structure in which the ascospores are formed endogenously by karyogamy and meiosis. The asci of the operculates differ from the inoperculates by the presence of lid or operculum at the tip of the ascus.

Melzer's reaction of the asci - Melzer's (iodine) reaction of the asci is of great significance. The presence or absence of bluing reaction of asci is very much characteristic. The bluing reaction of the entire ascus wall or tip of the ascus is believed to be due to the presence of an amyloid substance.

The asci of the Pyrenomycetes are of various shape : globose, oblong, elliptical, clavate and cylindrical. They may be short-or long-stalked. The ascus wall may be composed of single layer or of 2 layers unitunicate or bitunicate. The nature asci are usually 8-spored, but sometimes may be 2-, 3-, 4- and many-spored.

The wall of unitunicate asci may be uniform in thickness but more often with conspicuously thickened at the apex. The unitunicate asci are thin-walled and the ascospores are

discharged through an apical pore.

The bitunicate asci consist of a rigid outer and an extensible inner wall. At maturity the outer wall ruptures at the apex and the inner wall expands to form a long cylindrical sac.

Ascospores - They vary greatly in size, shape and colour. They may be septate or aseptate. The wall may or may not be variously ornamented. The ascospores of inoperculate species are always smooth-walled and may be uni-, bi-, or multicellular. The size of the spores is usually small except the long-spored species of Geoglossum Pers. ex Fr. and Trichoglossum Bond.

Paraphyses - These are sterile hyphal threads which remain intermingled with asci. Paraphyses may be filiform or slender, simple or branched, septate or aseptate. In some genera they are pigmented which give colour of the hymenium. On the other hand the paraphyses in some genera may be hyaline.

Hairs - The hair characters are of considerable taxonomic value. The hairs are stiff, erect, pointed, thick-walled, brown, bristle-like, septate as in Scutillinia (Cooke) Lambotte and with bulbous base in Tricharia Boudier.

Excipulum of apothecium - The excipulum may or may not be differentiated into two distinct zones. If differentiated, outer one is called outer excipulum and the inner one is called

Medullary excipulum.

The terminology employed here to describe the various sterile tissue of the apothecium is as applied by Starbäck (1896) and amended by Korf (1951 & 1958). The details of the excipulum are given below.

I. Short-celled tissue : the separate hyphae not distinguishable.

A. Cells round to polyhedral, almost isodiametric

1. Cells rounding up, with intercellular spaces :  
textura globulosa

2. Cells polyhedral by mutual pressure, no intercellular spaces :  
textura angularis

B. Cells more or less rectangular in section, not isodiametric:  
textura prismatica

II. Long-celled tissue : the separate hyphae easily distinguishable

C. Hyphae running in all directions, not parallel

3. Hyphae with their walls not united, usually with distinct interhyphal spaces : textura intricata

4. Hyphae with their walls united, without interhyphal space, usually forming a membranaceous tissue :  
textura epidermoidea

D. Hyphae running in one direction, more or less parallel

5. Hyphae with narrow lumina and strongly thickened walls, cohering : textura oblita

6. Hyphae with wide lumina and non-thickened walls, not cohering : textura porrecta

The members of the Pyrenomycetes possess fructification of varied forms which may or may not be associated with stroma : stromatic or non-stromatic respectively. Besides the characters of fructifications certain structures borne in or on the fructifications and others on hyphae have also been utilized for the taxonomic studies. Depending on their structural peculiarities and structures borne in them, the fructifications have been designated by various workers in a different manner. In the present work terminologies have been following interpretations of leading workers in respective orders, families and genera; a brief account of which is outlined below.

Hyphae - The hyphae are septate, simple or branched, thin- or thick-walled, hyaline to dark coloured, smooth or bearing some special structures-hypopodia and setae. The hypopodia may be one- to two-celled. The presence of hypopodia is the characteristic feature of the family Melicaceae. The presence of setae on mycelia is a taxonomic character in the delimitation of certain genera, e. g. Melicia.

Stroma - It is cushion-like mass of fungal hyphae which may or may not be associated with host tissue, in or on which the fructifications are developed. The stromata may be flattened crust-like, more or less hemispherically pulvinate, columnar, cylindrical, clavate, capitate, or dendroid. They may be sessile to stipitate, totally immersed or erumpent or totally superficial on the substratum. The stromata may be soft or hard being

made up of a pseudoparenchymatous or prosenchymatous tissue of definite outline. The fructifications borne in the stroma may be a typical perithecium with a definite perithecial wall or there may develop in the stroma cavities (locules) without any definite wall of their own.

Perithecium - It is superficial or flask shaped ascocarp with a short or long beak, characteristic of the Pyrenomycetes. Each perithecium is provided with a pore or slit at the tip-the ostiole, through which the ascospores escape. The ostiole is formed schizogenously and is lined with fine hyphae - paraphyses. The perithecium bears asci which are arranged in a large forming hymenium and are intermingled with slender, sterile hyphal threads, the paraphyses are free at the tip. The perithecia may be associated with a well-developed stroma-stromatic perithecia; or with some mycelial growth, the subiculum; or may be free from any kind of stroma or mycelial growth-non-stromatic perithecia. The perithecia may be glabrous or may be set with various types of hairs, appendages or setae of taxonomic importance. The perithecia may be singly or in groups. They may be superficial, erumpent or deeply embedded in the substratum. A perithecium regardless of whether it is associated with a stroma or not, has a true wall of its own.

Thyriothecium - It is a shield-shaped, flattened type of ascocarp. It is always superficial and characteristic of the

Microthyriaceae and Asterinaceae. It always contains bitunicate asci.

Ostiole - It is a mouth or opening, more specifically, the schizogenously formed canal in the tip of a true perithecium, lined with periphyses.

Setae - Other than hairs and appendages, the perithecial wall may bear certain stiff, pointed to hooked outgrowths setae.

The important structures that are used for the taxonomic treatment of the Uredinales are given below.

Stage 0. Pycnia (spermatogonia) bearing pycnosporae (spermatia) and receptive hyphae. There are several types of pycnia in the rusts. Some are more or less globose or flask-shaped, but others are flat and sprawling.

Stage I. Aecia bearing aeciospores. An aecium is a cup-like structure usually surrounded by a peridium which may be short or conspicuously long. Peridium may also be lacking in an aecium. An aecium is filled with closely packed parallel chains of aeciospores.

Stage II. Uredia bearing uredospores. Uredospores are single-celled stalked. In some cases they may be sessile forming in chains. Most uredia do not have a peridium, but some do.

Stage III. Telia bearing teliospores. Teliospores vary

enormously in different rusts. Classification of the Uredinales into families and genera depends largely on the teliospore characteristics. Teliospores may be sessile or stalked, single- to many-celled. They may be completely free from one another or they may be embedded in a gelatinous matrix or united laterally forming small groups, layers or columns.

Stage IV. Promycelium bearing basidiospores. Teliospore on germination produces a promycelium which may remain inside the teliospore (internal) or outside (external).

It is difficult to classify rusts whose teliospores are not available as because the classification of rusts is based on the nature of teliospores. As such, an artificial Group-Uredinales Imperfecti has been created in which some rusts are placed whose aecial and uredial stages are only known. These rusts are categorized as form-genera.

Members of the Deuteromycetes are separated into form-order, form-family, form-genus and form-species considering the nature of conidia, conidiophore, and related structures.

**PEZIZA (Dill.) L. ex St.-Amans, Fl.A gen. 530. 1821.**

Peziza Dill., Cat. Pl. Giss. 194. 1719.

Peziza (Dill.) L., Sp. Pl. 2 : 1180. 1753.

Scodollinia S. F. Gray, Nat. Arrang. Br, Pl.

1 : 668 : 1821.

Phaeopezia Sacc., Michelia 1 : 71 : 1877.

Peziza (Dill.) L. ex St.-Amans subgen. Phaeopezia

(Sacc.) ex Sacc. apud vido, Michelia

1 : 594. 1879.

Phaeopezia (Sacc. ex Sacc. apud vido) Sacc. apud

vido, Michelia 1 : 595. 1879.

Peziza (Dill.) L. ex St.-Amans (Ser. Aleuria Fr.)

Sub gen, Galactinia Cooke, Mycograph. 1 :

253. 1879.

Galactinia (Cooke) Bond., Bull. Soc. mycol. Fv.

1 : 101. 1885, esent Le Gal, Discom. Madag.

27. 1953.

Peziza (Dill.) L. ex St.-Amans (Ser. Aleuria Fr.)

Sub gen. Pustularia Cooke, Mycograph. 1 :

253. 1879.

Peziza (Dill.) L. ex St.-Amans subgen. Aleuria

(Fr.) Sacc. (Sect.) Geoscypba (Cooke) Sacc.,

Bot. Cbl. 13 : 215. 1884.

Geoscypba (Cooke) Lamb., Fl. mycol. Belg., suppl.

1 : 320. 1887.

Phaeopezia (Sacc. ex Sacc. apud vido) Sacc. apud

vido subgen. Aleurina Sacc., Bot. Cbl.

13 : 215. 1884.

Heteropogon Clem., Bull. Torrey Bot. Club. 30 : 92.  
1903.

Daleomyces Satchel, Mycologia 16 : 214. 1924.

Durandiomyces Seaver, N. Am. Cup Fungi (operc.) 242. 1928.

Nanomyces Clem. & Shear, Gen. Fung. 333. 1931.

Lectotype species : Peziza vesiculosa Bull. ex St.-Aman.

Apothecia scattered to gregarious, medium to large, superficial, sessile to sub-stipitate, smooth, discoid, sometimes flattened or becoming convex, brown, violet, almost black, or flesh-coloured, soft, fleshy; tissue of the excipulum varied considerably and of either textura globulosa or textura intricata or both; asci cylindrical, 8-spored, blued by Melzer's reagent; ascospores ellipsoidal, occasionally subhyaline to brownish with or without oil globules, walls smooth or ornamented of various markings; paraphyses slender or stout, septate, unbranched, apex subclavate to clavate or subcylindrical, straight or gently to strongly curved, often containing coloured granules.

Habitat - On damp or burnt soil, sometimes on decaying wood or bark, a few on manured ground or on dung.

The old genus Peziza, which has been subjected to various interpretation and frequent emendations, so that one can easily be confused for its nomenclatural application, was named by Dillenius (1919) to include almost any cupulate discomycetes without mentioning the type.

In 1885 Boudier divided the genus Peziza into two portions : one part called as Alenia(Fr.) Gill. emend, Boud. emend Le Gal (1953, 1959, 1962), Gamundi (1960, 1964), Sevcak & Kubicka (1961), Svrcek (1962 and 1965) and others. But under the current international Code of Botanical Nomenclature the genus Alenia (Fr.) Gill. cannot be used as it is the later synonym of Alenia Fuckel. Hence the genus is called Peziza by Seaver, Dennis, Korf and others.

Suggested key to the species of Peziza

- a. Ascospores smooth-walled
  - b. Apothecia cup-shaped becoming expanded with age,  
hymenium yellowish-brown ... Peziza cerea
  - bb. Apothecia cupulate becoming revolute with age,  
hymenium at first white turning dingy buff  
... Peziza denticilliana
- aa. Ascospores with minutely warted wall
  - c. Apothecia brown to dark-brown, ascospores without  
oil globules ... .. Peziza echinospora
  - cc. Apothecia pale brown to pale reddish brown,  
ascospores with two large oil globules  
... .. Peziza nataraii

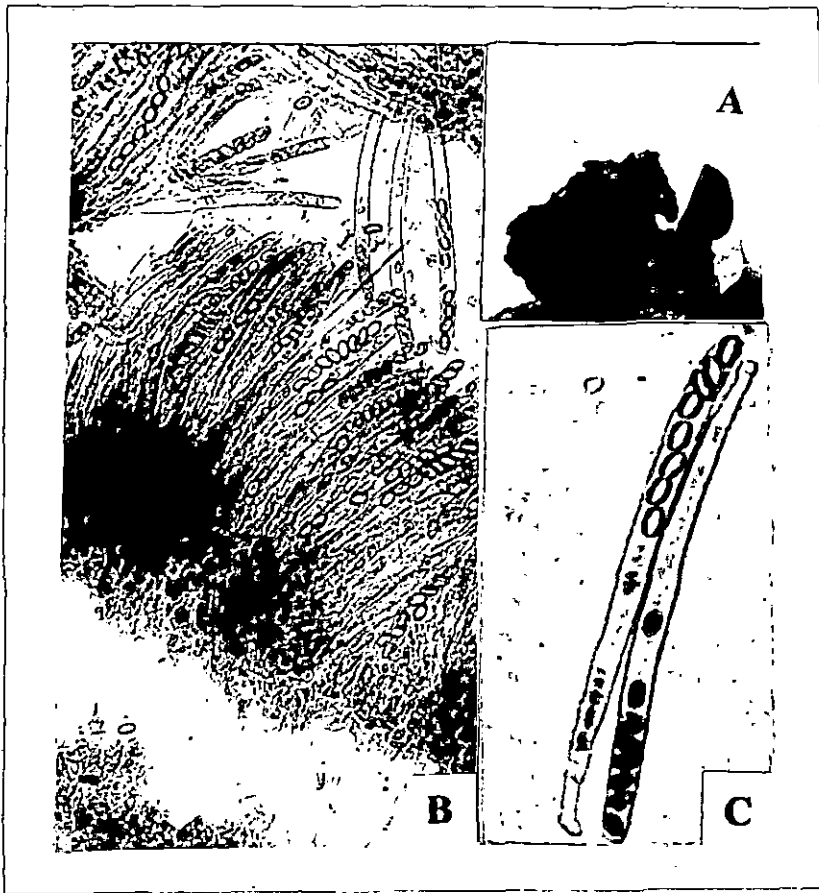


Fig.1. Peziza cerea - A. Apothecium,  $\times \frac{1}{2}$ ;  
B. Vertical section of the hymenium  
showing asci and ascospores,  $\times 184$ ;  
C. Asci with ascospores,  $\times 388$ .

Peziza cerea Sowerby ex M érat, Nouvelle Flora Paris 1:25  
(1821).

Peziza vesiculosa Bull., var. cerea (Bull.) Bull., Hist.  
Champ. Fr. 270. 1791.

Peziza cerea Bull. ex M érat, Nouv. Fl. Paris, 2e Ed., 1:  
25. 1821; Fr., Syst. mycol. 2 : 52. 1822.

Macroscyphus cereus (Bull. ex M érat) S.F. Gray, Nat,  
Arrang. Br. Fl. 1 : 672. 1821.

Plicaria cerea (Bull. ex M érat) Fuckel in Jb. nassau.ver.  
Naturk. 23-24 : 327. 1870 (misapplied, -  
Peziza domicilliana Cooke ?).

Pustularia vesiculosa (Bull. ex St - Amans) Fuckel var.  
cerea (Bull. ex M érat) Rehm, Ascomyceten  
no. 201. 1875; Rehm in Rabenh. Kryptog. -  
Fl. 13 : 1016. 1894.

Alouria cerea (Bull. ex M érat) Gill., Champ. Fr., Discov.  
44. 1879.

Zustularia cerea, (Bull. ex M érat) Rehm in Ber. naturhist.  
ver. Augsburg 26 : 51. 1881.

Galactinia vesiculosa (Bull. ex St - Amans) Le Gal, f.  
cerea (Bull. ex M érat) Svřeek in Česká Mycol.  
14 : 219. 1960.

Galactinia cerea (Bull. ex M érat) Le Gal in Bull. Soc.  
mycol. Fr. 78 : 208. 1962.

( Fig. 1 )

Apothecia short-stipitate when young, disc cup-shaped,

becoming expanded upto 5 cm. diameter; hymenium yellowish - brown, outer surface white, minutely downy to almost scurfy; asci sub-cylindrical, 192 - 198 x 10 - 13  $\mu$ , narrower towards the base, apex blued in Melzer's reagent; ascospores uniseriate, hyaline, ellipsoidal, smooth-walled, without oil globules, 10 - 13 x 7 - 10  $\mu$ ; paraphyses straight, septate, apex enlarged upto 7  $\mu$ .

Habitat - On moist soil mixed with coal dust and on waste paper.

Locality - Birch Hill, Darjeeling, altitude 7000 ft., West Bengal.

Specimen studied - DGC 50; June 9, 1974.

Peziza demicilliana Cooke, Gardner's Chronicle 41 : 793 (1877).

Octospora varia Hedw. Descr. 2 : 22. 1783.

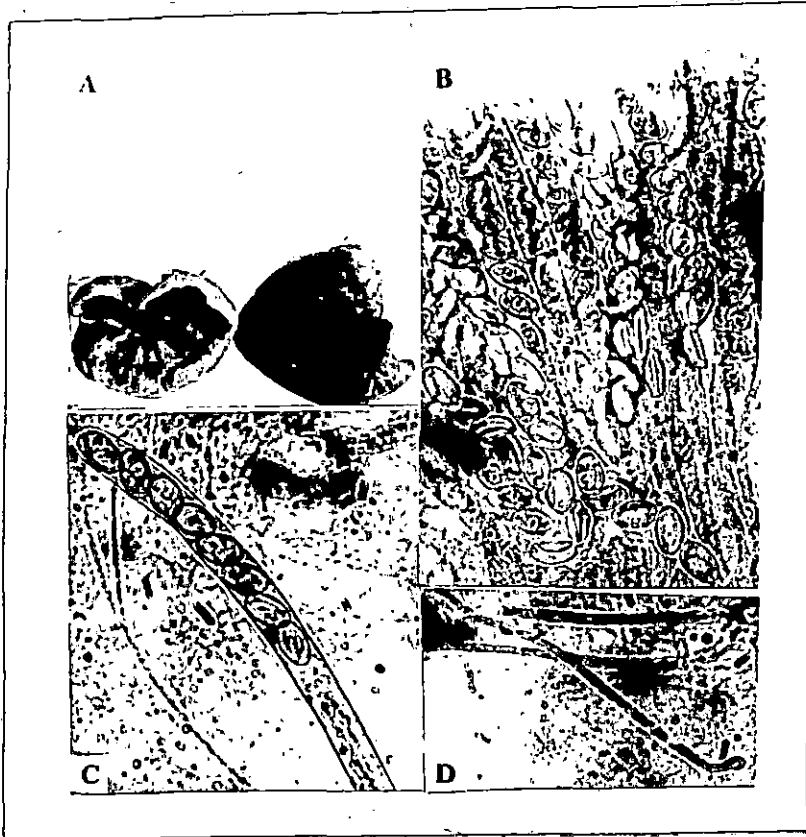
Peziza adae Sadler; Cooke, Trans. Bot. Soc. Edinburgh 13 : 45. 1877.

Peziza odorata Peck, Bull. Torrey Club 23 : 420. 1877.

Peziza varia f. typica Bres. Fungi Trid. 2 : 75. 1898.

( Fig. 2 )

Anthecia gregarious, usually short-stipitate, at



**Fig. 2. *Peziza domicelliana* - A. Apothecia, x1; B. Vertical section of the hymenium showing asci and ascospores, x161; C. Ascus with ascospores, x161; D. Paraphysis, x1500.**

first cupulate, soon becoming revolute with age leaving a depression in the centre, at first rounded, soon becoming irregular and often decidedly angular in outline, externally white, margin entire or occasionally splitting, reaching a diameter of 10 cm; hymenium at first concave, becoming plane or convex distinctly umbilicate, at first white becoming dingy buff, thick, irregular; asci cylindric to sub-cylindric reaching a length of 214 - 244  $\mu$  and a diameter of 10 - 13  $\mu$ , ascus tip blued in Melzer's reagent; ascospores ellipsoid, hyaline 1 - seriate, without oil globules, smooth-walled, 7x13  $\mu$ ; paraphyses slender, filiform, septate, slightly enlarged above.

Habitat - On wall plaster with mosses about 8' from the soil.

Locality - Birch Hill, Darjeeling, altitude 6900ft., West Bengal.

Specimen studied - DGC 60; November 7, 1973.

Peziza echinospora Karst., in Not. Gallisk. Fanna et Flora fennica 10 : 115. 1869.

Plicaria echinospora (Karst.) Rehm Ber. naturhist. Ver. Augsburg 26 : 122. 1881.

Alouria echinospora (Karst.) Svrcek & Kubicka in Ceska Mycol. 15 : 74. 1961.

Galactinia echinospora (Karst.) Svrcek & Kubicka in Ceska Mycol. 15 : 74. 1961.

Peziza umbrina Boud. apud Cooke, Mycograph. 1 : 226 1879 non Peziza umbrina Pers., Mycol. eur. 1 : 220. 1822.

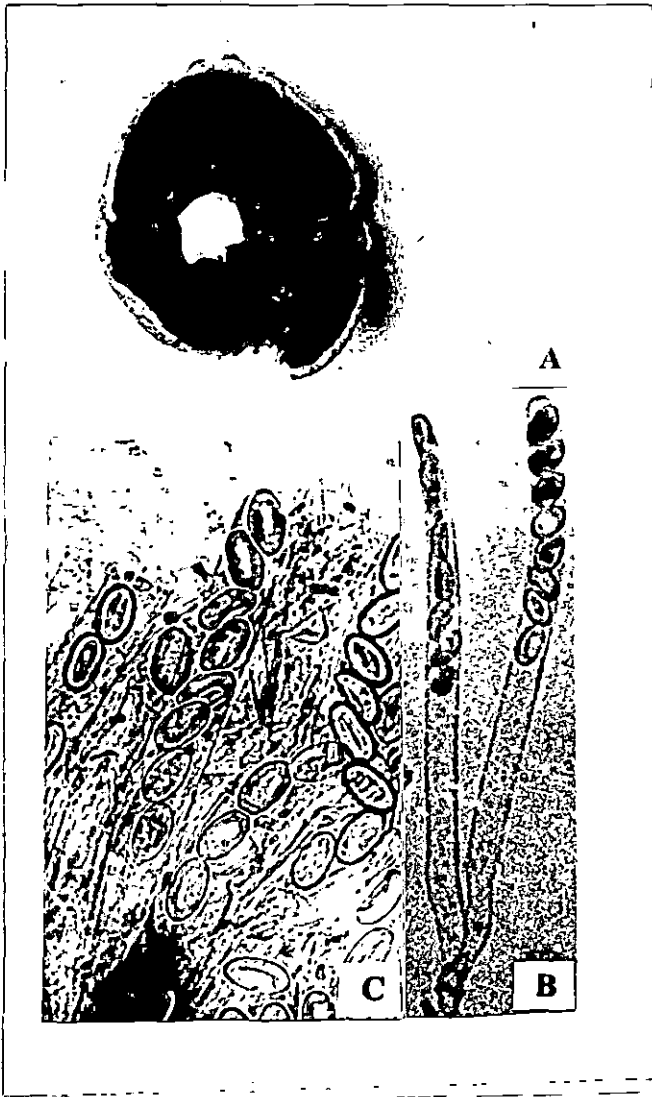


Fig. 3. *Peziza echinospora* - A. Apothecium, x $\bar{4}$ ;  
B. Asci with ascospores, x356;  
C. Hymenium showing asci and ascospores, x529.

Aleuria umbrina (Boud. apud Cooke) Gill., Champ. Fr.,  
Discom. 42. 1879.

Peziza anthracophila Dennis, Br. Cup Fungi 13. 1960.

( Fig. 3 )

Asothecia gregarious, occasionally caespitose, usually rather large, upto 8 cm diameter; disc concave, undulate, smooth, brown to dark brown, receptacle cup shaped, sometimes becoming contorted to almost Quidia - like by mutual pressure, broadly sessile, margin often crenate outer surface paler than the disc, often whitish, scurfy to furfuraceous, the outermost surface layer of the excipular tissue composed of interwoven, septate, short-celled hyphae, the lower pseudoparenchymatous layer thick, of large subglobose or polygonal, cells, separated from the upper pseudoparenchymatous tissue by a layer of compact texture intricata or textura epidermoidea; polygonal, thin-walled subhymenium of compact angular or lobed and slightly narrower below, apex blue in Melzer's reagent, 8-spored, upto 231  $\mu$  long by 13  $\mu$  diameter; ascospores uniseriate, hyaline, without oil guttules, ellipsoidal to oblong-ellipsoidal, finely warted, 7 x 17  $\mu$ ; paraphyses slender, septate, apex subclavate, slightly curved tip swollen reaching a diameter 7  $\mu$ .

Habitat - On burnt soil.

Localities - Birch Hill, Darjeeling, altitude  
6,800 ft., West Bengal.

Specimen studied - DGC 37, March 12, 1974.

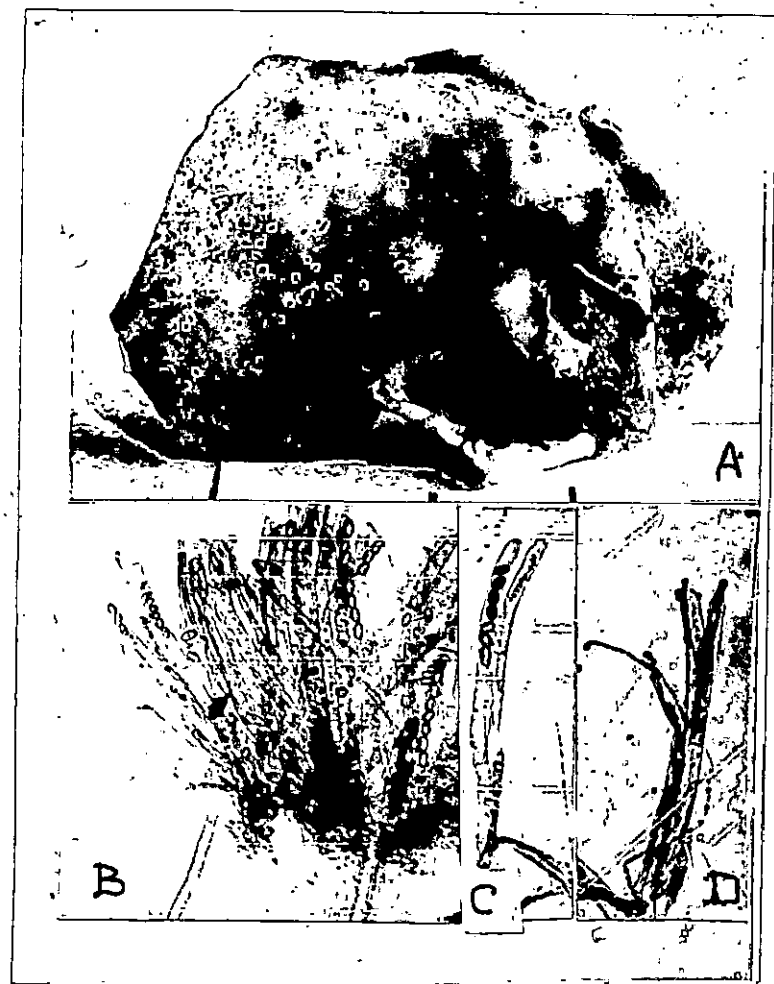


Fig. 4. Peziza petersii - A. Apothecium,  $\times 2$ ;  
B. Hymenium,  $\times 162$ ; C. Asci and ascospores,  $\times 182$ ;  
D. Young asci and paraphysis,  $\times 182$ .

Peziza oterali Berk. in Grevillea 3 : 150 (1875).

Galactinia oteralii (Berk.) Le Gal, Discosm. Madag.

Sl. 1953.

Peziza lubricalis Cooke in Grevillea 3 : 61. 1879.

Discina lubricalis (Cooke) Sacc., Syll. Fung. 3 :

101. 1889.

Galactinia sarrazini Boud. in Bull. Soc. mycol. Fr.

3 : 147. 1937.

( Fig. 4 )

Asothecia scattered to gregarious, upto 7.5 cm, disc regular to contorted, pale brown to pale reddish brown, margin undulate, outer surface much paler than the inner, some what scurfy; asci cylindrical, slightly narrower towards the base, apex turned blue in Molzer's reagent, 8-spored,  $247 \times 10 \mu$ ; ascospores uniseriate,  $13.2 \times 7 \mu$ , ellipsoid to oblong ellipsoid, hyaline, with two large oil globules, covered with minute warts; paraphyses slender, septate, unbranched, apex distinctly enlarged to about  $7 \mu$ , slightly curved, containing brown granules.

Habitat - On soil.

Locality - Ohoom, Darjeeling, altitude 7,500 ft.,  
West Bengal.

Specimen studied - DGC 47, April 19, 1973.

TRICHARIA Bckblad, Nytt Mag, Bot. 15 : 60. 1968.

Apothecia terrestrial, less than 1 cm. in diameter, sessile, scutellate to cupulate, excipulum of two layers, an outer layer of textura intricata, and an inner layer of textura angularis, hairs simple, straight, septate; hymenium grey, brownish or orange-brown; asci cylindrical, eight-spored; ascospores mostly uniseriate, ellipsoid, mostly smooth or rough, without any oil drops; paraphyses straight, septate, not or only slightly enlarged above.

= Tricharia Boudier, Bull. Soc. Mycol. France 1 : 104.

1885, non Tricharia Fee, 1824 (Fee, A.L.A. Essais sur les cryptogames des écorces exotiques officinales. U. Supplement et revision, Paris. named here as a lichen).

Type : Pozzia silva Boud. et Cooke.

Suggested key to the species of Tricharia

- a. Apothecia pale fawn, outer surface concolorous, hairs upto 200  $\mu$  long ... Tricharia silva
- aa. Apothecia white, outer surface reddish brown, hairs upto 300  $\mu$  long ... Tricharia cratera

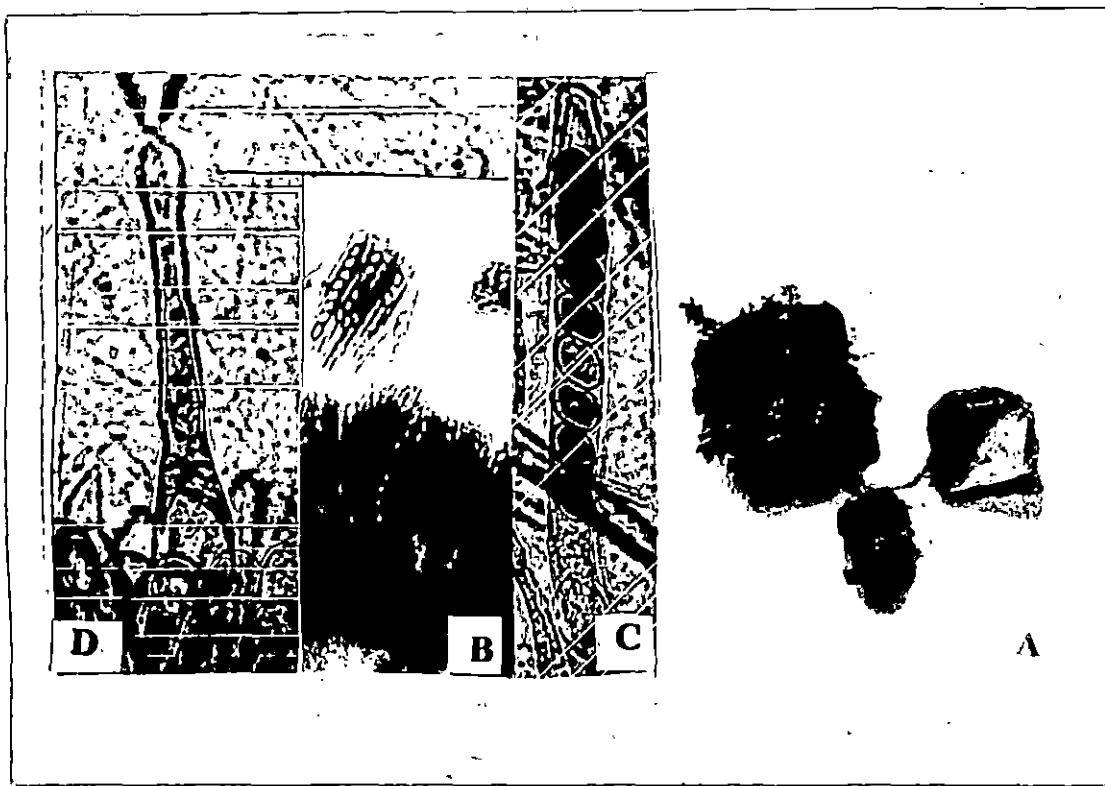


Fig. 5. Tricharina gilva - A. Apothecia, x7;  
B. Hymenium, x118; C. Ascus with ascospores, x529;  
D. Hair, x529.

Tricharia gilva Boudier, Icones mycologicae

Liveraison 2 (1904).

Peziza gilva Boud. in Cooke, Mycographia 240, 1879.

Tricharia gilva Boud., Icon. Myc., Livr. 2 Pl. VIA,  
1904.

Lochnes gilva Sacc., Syll. Fung. 2 : 181, 1889.

( Fig. 5 )

Anothecia sessile, disc flat, pale fawn, reaching 7 mm in diameter, margin dentate, outer surface covered with septate stiff reddish brown hairs with bulbous base, tapering to a rounded apex upto 200  $\mu$ , the ental layer is of textura intricata of thin-walled, hyaline branched hyphae, the ectal layer is of textura angularis of radially stretched cells; asci no change in iodine, 231 x 13  $\mu$ ; ascospores ellipsoidal, smooth-walled, 17 x 10  $\mu$ ; paraphyses slender, 3.3  $\mu$  thick.

Habitat - On ground with mosses.

Locality - Birch Hill, Darjeeling, altitude  
7000 ft., West Bengal.

Specimen studied - DGC 46, April 24, 1974.

Tricharia cretes (Cooke) Boudier, Hist. class. Discom.

d'Europe. 58 (1907).

( Fig. 6 )

Anothecia gregarious or more often densely crowded,

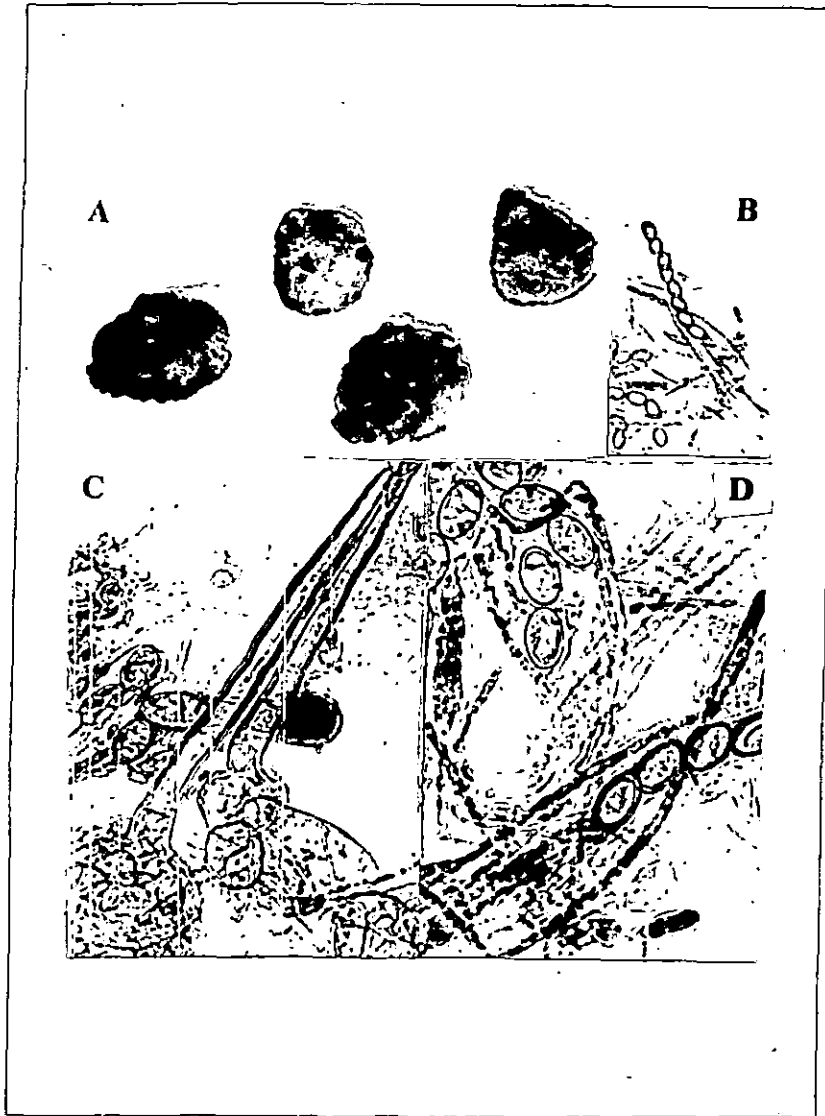


Fig. 6. Tricharia crataea - A. Apothecia, x4; B. Ascospores showing 1-seriate arrangement and paraphyses, x117; C. Hairs showing bulbous base, x470; D. Ascospores and paraphyses, x470.

reaching a diameter of 1.3 cm., margin dentate, externally clothed with pale hairs; hymenium concave, reddish-brown, outer surface covered with stiff reddish-brown septate hairs with swollen base tapering above into a bristle like apex, 274  $\mu$  long; asci cylindric, tapering below, 178 x 10  $\mu$ ; ascospores 1 - seriate, ellipsoid, without oil globule, 17 x 10  $\mu$ ; paraphyses enlarged, above, upto 6.6  $\mu$ .

Habitat - On plaster of walls.

Locality - Goody Road, Darjeeling, altitude  
7000 ft., West Bengal.

Specimen studied - DGC 48, May 24, 1974.

SCUTELLINIA (Cooke) Lambotte emend. Le Gal, Les

Discomycetes de Madagascar. Paris. 116. 1953.

Peziza (Dill.) St.-Amans. subgen. Scutellinia Cooke,  
Mycographia 1 : 260. 1879.

Ciliaria Quel., Mem. Soc. Emul. Montbelliard II 5 : 328.  
1893.

Ciliaria (Quel.) Boud., Bull. Soc. Myc. Fr. 1 : 103.  
1885.

Scutellinia (Cooke) Lambotte, Fl. Myc. Belg. suppl. 1 :  
299. 1887.

Humariella Schröter, Krypt.-Fl. Schles. 2(2):36. 1893.

Patella wigg., Fl. hols. 106. 1780.

Patella wigg. ex seaver, N. Am. Cup Fungi. (Operculates)  
156. 1923.

Gillet (1879), Saccardo (1889), Phillips (1887), Rehm (1887-1896), and Svrček (1943) described the small operculate discomycetes with conspicuous hairs as the members of a single genus under the name Lochna, whereas, Morgan (1908) and Seaver (1928) designated them as Patella. Denison (1959) established the validity of the genus Scutellinia (Cooke) Lambotte (= Ellaria Boudier, 1885).

Suggested key to the species of Scutellinia

- a. Ascospores ornamented
  - b. Ascospore ornamentation of small distinct warts, these if anastomosing never forming reticulum
    - c. Hairs with often simple bases; ascospores broadly elliptical almost subglobose with ornamentations consisting of minute but distinct warts ... Scutellinia kernuelensis
    - cc. Hairs with forked bases; ascospores elliptical with ornamentation consisting of small warts barely visible in optical section.
      - ... Scutellinia scutellata
  - bb. Ascospore ornamentation of ridges which anastomose, to form incomplete reticulum, broadly elliptical to somewhat subglobose
    - ... Scutellinia pennsylvanica

Sphaerospora Sacc. Syll. Fung. 8 : 188. 1889.

Sphaerosporula O. Kuntz, Rev. Gen. Pl. 3(3) : 530. 1898.

Stereolachne von Höhnel, Ann. Myc. 15 : 353. 1917.

Type species : Peziza scutellata L. ex St.-Aman.

Apothecia small to medium sized, scattered, gregarious or rarely caespitose, broadly sessile, discoid or scutellate, externally covered with hairs; hairs two types: rooting hairs deeply buried in the ectal excipulum, dark brown, stiff, wall thick, septate, unbranched, rarely branched, tapering gradually to a pointed end, forked once to several times at the base; superficial hairs arising from the outer cells of ectal excipulum, hyaline to pale brown, thin-walled; asci sub-cylindrical, apex not blued in Melzer's reagent, 2-spored; ascospores globose, subglobose or ellipsoidal to oblong ellipsoidal, smooth or sculptured, uni or biguttulate, sculpturing of warts to form reticulum; paraphyses unbranched or branched at the base, clavate to irregularly lobed, containing carotenoid pigments that turn blue in cone, H. So.  
2 4

Habitat - On decaying wood and herbaceous stems or on soil.

Cooke (1879) first named Scutellinia as a subgenus of Peziza, which was raised to generic rank by Lambotte (1887). Later on Legal (1953) emended the genus Scutellinia with lectotype species Scutellinia scutellata (L. ex Fr.) Lambotte.

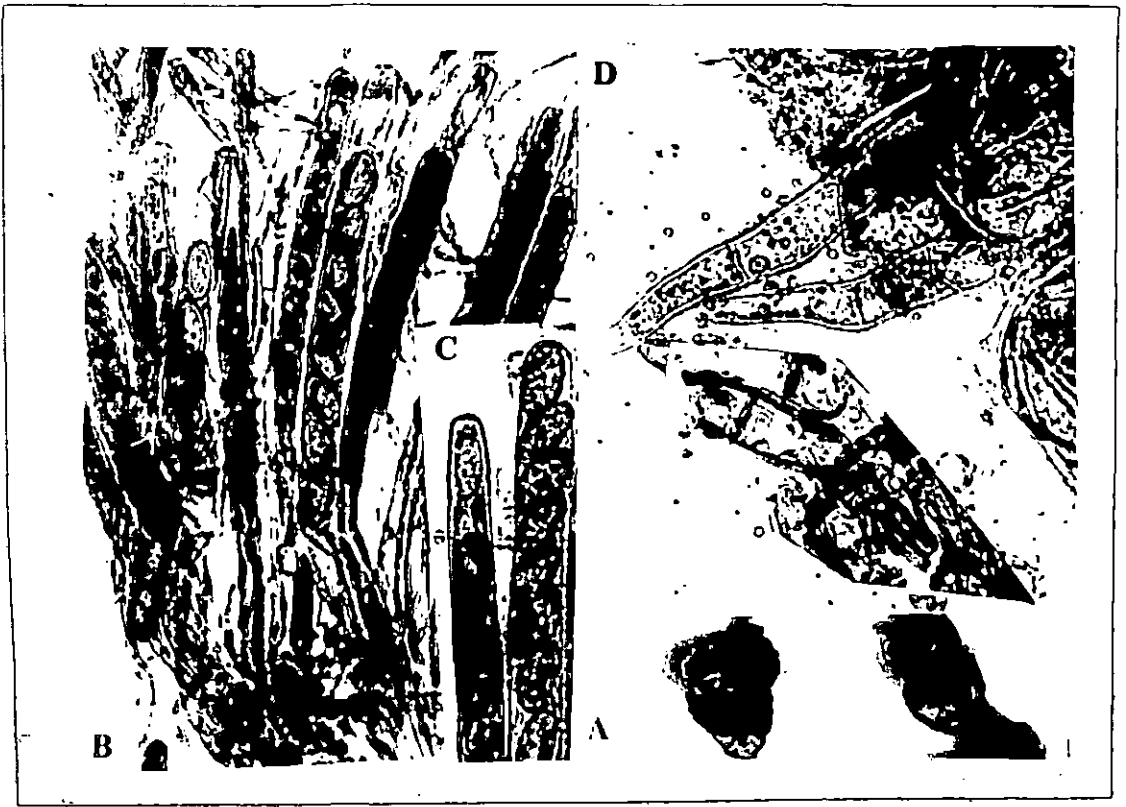


Fig. 7. Scutellinia kerguelensis - A. Apothecia, x1; B. Vertical section of the hymenium showing asci and ascospores, x319; C. Ascospores showing warty surface, x588; D. Hairs showing apex and base, x588.

Scutellinia karsuolensis (Berk.) O. Kuntze Rev. Gen. Pl.  
2: 369. 1891.

Peziza karsuolensis Berk in Hook. f., Fl. Antares. 2:  
451. 1847.

Lechna karsuolensis (Berk.) Sacc., Syll. Fung. 8:  
176. 1889.

Lechna nympharum vol., Monogr. Discom. Boh. 1: 307.  
1934.

Scutellinia nympharum (vol.) Svrček & Kubička in Česká  
Mykol. 15: 63. 1961.

( Fig. 7 )

Anthecia scattered to gregarious, sessile, yellow,  
1 - 3 mm, outer surface covered with brown short hairs which  
form a fringe-like border around the margin; setine hairs  
numerous, straight, stiff short but massive and arise from the  
ectal excipulum, forked, thick-walled, light reddish brown; asci  
sub-cylindrical, slightly narrower towards the base, 8-spored,  
230 - 241 x 10 - 13  $\mu$ ; ascospores 1-seriate, hyaline, filled with  
oil globules, their surface covered by minute warts, broad  
ellipsoid, warts very rarely anastomosing with one another;  
17 - 20 x 10  $\mu$ ; paraphyses projecting above the ascus, septate.

Habitat - On soil.

Locality - Ghoom, Darjeeling, altitude 6,800 ft.,  
West Bengal.

Specimen studied - DGC 99, May 2, 1976.

Scutellinia scutellata (L. ex St.-Amans) Lamb., Mem. Soc.

Roy. Sci. Liège. 2, 14 : 299, 1888.

Peziza scutellata L., sp. Pl. 2 : 1161. 1753.

Octospora scutellata (L.) Hedw. Desc. Musc. frond. 2 :

10. 1788.

Peziza scutellata L. ex St.-Amans, Fl. agen. 531. 1821;

Fr., Syst. mycol. 2 : 85. 1822.

Humaria scutellata (L. ex St.-Amans) Fuckel in Jb.

nassau. ver. Naturk., 23-24 : 321. 1870.

Lecknea scutellata (L. ex St.-Amans) Gill., Champ. Fr.,

Discom. 75. 1879.

Scutellinia scutellata (L. ex St.-Amans) Lamb., Fl.

mycol. Belg., Suppl. 1 : 299. 1887.

Humariella scutellata (L. ex St.-Amans) Schroeter in

Kryt.-Fl. Schles. 2(2) : 37. 1893.

Giliaria scutellata (L. ex St.-Amans) Bond., Icon. mycol.

2 : pl. 368. 1906; Hist. class. Discom. Eur. 62.

1907.

Patellia scutellata (L. ex St.-Amans) Morgan in J. Mycol.

2 : 187. 1902.

Patellia scutellata (L. ex St.-Amans) Morgan ex Seaver,

H. Am Cup Fungi (Operc.) 159. 1928.

Lecknea balnei Stanb. in Bih. K. Svenska Vetensk Akad.

Handl. (III) 21(5) : 39. 1895.

Scutellinia scutellata (L. ex St.-Amans) Lamb. f.

terrigena (Karst.) ex Le Gal in Bull. Soc. mycol

Fr. 22 : 312. 1888.

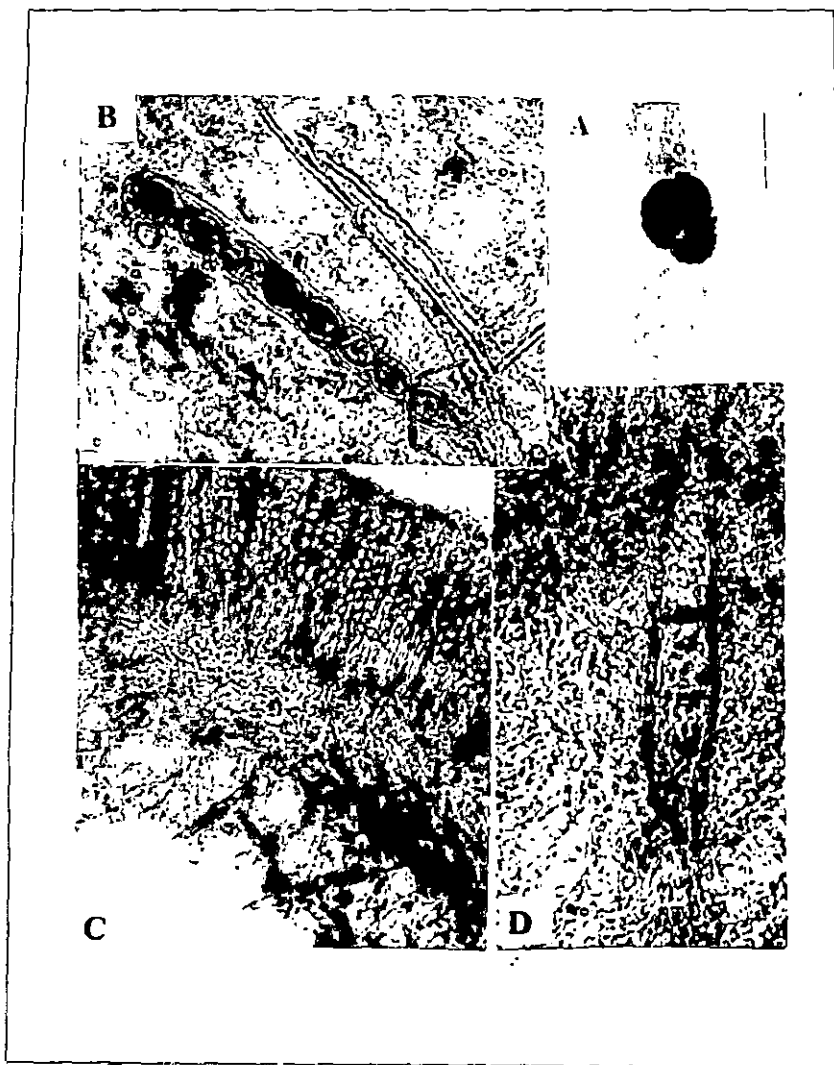


Fig. 8. *Scutellinia scutellata* - A. Apothecium, x1;  
B. Ascus with ascospores and paraphyses, x388;  
C. Vertical section of the hymenium, x90;  
D. Rooting hair, x625.

( Fig. 8 )

Apothecia scattered to gregarious, sessile, 3-5 mm diam.; disc concave, flat or undulate, scarlet red; receptacle scutellate sometimes becoming irregular due to mutual pressure; rooting hairs abundant, straight or curved, brown, septate, base distinctly but irregularly forked, simple hairs present, sub-hyaline to very pale brown, blunt-tipped, septate; asci narrowly clavate, cylindrical, 8-spored, 232 - 248 x 13 - 17  $\mu$ ; ascospores 17 - 20 x 3 - 7  $\mu$ , uniseriate, ellipsoid to oblong ellipsoidal, at first smooth-walled but ultimately minutely ornamented; ornaments taking the form of minute warts, irregular in shape, hardly visible in optical section of the ascospores; paraphyses slender, septate, apex distinctly enlarged.

Habitat - On the ground along with mosses.

Locality - Birch Hill, Darjeeling, altitude 6,800 ft., West Bengal.

Specimen studied - DGC 155, July 17, 1977.

Scutellinia pennsylvanica (Seaver) Denison, Mycologia 51: 619. 1959.

( Fig. 9 )

Apothecia 8 mm - 1.5 cm., gregarious, sessile, soft, fleshy, external surface red, hairy; rooting hairs brown, longer

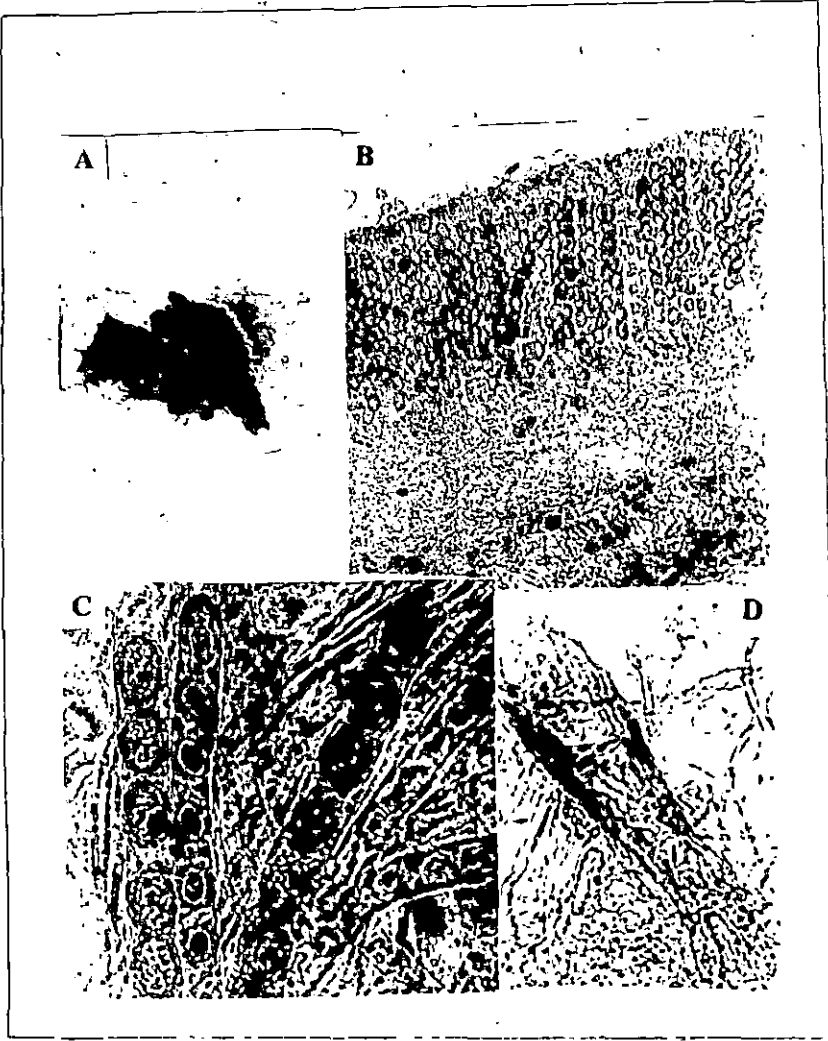


Fig. 9. Scutellinia nensvtavia - A. Apothecium, x8;  
B. Vertical section of the hymenium, x110;  
C. Asci with ascospores showing ornamentation, x550  
D. Rooting hair, x600.

and denser along the margin, bristly, multiseptate, tapering upwards into acute apices, base narrowed below and forked; superficial hairs blunt tipped, originating from superficial layer of ectal excipulum; asci cylindrical, 238 - 264 x 17 - 20  $\mu$ ; ascospores 20 - 24 x 14 - 17  $\mu$ , with ornamentations, 17 - 20 x 10 - 14  $\mu$  without ornamentations, uniseriate, hyaline, broadly ellipsoid to sub-globose, ornamented with coarse, rounded or somewhat truncate warts; paraphyses slender, straight, septate; ectal excipulum *textura angularis* and medullary excipulum *textura prismatica*, formed by thin walled hyphae.

Habitat - On rotten bark of a tree.

Locality - Birch Hill, Darjeeling, altitude  
6,800 ft., West Bengal.

Specimen studied - DGC 149, July 20, 1977.

NEOTTIELLA (Cooke) Saccard, *Sylloge Fungorum* 8 :  
190 (1889), emend Boudier, *Hist.*, class.  
*Discom.* 'Europe : 64 (1907).

Apothecia small, sessile, red, outer surface covered with inconspicuous, hyaline hairs; asci cylindrical; ascospores smooth or rough, with oil drops, hyaline.

The genus Neottrella falls into two series, one with rough spores and showing affinity with Alouria, the other

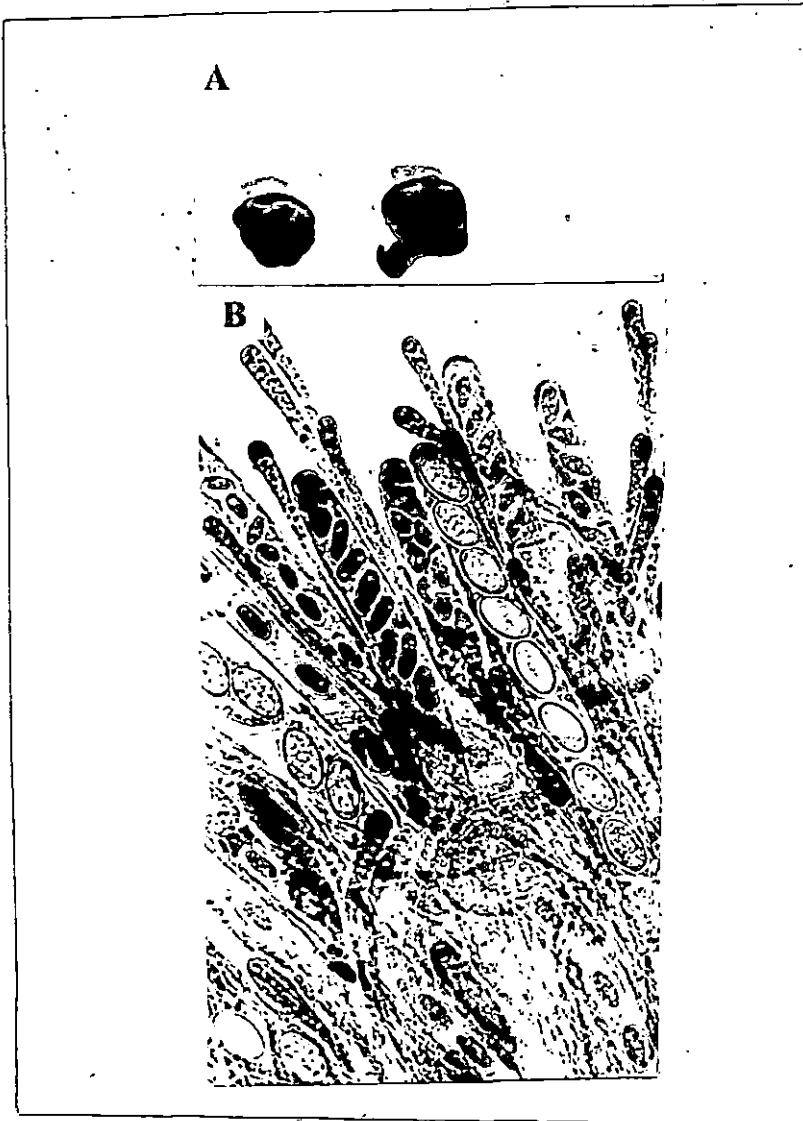


Fig. 10. Neottiella vivida - A. Apothecia,  $\times 4$ ;  
B. Vertical section of the hymenium showing  
asci ascospores and paraphyses,  $\times 412$ .

with smooth spores, showing affinity with Chaelymenia on one and Ocotospora on the other hand.

Lectotype : H. alba-cincta (Berk. & Curt.) Sacc.

= Peziza alba-cincta Berk. & Curt., vide Eckblad,  
Nytt Mag. Bot. 15 : 160. 1968.

Habitat - On bryophytic plant material.

Neottiella vivida (Nylander) Dennis Ed. 1 : 28.

Peziza vivida Nylander in Flora 48 : 467. (1865).

( Fig 10 )

Apothecia  $\beta$  - 10 cm diameter, sessile, disc deep pink, flat with undulating margin, outer surface downy; hymenium blue-green in iodine; asci 214 - 247 x 10 - 13  $\mu$ ; ascospores uniseriate elliptic-cylindric, 13 - 17 x 7  $\mu$  containing one large <sup>oil</sup> drop, wall with warts; paraphyses aseptate, projecting above the asci tip upto 7  $\mu$  thick.

Habitat - On sandy soil along with the mosses and grasses.

Locality - Victoria falls, Darjeeling, altitude 6,000 ft., West Bengal.

Specimen studied - DCC 20, July 22, 1973.

ALBUZIA Fuckel, Jahrb. Nass, ver. f. Naturk. 23-24 :  
326. 1870.

Peziza (Dill.) St.-Amans 'div.' Discina Fr. "Ser".

Aleuria Fr., Syst. Mycol. 2 : 41. 1822.

Aleuria (Fr.) Gill., Champ. Fr., Discom. 30. 1879.

Peziza (Dill.) St.-Amans (Ser. Aleuria Fr.) Subgen.

Cochlearia Cooke, Mycograph. 1 : 252. 1879.

Cochlearia (Cooke) Lamb., Fl. mycol. Belg., Suppl. 1 :  
323. 1887.

Type species : Peziza augustia Pers. ex Hook.

Anothecia small to large, scattered, gregarious, sessile to substipitate bright yellow to orange-red, discoid to shallow cup-shaped, often margin downwards, occasionally one-sided, externally glabrous to pruinose; medullary excipulum of textura intricata, ectal excipulum of textura globulosa to textura angularis; asci cylindrical, slightly narrower towards their base, apex not blue in Melzer's reagent, 8-spored; ascospores uniseriate, ellipsoidal or oblong ellipsoidal, hyaline, warty with reticulation, sometimes apiculate, containing one or two large oil globules; paraphyses simple, unbranched, septate, with enlarged tip, containing orange pigments.

Habitat - On bare damp soil rich in humus.

The genus Aleuria was published by Fuckel (1870) without citing Fries' (1822) name Aleuria for an infrageneric grouping within the genus Peziza Dill. Gillet (1879) raised Fries' infrageneric name Aleuria to the generic level to accommodate Peziza aurantia as the type. This typification for Aleuria (Fr.) Gill. was not only a synonym but also an obligate synonym of Aleuria Fuckel.

Boudier (1885, 1907) emended the name Aleuria (Fr.) Gill. typified by Peziza vesiculosa. He also pointed out that the species of Aleuria (Fr.) Gill. emend. Boud. have iodine positive asci containing smooth-walled ascospores. For the present genus Boudier used the name Peziza which was followed by McLennan & Halsey (1936), Le Gal (1947), Ramsbottom & Balfour-Brown (1951), and Heim (1962). But Aleuria aurantia which was included in Peziza by Boudier (1885) as Peziza aurantia Pers., is now widely accepted as the type species of Aleuria Fuckel.

Aleuria aurantia (Pers. ex Hook.) Fuck., Jb. Hassau.

ver. Naturk. 23-24 : 325. 1870.

Peziza aurantia Pers., obs. mycol. 2 : 76. 1799.

Peziza aurantia Pers., ex Hook., Fl. Scot. 2 : 39.  
1821.

Cochlearia aurantia (Pers. ex Hook.) Lamb., Fl.  
mycol. Belg., Suppl. 1 : 323. 1887.



Fig. 11. Aleuria aurantia - A. Apothecium,  $\times 4$ ;  
B. Ascus with ascospores,  $\times 537$ ; C. Ascospore  
showing reticulation,  $\times 1923$ .

Otidea aurantia (Pers. ex Hook.) Massée, Brit. Fung.-Fl.  
4 : 448. 1895.

Elvellia coccinea Schaeff., Icon. Fung. Bavar. 4 : 100.  
1774.

Peziza coccinea (Schaeff.) Bull., Herb. Fr. t. 474. 1790.

Aleuria coccinea (Schaeff. ex St.-Amans) Maesz, Schedis  
Fl. hung. exsicc., cent. 5 : no 488. 1918.

Scordellina aurantiaca SF. Gray, Nat. Arrang. Br. Pl : 663.  
1821.

Peziza aurantiaca Pers., Mycol. eur. 1 : 222. 1822.

Peziza pseudoaurantia Crouan, Fl. Finist. 54. 1867.

Peziza aurantia Pers. ex Hook. Forma nigra Cooke,  
Grevillea 8 : 61. 1879.

Peziza antarctica Speg., Boln Acad. nac. ci. cordoba 11 :  
256. 1887.

Humaria antarctica (Speg.) Sacc., Syll. Fung. 8 : 121. 1889.

Humaria phoenicea Speg. An. Mus. nac. Hist. nat. B. Aires  
II 6 : 303. 1899.

Humaria etilis Speg., Physis 2 : 13. 1923.

( Fig. II )

Anothecia gregarious, sessile, small to large, at first  
cup shaped, becoming discoid to flat, often margin recurved  
downwards, 2 to 4 cm. diameter; hymanium bright orange, flesh  
thin, fragile, turning green in iodine; medullary excipulum  
of textura intricata, hyphae with more or less barrel-shaped

cells; apical excianium of textura sub-globulosa to angularis whose outermost cells are rectangular with obtuse free end running at a right angle to the receptacle; asci cylindric with hemispherical tip, not blued by Melzer's reagent, 8-spored, 132 - 181 x 13  $\mu$ ; ascospores ellipsoid, slightly obliquely uniseriate, ornamented with a coarse reticulum, 13 x 10  $\mu$ , containing two oil drops; paraphyses clavate, projecting above the asci, apical portion swollen deeply pigmented with orange granules, 7  $\mu$  thick.

Habitat - On bare sandy soil.

Locality - Mongpoo, Darjeeling, altitude 6,000 ft.,  
West Bengal.

Specimen studied - DGC 17, July 8, 1973.

ASCOBOLUS Pers. For Hook., Fl. Scot. 2 : 33. 1821;

Fr., Syst. Mycol. 2(1) : 161. 1822.

Ascobolus Pers. apud Gmel., C. Linn. Syst. Nat 2 :  
1461. 1791.

Dasyscypha (Sacc.) Sacc., Syll. Fung. 11 : 421. 1895.

Type species : Ascobolus nazicoides Pers.

Anthecia superficial or partially immersed, sessile or short stipitate, cupulate, rarely lenticular, smooth, disc concave, plane or convex, soft, fleshy; excianium of textura

globulosa to angularis; asci cylindric-clavate to clavate, 8-spored, blued by Melzer's reagent, at maturity protruding above the hymenium; ascospores free, ellipsoid to sub-globose, warty or irregularly longitudinally striated, brownish; paraphyses filiform or slender, hyaline, septate.

Habitat - On various substrata, most often on animal dung.

The genus Ascobolus, established by Persoon(1791), is characterized by its mutually free ascospores, viz., they are never grouped together by a common sheath which is the character of Saccobolus.

Different workers have separated various species of Ascobolus based on spore characters and created new genera of which Sphaeridiobolus Boud, is one. Another genus Dasyobolus (Sacc.) Sacc. was created by Saccardo (1895) including the species of Ascobolus having hairs on their receptacles. But subsequently the nature of hairs were thought to be as secondary mycelium and superficial hyphae of originally immersed fruit bodies. Van Brummelen (1967), in his world monograph, considered this creation of new genera as very artificial. He was supported by Rifai (1968).

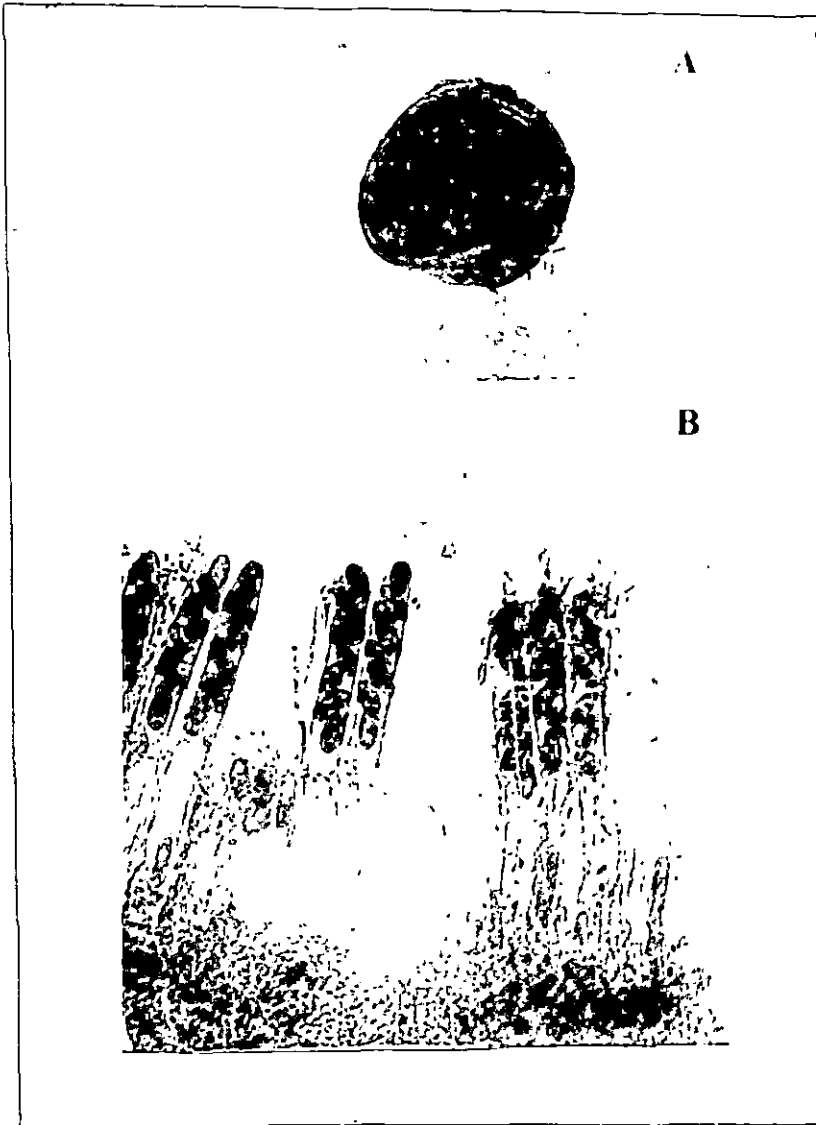


Fig. 12. Ascobolus scatigenus - A. Apothecium, x1;  
B. Vertical section of the hymenium showing  
asci and ascospores, x300.

Ascobolus scatigenus (Berk.) Bruan. Persoonia (Suppl.)  
1:1-260. 1957.

Poriza (Humaria) scatigona Berk. Curt. apud. Berk.,  
J. Linn. Soc. (Bot.) 10 : 366. 1869.

Ascobolus lolocarpus Berk. & Broome, J. Linn. Soc.  
(Bot.) 14 : 109. 1873.

Ascobolus major Berk. & Curt. apud, Grevillea 4 : 6.  
1875.

Ascobolus australis Berk., J. Linn. Soc. (Bot.) 18 :  
389. 1881.

Ascobolus hallevi Berk. & Broome, Trans. Linn. Soc.  
Lond. II(Bot.) 2 : 69. 1883.

Ascobolus phillipsii Berk. apud Cooke, Handb.  
Australian Fungi. 268. 1892.

Ascobolus sarawacensis Cestai apud Cooke, Grevillea  
21 : 74. 1893.

Ascobolus megalosporus Speg., Anal. Mus. nac. B.  
Aires 6 : 307. 1899.

Ascobolus magnificus Dodge, Mycologia 4 : 218. 1912.

Populospora magnifica Boston, Bot. Ga. 64 : 1917.

( Fig. 12 )

Apothecia sessile, scattered, gregarious, smooth,  
0.5 - 2.5 cm in diameter, hymenial surface originally greenish  
but appearing dark-brown due to the protruding asci containing  
dark coloured spores; in section subhymenium medullare  
excipulum and ectal excipulum not distinguishable and of texture

globulosa; asci cylindrical, operculate, blued in Melzer's reagent, 8-spored, 198 - 215 x 20 - 23  $\mu$ ; ascospores irregularly biseriolate at maturity, ellipsoid at first violet and becoming brown at the time of discharge, at first smooth and then sculptured, sculpturing consisting of longitudinal striation formed at the time of maturity, 20 - 23 x 10 - 13  $\mu$ ; paraphyses slender, septate, unbranched, 7  $\mu$  in diameter at the apices.

Habitat - On cow dung.

Locality - Malda, altitude 500 ft., West Bengal.

Specimen studied - DGC 118; July 2, 1976.

GEOGLOSSUM Pers. ex Fr., Syst. Myc. 1 : 497. 1821.

Glossoglossum Durand, Ann. Myc. 6 : 418. 1908.

Lectotype species : Glossoglossum alatum Pers. ex Fr.

Ascocarpus usually clavate, compressed above, black brownish-black, fleshy when fresh, becoming black on drying; hymenium confined to the upper portion of ascocarp, smooth; stipe terrete, smooth; in section of upper portion of ascocarp shows hymenium spread all over the ascigerous portion enclosing the medulla of textura intricata; asci clavate, 8-spored, inoperculate; ascospores sub-cylindrical or subfusoid, brown, sometimes hyaline, 0-15-septate; paraphyses slender, septate,



Fig. 13. Geoglossum cohaerens - A. Ascophore, x1;  
B. Vertical section of the hymenium showing  
ascus, x562; C. Ascospores, x350.

straight or curved.

Habitat - On ground.

The genus Geoglossum of Persoon, validly accepted by Fries is characterized by brown to black, clavate ascocarps and absence of setae from the hymenium.

Suggested key to the species of Geoglossum

Paraphyses conspicuously brown above, spores 0 to 7-septate.

... Geoglossum cohaerens

Paraphyses nearly hyaline, spores 7 - 12 septate.

... Geoglossum fallax

Paraphyses remotely septate, scarcely moniliform, spores

7-septate ... Geoglossum nigratum

Cells of the paraphyses swollen giving moniliform appearance,

spores 4-7 septate ... Geoglossum sphagnophilum

Geoglossum cohaerens Durand, Ann. Myc. 6 : 430.

1908.

( Fig. 13 )

Ascones clavate, clustered, 2.5 - 4.5 cm, black; ascigerous portion about one half the total length, terrete or compressed; asci clavate, reaching a length of

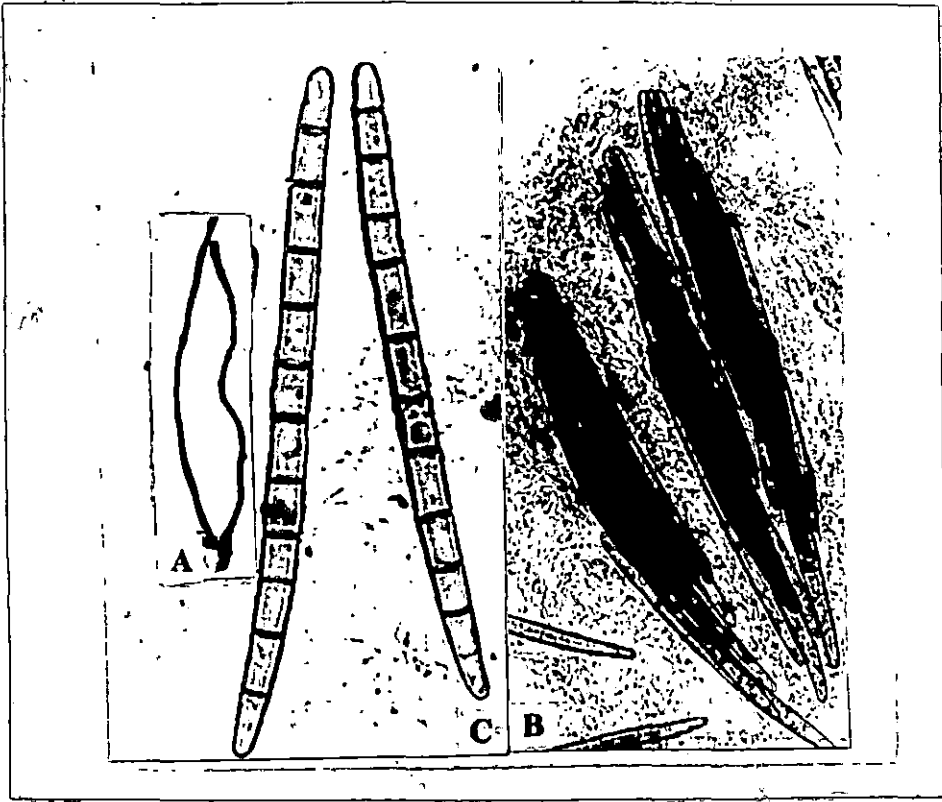


Fig. 14. *Geoglossum fallax* - A. Ascophore,  $\times 40$ ;  
B. Asci,  $\times 467$ ; C. Ascospores,  $\times 850$ .

148.5 - 165 x 12 - 15  $\mu$ , 8-spored; ascospores multiseriate in the ascus, cylindric, straight or curved, for a long time hyaline, later becoming brown, from simple to 7-septate, length 89 - 106 x 3  $\mu$ ; paraphyses numerous, longer than the ascus, septate, tip clavate, conspicuously brown.

Habitat - On soil.

Locality - Botanical garden, Darjeeling,  
altitude 6,500 ft., West Bengal.

Specimen studied - DGC 153, July 12, 1977.

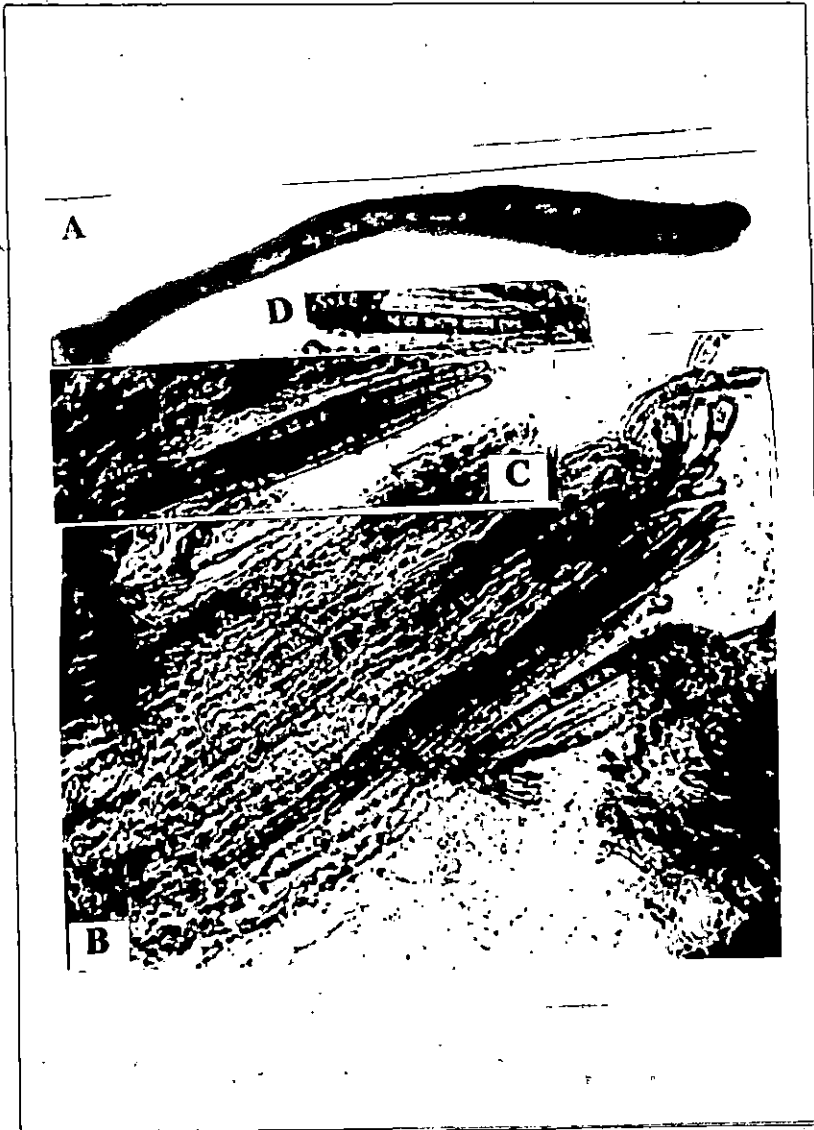
Geoglossum fallax Durand, Ann. Myc. 6 : 428. 1908.

( Fig. 14 )

Ascophores solitary, 2 - 7 cm high, umber brown; ascigerous portion one fifth to one half the total length of the ascocarp, lanceolate-obtuse; stem elongated and slender, slightly thickened upwards; asci clavate-cylindric with narrowed apex, 149 - 165 x 13 - 17  $\mu$ , 8-spored; ascospores multiseriate in the ascus, straight, 11-septate, 96 - 102 x 7  $\mu$ ; paraphyses entirely hyaline, septate, apex ellipsoid to globose.

Habitat - On loamy soil along slopes.

Locality - Darjeeling, altitude 6,800 ft.,  
West Bengal.



**Fig. 15. *Geoglossum nigrum* - A. Ascophore, x1;  
B. Vertical section of the ascocarp showing  
asci and paraphyses, x410; C. Ascus, x410;  
D. 7-septate ascospore, x410.**

Specimen studied - DGC 24, July 23, 1973.

Geoglossum nigratum (Pers.) Cooke, Mycographia 205. 1873.

Clavaria nigrita Pers. Syn. Fung. 604. 1801.

( Fig. 15 )

Ascophores solitary, clavate, black upto 9 cm high; ascigerous portion lanceolate, compressed, one half the total length of the ascophores; stem slender, thick, smooth; asci clavate, apex narrowed reaching a length 149 - 165 x 16  $\mu$ , 8-spored; ascospores in parallel fascicle in the ascus, clavate, 7-septate, 83 - 89x7 $\mu$ ; paraphyses rather longer than the asci, cylindrical, septate, apex of the terminal cell more or less curved, swollen, diameter 7  $\mu$ .

Habitat - On wet soil amongst mosses.

Locality - Botanical garden, Darjeeling,  
altitude 6,000 ft., West Bengal.

Specimen studied - DGC 114, August 8, 1973.

Geoglossum sphaerophilum Threnb. ex Wallr. Sylv. Myc.

Ber. 30. 1818.

Clavaria ophioglossoides L. sp. Pl. 2 : 1182. 1753.

Geoglossum difforme sensu Cooke, Mycographia 6,  
Pl. 2. f. 7. 1875.

Geoglossum simile Peck, Bull. Soc. Nat. Sci. 1 :  
70. 1873.

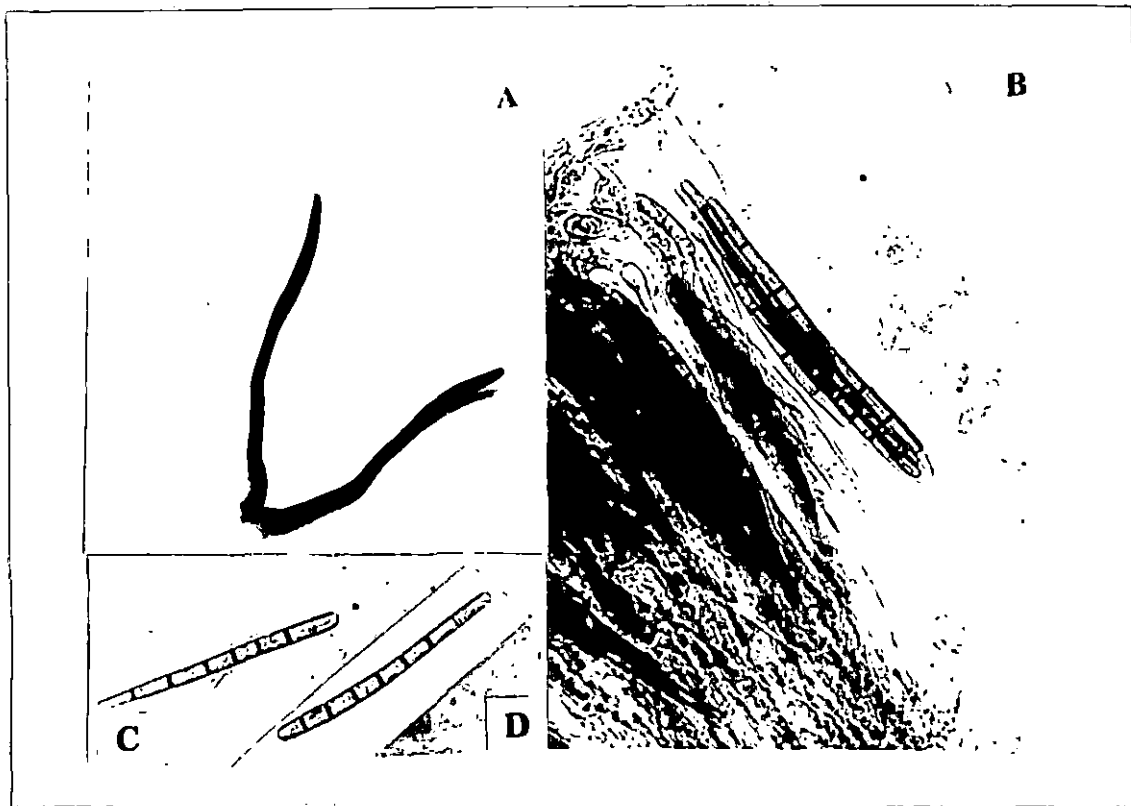


Fig. 16. Geoglossum sphaculophilum - A. Ascophore, x1;  
B. Vertical section of the ascocarp showing  
asci and paraphyses, x353; C. 6-septate ascospore, x533;  
D. 7-septate ascospore, x533.

( Fig . 16 )

Ascophore: solitary, rarely clustered, gregarious  
3.5 - 5 cm high; ascigerous portion black, about one third  
the total length of the ascocarp, compressed 1 - 2 cm long  
and 2 - 3 mm thick, slightly acute, not sharply delimited  
from the stem; stem brownish-black, narrowly rounded apex,  
pore blue in iodine, measuring 161 - 182 x 17  $\mu$ , 8-spored;  
ascospores fasciated, brown, slightly curved, 4 - 7 - septate,  
59 - 65 x 3  $\mu$ ; paraphyses numerous, slightly longer than the  
asci, septate, tip thickened, cells swollen giving moniliform  
appearance.

Habitat - On soil.

Locality - Birch Hill, Darjeeling, altitude  
6,200 ft., West Bengal.

Specimen studied - DCC 16, July 20, 1973.

TRICHOGLOSSUM Bond., Bull. Soc. Myc. France 1 : 110.  
1885.

Type species : Trichoglossum hirsutum (Pers. ex Fr.)  
Bond

Ascophores, erect, tall, clavate to capitata, black or  
brownish-black, fleshy; stipe, slender, terete, hirsute from  
the setae; in section : hymenium spreading all over the  
ascigerous portion of the ascocarp, with blackish-brown  
pointed setae, enclosing the medulla of textura intricata;



Fig. 17. Trichoglossum farlowii - A. Ascophore, x8;  
B. Vertical section of the hymenium showing  
setae, x177; C. Asci, x384; D. Ascospore(5-septate), x778.

asci clavate, pore blued by Melzer's reagent, 8 or 4 spored; ascospores cylindrical-fusiform, brown, 0-15 septate; paraphyses slender, cylindrical, with enlarged apices, erect or curved above interspersed with long, stiff, pointed, black-brown setae.

Habitat - On ground.

The genus Trichoglossum, erected by Boudier (1833), is closely related to Geoglossum from which it is easily distinguished by the presence of long, stiff, pointed, blackish-brown setae.

Trichoglossum farlowii (Cooke) Durand, Ann. Myc.

6 : 433. 1908.

Geoglossum farlowii Cooke, Grevillea 11 : 107.

1833.

Geoglossum valentinus Peck, Ann. Rep. N. Y. State

Mus., 28 : 65. 1876.

(Fig. 17)

Ascophore solitary or clustered, two or three together, 2.5 to 5.5 cm high; ascigerous portion lanceolate, not sharply distinguished from the stem, brownish-black, 1.8 to 2.2 cm long, often flexuous, rarely somewhat compressed asci are many, clavate, sessile, 8-spored, 112-152 x 14-18  $\mu$ ; ascospores crowded, clavate-cylindrical, multiseriate in the ascus, brownish, 90 - 97 x 4 - 7  $\mu$ , 1-(5)-7 septate; paraphyses cylindrical, curved to circinate at the somewhat

thickened tips; setae acicular, somewhat narrowed, dark-brown.

Habitat - On soil in moist shady places.

Locality - Birch Hill, Darjeeling, altitude  
6,500 ft., West Bengal.

Specimen studied - DGC 5, August 12, 1972.

CUDONIELLA Saccardo, Sylloge Fungorum 8 : 41 (1889).

Cudoniella clavus (A. & S. ex Fr.) Dennis, Comb.

nov.-Peziza clavus A. & S. ex Fr., Syst.  
mycol. 2(1): 137. 1822.

Cudoniella clavus var. grandis (Boud.) Dennis, Comb.

nov.-Ombrophila clavus var. grandis Boud.,  
Icon. mycol. 4 : 249. 1910.

Cudoniella rubicunda (Rehm) Dennis, Comb. nov.-

Mollisia rubicunda Rehm in Hedwigia 81 :  
103. 1892.

Type species : Cudoniella acicularia (Bull. ex Fr.)

Schroet in Cohn, Kryptog.-Fl. Schles.  
3(2) : 21. 1833.

Apothecia typically with a convex hymenium, ascus pore  
neither blued nor outlined by iodine; ascospores sometimes  
becoming 1-septate at maturity.

Habitat - On dead plant trunk.



Fig. 18. *Gudoniella neicularis* - A. Apothecia,  $\times 45$ ;  
B. Vertical section of the hymenium showing  
asci, ascospores and paraphyses,  $\times 680$ ; C. Ascospores,  $\times 800$

Gudoniella scicularis (Bulliard ex Fries) Schroeter  
apud cona, Krypt. Flora Schles. 3(2) :  
21 (1893).

( Fig. 18 )

Apothecia gregarious, superficial, with short, smooth, cylindrical stalks, disc convex; hymenium bright yellow, 0.3 mm - 1 cm diameter; sterg 1-2 mm length, lighter colour than hymenium; asci cylindric, 178 - 188 x 10  $\mu$ , apex somewhat conical, 8-spored; ascospores biseriolate, narrow with pointed ends, no appendages, 23 - 29 x 7  $\mu$ ; paraphyses slender, tip 1 mm thick.

Habitat - On rotten Quercus trunks.

Locality - Govt. College Garden, Darjeeling,  
altitude 7,000 ft., West Bengal.

Specimen studied - DGC 29, August 14, 1973.

PSEUDOPSEZIZA FUECKEL? Symb. Myc. 290. 1869.

Drepanopeziza (Kellb.) Hohn. Ann. Myc. 15 : 332.  
1917.

Pseudopeziza subg. Drepanopeziza Kellb. Zeitsch.  
Pflanzenker. 16 : 76. 1906.

Type species : Aschelus trifolii Nev.-Barn.

Apothecia eruptent, usually on living leaves,

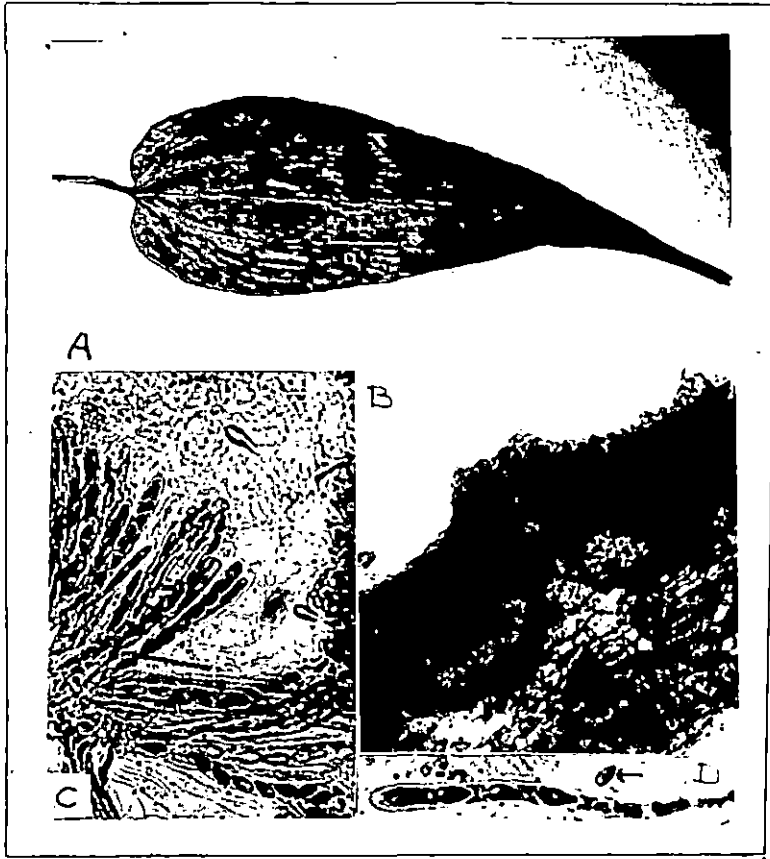


Fig. 19. Pseudopeziza rubra - A. Leaf of Eubia cordifolia bearing apothecia, x7; B. Vertical section of the leaf through the apothecia, x147; C. Asci with ascospores, x334; D. Ascus with ascospores, x625.

gregarious, minute, soft and fleshy, the margin often crenulate; asci cylindric-clavate, 4-8-spored; spores ovoid, simple, hyaline, non-septate; paraphyses filiform and often much curved.

Pseudopeziza rubiae T.S. and K. Hamakr., Proc.  
Indian Acad. Sci. 25 : 31 (1947).

( Fig. 19 )

Apothecia minute, brown, seated in the tissue of the host; hymenium plane or convex, 0.5 - 1 mm diameter, sessile; asci clavate 8-spored, 73 - 86 x 3 - 7  $\mu$ ; ascospores oval, 7 - 10 x 3  $\mu$ , uniseriate; paraphyses simple, filiform.

Habitat - On living leaves of Rubia cordifolia  
Linn.

Locality - Darjeeling, altitude 6,800 ft., West  
Bengal.

Specimen studied - DGC 145, August 12, 1977.

PHYLLACHORA Witschke sp. Fuckel Syb. myc., p. 216.  
1869.

Geminispora Pat., Bull. soc. myc. France 9 : 151.  
1893.

- Pseudocelastria P. Henn., Hedwigia 41 : 115. 1902.  
Discosporocarpella P. Henn., Hedwigia 41 : 146. 1902.  
Diplosporix Clem., Gen. fung., p. 27. 1909.  
Metachora Syd. et Bull., Ann. Myc. 9 : 400. 1911.  
Trabutiella Theiss. et Syd., Ann. Myc. 12 : 180. 1912.  
Endophyllochora Rehm, Phil. Jour. Sci. 7 : 197. 1913.  
Catacaura Theiss. et Syd., Ann. Myc. 12 : 280. 1914.  
Phaeotrabutiella Theiss. et Syd., Ann. Myc. 13 : 360. 1915.  
Glyceostigma V. Köhn., Sitzber. K. Akad. Wiss. Wien, math.-nat. Kl., 1. Abt. 128 : 565. 1919.  
Halstedia Stevens, Bot. Gaz. 52 : 253. 1920.  
Glyceotrabutia Seav. et. chard., Scienc. Surv. Porto Rico virg. 1 s1. 8/1, Bot. p. 60. 1926.  
Endotrabutia chard., Journ. Agr. Porto Rico. 14 : 270. 1930. teste Petrak (1951).  
Phaeotrabutia Gavces, Caldasia (columbia) 1 : 77. 1941.  
Tolediiella viogas, Bragantia 3 : 123. 1943, teste Petrak (1951)

Type species : Phyllochora araminis (Pers.) HKo

Leaf parasites with a well developed stroma; stroma sometimes covering the entire thickness and then forming epidermal clypeus on both sides, sometimes on one side of the leaf; perithecia one to many, sub-cuticular, subepidermal in the mesophyll, ostiolate; asci numerous, cylindrical or clavate, 8-spored, intermingled with hyaline fibrous paraphyses;

ascospores round to elliptical, hyaline.

Nitschke (1869) erected the genus Phyllachora for Pyrenomycetous fungi having clypeate stromata, paraphyses and unicellular ascospores. Fries (1823) described Sphaeria graminis Pers. only as species in Sphaeria (ciafertae) and later (1849) changed the name to Dothidea graminis. Nitschke erected the genus on the Friesian species placed in the family Dothideaceae, which is characterised by ascocarps embedded in the stroma, and lacking true perithecial walls. Theissen & Sydow (1915) in their monograph of the Dothideales included Phyllachora, also with the assumption that the ascocarp was a locule rather than a perithecium. Orton (1924), in critical study of P. graminis, described a compound fructification with ascocarps having true perithecial walls and a clypeus resulting from the lateral proliferation of the pseudoparenchymatous wall is not stromatic but only resembles such tissue. Petrak (1924), Miller (1941) and Orton (1944) separately suggested for the removal of the graminicolous phyllachoras from the Dothideaceae. All the subsequent workers, Miller (1949), Von Arx & Muller (1954), Munk (1957), Dennis (1968) and others placed all the species of Phyllachora in the Phyllachoraceae under the order Sphaeriales.

Phyllachora graminis (Pers. NKe., Symb. myc.  
p. 216. 1869.

Sphaeria graminis Pers., obs. myc., p. 18.1786.

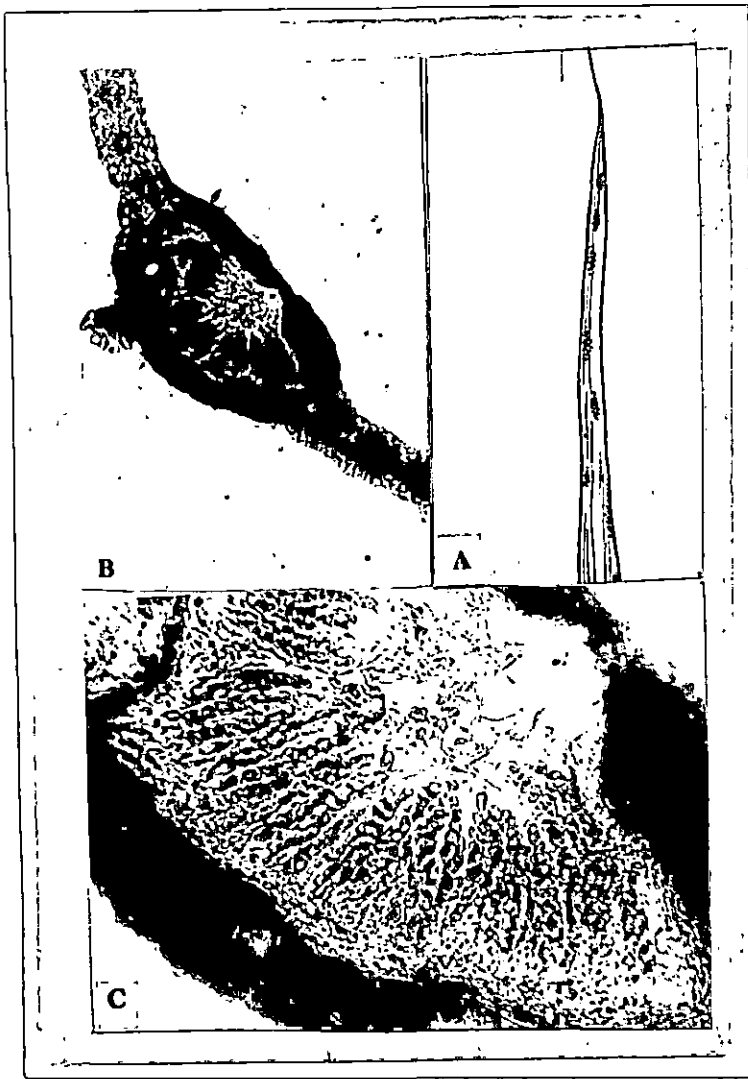


Fig. 20. *Phyllachora graminis* - A. Leaf showing stromata, x1;  
B. Vertical section of the leaf showing perithecium, x130;  
C. Vertical section of the perithecium showing asci  
and ascospores, x310.

Phyllachora graminis olivorum Schw., Trans. Am. Phil.  
soc., II, 4 : 208. 1832.

Dothidea graminis Fr., Summa veg. Scand., p. 387. 1845.

Phyllachora hrami Fekl., Symb. myc., p. 216. 1869.

Phyllachora asperillae Roum. et Fantr., Rev. myc., p.  
175. 1892.

Phyllachora graminis fa. hystericis Hehm, Ascom., Nr.  
1917.

Phyllachora areolaris Orton, N. Y. State Mus. Bull.,  
243/44:92. 1923.

Phyllachora melicis Deara et House, N. Y. State Mus.  
Bull., 266/67. 1925.

Phyllachora cingae Tehon et Dan., Mycologia, 19 : 110.  
1927.

( Fig. 20 )

stromata prominent, on both surfaces of the leaves,  
but more prominent on the upper surface, scattered irregularly,  
sometimes in a row, oval, black, shiny, immersed into the  
host tissue, forming clypeus in the epidermis of the leaf;  
perithecia ovoid to oblong, ostiole, deeply embedded  
extending upto the lower epidermis, 280 - 297  $\mu$  diameter;  
asci many, lining the bases and sides of the perithecia,  
clavate, thin-walled, 8-spored, 60 - 75 x 10 - 12  $\mu$  and  
intermingled with many thread-like hyaline, paraphyses;

ascospores biseriate, ellipsoid, thin-walled, hyaline 13 - 17 x 7 - 10  $\mu$ .

Habitat - On living leaves of Eragrostis alara,  
Nees.

Locality - Ging, Darjeeling, altitude 6,000 ft.,  
West Bengal.

Specimen studied - DSC 57, July 10, 1973.

MELIOLA Fr. emend. Bernet Ann. Sci. Nat. III : 16 :  
267. 1851.

Amphitrichum Nees ex sprong., Pl. crypt. Trop.  
P. 46. 1820, Proparte.

Sphaeria Fr., Syst. Myc. 2 : 513. 1823, Proparte.

Meliola Fr., Syst. orb. veg. p. 111. 1825.

Myrothecium Kuntze ex Fr., Syst. Myc. 3 : 232.  
1829.

Goutures Cast. in Fr., Summ. veg. Scand. p. 407.  
1846.

Asteridium Sacc., Syll. Fung. Fung. 1 : 49. 1882.

Lectotype species : Meliola trichostroma (Kze.) Toro

Parasitic fungi, normally occurring as superficial thin  
dense or sub dense patches on leaves and young stems, having  
dark superficial, straight or wavy mycelium, with alternate  
opposite or irregular branched hyphae at an acute to wide

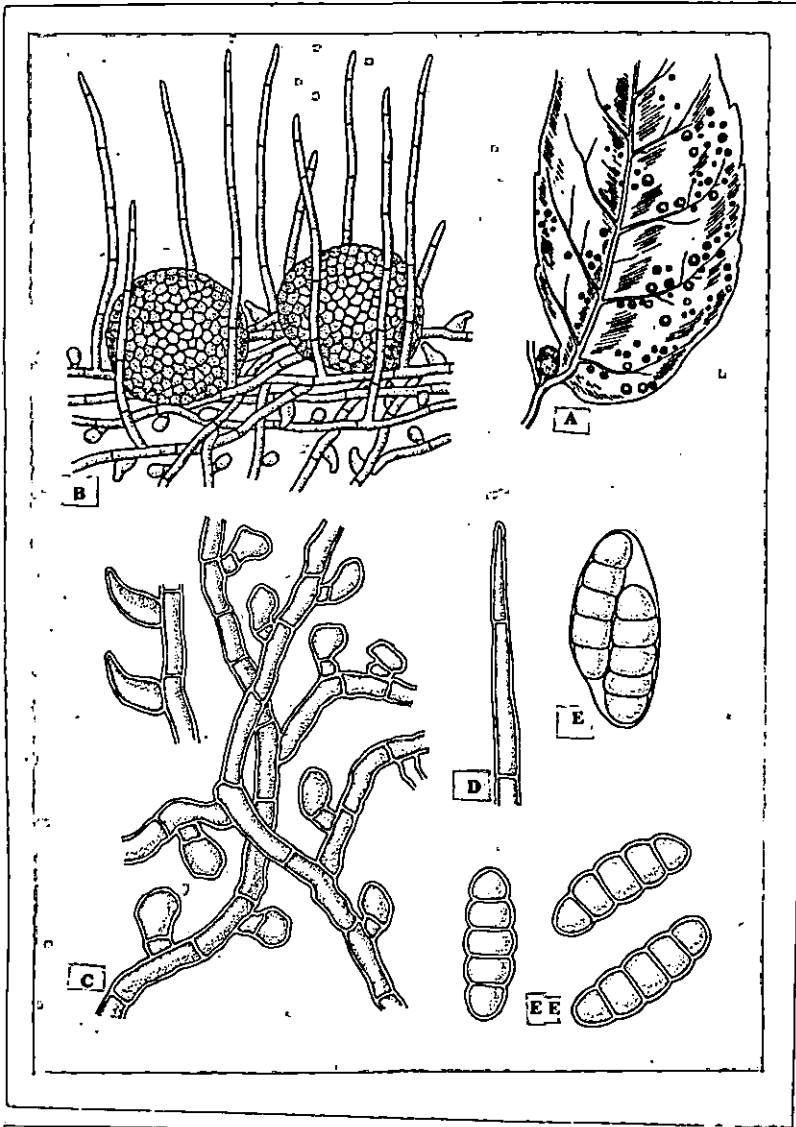


Fig. 21. *Meliola thomasiensis* - A. Leaf showing perithecia, x7; B. Perithecia hypopodia and mycelial setae, x100; C. Capitulate hypopodia and mucronate hypopodia, x500; D. Mycelial setae, x500; E. Ascus with ascospores, x570; EE. Ascospores, x570.

angle, which produces both capitate and mucronate hyphopodia; capitate hyphopodia 2-celled, alternately or oppositely arranged, straight, bent, antrorse or retrorse; antrorse hyphopodia unicellular, solitary or alternately oppositely or irregularly arranged, ampulliform; mycelial setae scattered, especially crowded around the base of the perithecium, stiff, straight or curved, unbranched or branched; perithecia on the mycelial colony, round, black, with verrucose wall, often cupulate-collapse in the dry state; asci erect, sessile or sub-sessile, round to ellipsoidal, unitunicate, at first 4 - 8 - spored, at maturity usually with 2 spores, less commonly with 3, rarely with 4, thin-walled at maturity, soon disappearing; ascospores brown to dark brown, cylindrical or ellipsoidal, straight or bent, smooth-walled.

The genus Meliola was founded by Fries in 1825 and was emended by Bernat in 1851. Until 1917, it was the only genus recognised in the group, Meliolineae.

For many years Meliola amphitricha Fr., based on Sphaeria amphitricha Fr., was regarded as the type species of Meliola and concluded that the lectotype should be Meliola trichostroma (Kze.) Toro. Mansford (1961) accepted this.

Meliola citicola Syd., Ann. Mycol. 15 : 183.

1917.

( Fig. 2 )

Fungus borne on the upper surface and lower

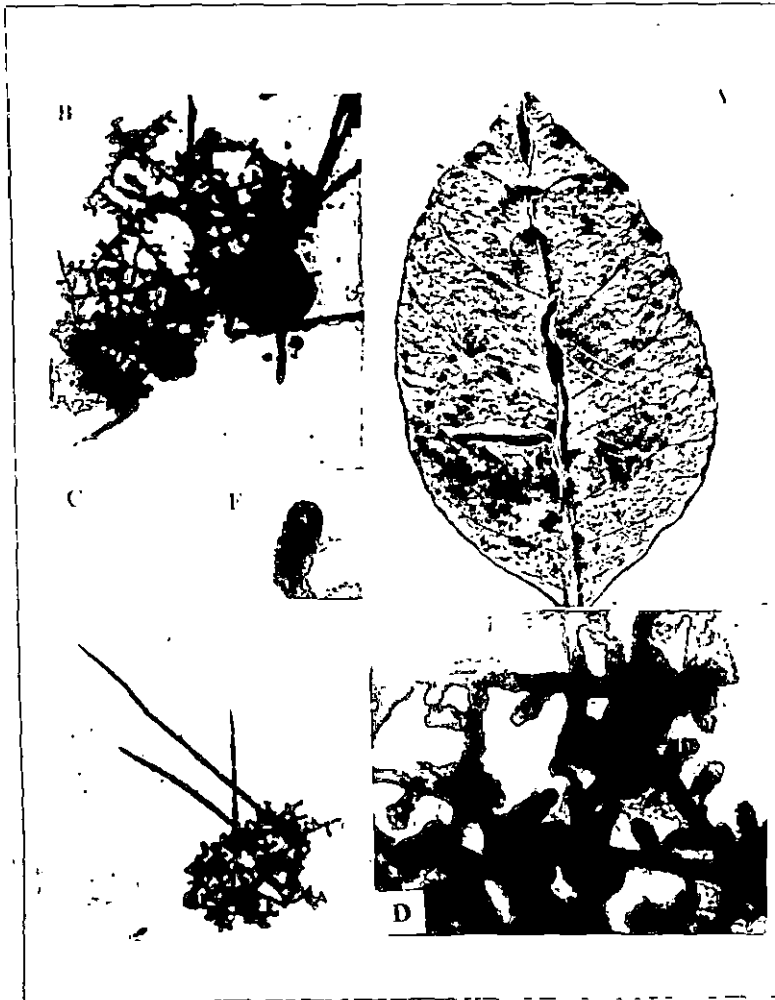


Fig. 22. Meliola citricola - A. Leaf showing perithecia,  $\times 1$ ;  
 B. Perithecium hypopodia,  $\times 200$ ; C. Mycelial seta,  $\times 300$ ;  
 D. Capitulate and mucronate hypopodia,  $\times 450$ ;  
 E. Ascospore,  $\times 550$ .

surface of the leaf; spots black, scattered, round, superficial composed of brown, septate branched hyphae; the hypoconidia are of two types : capitata hypoconidia and mucronate hypoconidia, the capitata hypoconidia many, brown, straight or bent and the mucronate hypoconidia rare, brown; the mycelial setae scattered, encircling the perithecia, stiff, straight 300 - 360 x 7  $\mu$ ; the perithecia many, black, seated in the mycelial colony, rounded, 132 - 230  $\mu$  diameter; asci sessile 46 - 52 x 20 - 26  $\mu$ ; ascospores 4-septate, smooth-walled, brown, 36 - 40 x 13 - 17  $\mu$

Habitat - On living leaves of Citrus sp.

Locality - Pokrabong, Darjeeling, altitude  
6,000 ft., West Bengal.

Specimen studied - DGC 171, June 20, 1973.

Meliola thomasi Sacc.-in Bull. Soc. Boteriana  
21 : 4, (1904).

( Fig. 2 )

Fungus borne on the upper and lower surfaces of the leaf; spots black, scattered, round, superficial, composed of brown septate branched hyphae; hypoconidia two types : capitata hypoconidia and mucronate hypoconidia; capitata hypoconidia many, brown, straight or bent and mucronate hypoconidia rare, brown; mycelial setae scattered, encircling the perithecia, stiff, straight, 231 - 379 x 10 - 13  $\mu$ ; perithecia many, black, seated in the mycelial colony, rounded, 165 - 214  $\mu$

diameter; asci sessile, 2-spored, 43 - 46 x 20  $\mu$ ; ascospores 4-septate, smooth-walled, brown, 33 - 40 x 16  $\mu$ .

Habitat - On living leaves of Elatostema sp.

Locality - Darjeeling, altitude 6,500 ft., West Bengal.

Specimen studied - DGC 140, July 12, 1977.

COLEOSPORIUM Leveille in Ann. Sci. Nat. Bot. 3, ser. VIII, p. 343, 1847.

Eragnium Bot. Zur Kenntniss ... coniomyceten und cryptomyceten.

Stichospora Dietel in Engler's Bot. Jb. 22 : 566, 1899.

Synomyces Arthur in North Amer. Fl. 2. 661, 1924.

Type species : Coleosporium rhinanthacearum (DC.) Lev.  
in Rhinanthus glaber.

Perithecia subepidermal, flattened to conoid, opening by a slit, with ostiolar paraphyses; ascia peridermiumlike, subepidermal, laterally compressed, surrounded by a peridium composed of a single layer of cells, dehiscing irregularly; asciospores catenulate, verruculose and with distinct germpores; uredia subepidermal, erumpent, without peridium, golden yellow; urediospores globose to oblong, produced in chains, manifesting sterile, intercalary cells; telia subepidermal, flat to convex,



Fig. 23. Coleosporium hletae - A. Infected leaf,  $\times 1$ ;  
B. Mature teleutospores producing basidiospore,  $\times 900$ ;  
C. Section through a teliosorus showing laterally  
united one-celled teliospores,  $\times 900$ .

somewhat waxy, becoming gelatinous on germination;  
teliospores 1-celled, cylindric sessile, laterally coalescent,  
thin-walled germinating at maturity by an internal promycelium;  
sporidia borne on long strigata.

The genus has a wide geographic distribution in warmer and temperate regions. Pycnia and aecia are produced on Pinus while uredia and telia are borne on dicotyledonous plants.

The development of internal promycelium in the form of a phragmobasidium is characteristic of most of the species. In Coleosporium pulsatillae weir (1912) showed that vertical septations took place as in Tremellaceae. Strigata are of unequal length, bearing sporidia above the surface of sorus.

Coleosporium bletiae Diet. Hedwigia 37 : 216,  
1898.

( Fig . 28 )

Symptoms-Lesions confined to the leafsheath, leafblade, and stem but principally on the under surface of the leafblade, they appear in the form of very small typically orange coloured oval to lenticular pustules, slightly erumpent with are, scattered irregularly on the under surface of the leafblade; pustules solitary and distinct during early

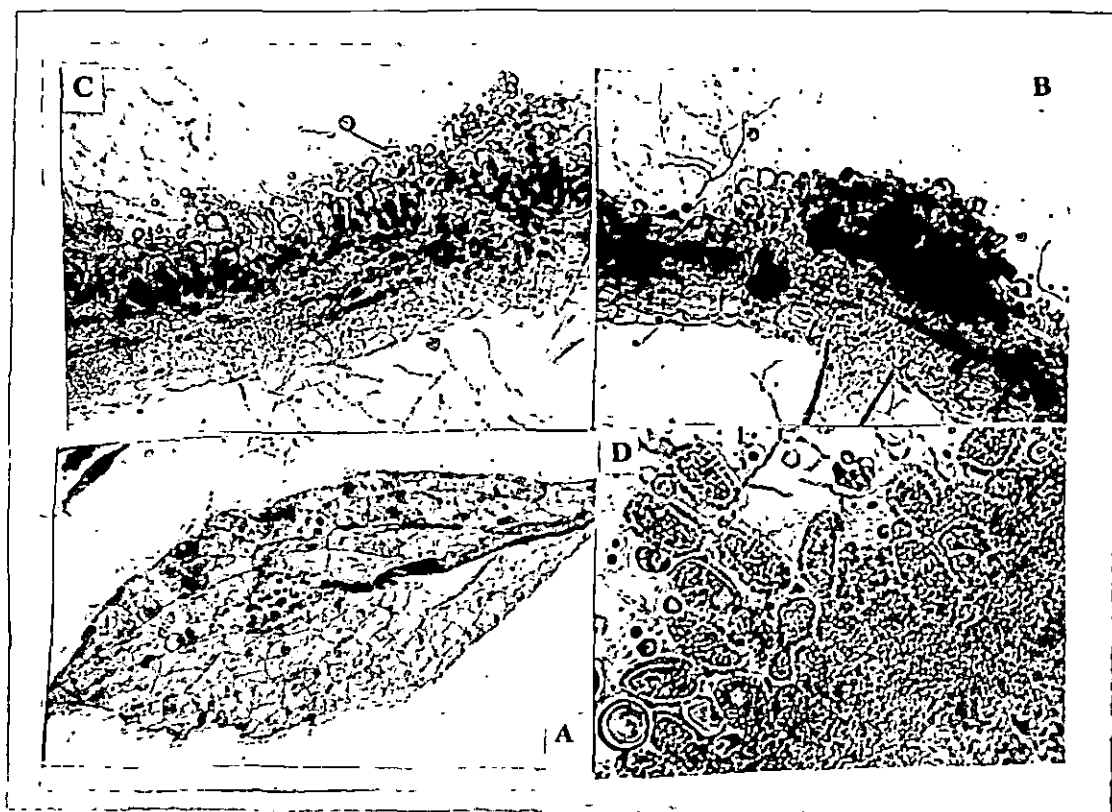


Fig. 24. Coleosporium campanulae - A. Infected leaf,  $\times\frac{1}{2}$ ; B. Section through a telium,  $\times 400$ ; C. Section through a telium showing laterally united one-celled teliospores,  $\times 400$ ; D. Section through a uredosorus showing uredospores,  $\times 500$ .

infection but with severity of infection they coalesce forming circular patches (0.5 mm to 2 mm) around a central light yellowish zone, leaf margins often curl with the virulence of infection, older lesions are blackish-brown with ruptured epidermis clinging to the pustules in form of white flakes.

Causal organism - teliospores laterally united and form 1-celled thick subcuticular crusts, 77-99 x 6-12  $\mu$ . uredia not found.

Habitat - On living leaves of Habenaria densa Wall; Hemimium angustifolium Benth; Satyrium nepalense DonProde; Anthoxanthum gracile Lindl.

Locality - Birch Hill, Darjeeling, altitude 6,500 ft., West Bengal.

Specimen studied - DCC1, DCC2, DCC3, DCC4, July 18, 25 & August 10, 1972.

Coleosporium campanulae Cooke, Microscopic Fungi 213 (1865).

( Fig. 24 )

Symptoms-Lesions characterised by orange coloured pustules distributed on the under surface of the leaves; pustules distinct, erumpent, with severity of infection coalesce forming patches.

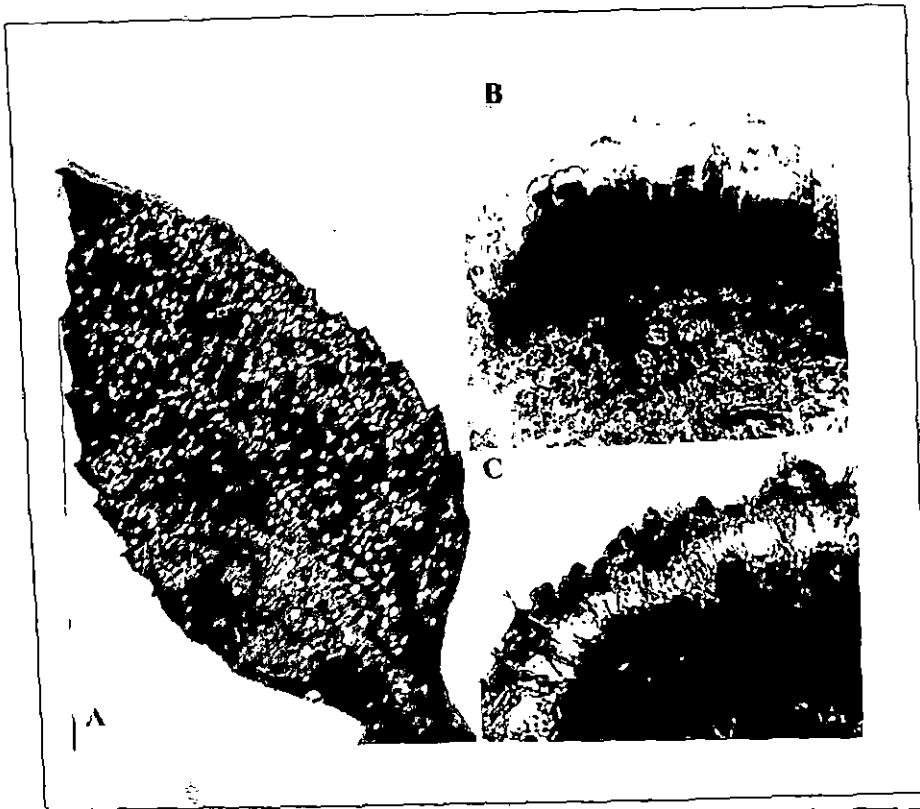


Fig. 25. Coleosporium myriactides - A. Infected leaf, x4; B. Section through a telium showing laterally united teliospores, x214; C. Mature telium showing germination of teliospores, x143.

Causal organism - uredospores ovoid, 1-celled in chains, with spiny wall, 16 - 20  $\mu$  in diameter; teliospores laterally united forming crust, 40 - 53 x 16  $\mu$ ; internal promycelium in mature spores.

Habitat - On leaves of Campanula colorata Wallich.

Locality - Darjeeling, altitude 6,500 ft., West Bengal.

Specimen studied - DGC 123, September 15, 1976.

Coleosporium myriactidia Syd., Ann. Mycol. 35 : 2291 (1937).

( Fig. 25 )

Symptoms-Lesions confined to the leaf sheath, principally on the under surface of the leafblade, appear in the form of small typically orange coloured pustules, erumpent with age, scattered irregularly; pustules solitary but with severity of infection they coalesce forming circular patches.

Causal organism - teliospores laterally united to form sub-cuticular crust with internal promycelium 66 - 82 x 16 - 20  $\mu$ .

Habitat - On living leaves of Myriactia nepalensis Loss.

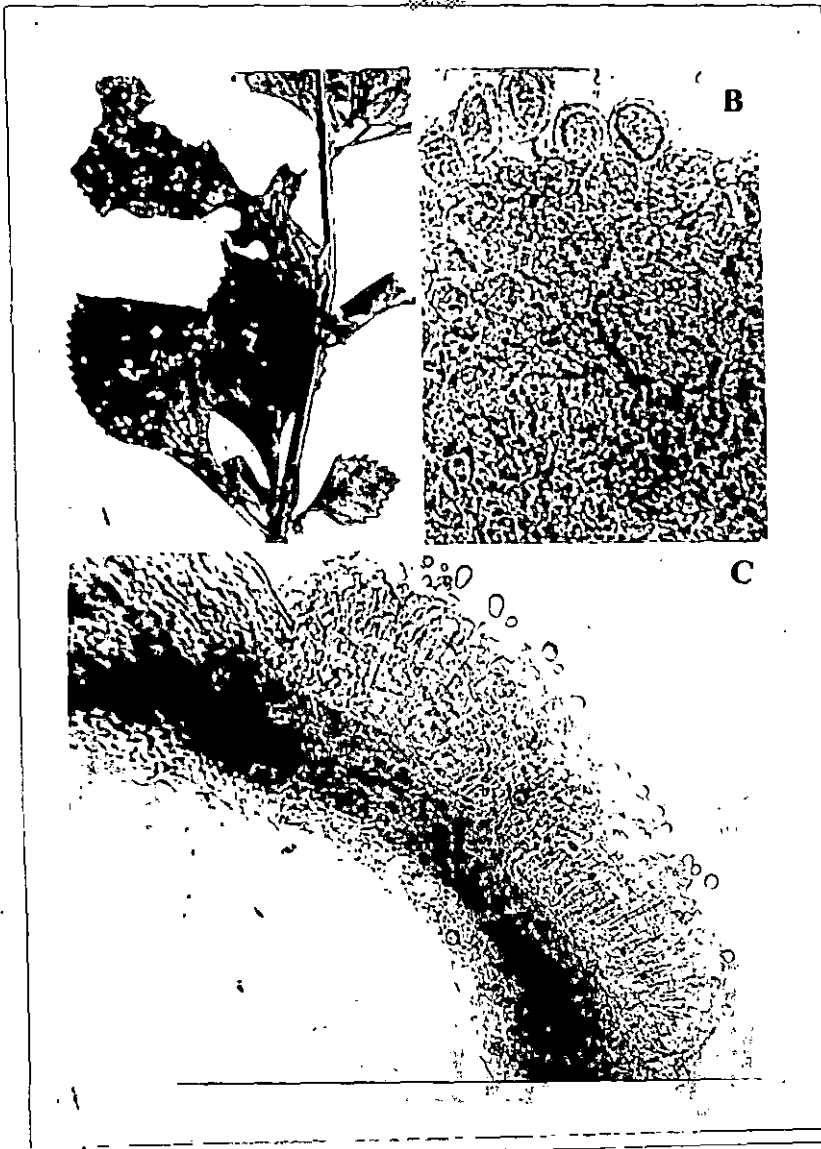


Fig. 26. Coleosporium nectaranthi - A. Infected leaf, x4; B. Section through a uredosorus showing uredospores, x500; C. Section through a telium showing laterally united teliospores, x189.

Locality - Sonada, Darjeeling, altitude 6,600 ft.,  
West Bengal.

Specimen studied - DGC 121, September 10, 1976.

Coleosporium electranthi Barclay, JI. Asiatic Soc.  
Bengal 59 (2) : 89 (1890).

( Fig. 26. )

Symptoms-lesions distributed irregularly on the lower surface of the leaves; pustules solitary, distinct, scattered irregularly, orange coloured, powdery.

Causal organism - ured/ossoras 1-celled in chains, outer surface spiny, 15 - 26  $\mu$  diameter, hyaline; teliospores crowded laterally within the sub-epidermal layer forming a crust, promycelium internal, 1-celled, hyaline, 86 - 99 x 10 - 13  $\mu$ .

Habitat - On living leaves of Electranthus  
zevardiensis Benth.

Locality - Darjeeling, altitude 6,800 ft., West  
Bengal.

Specimen studied - DGC 85, September 25, 1974.

MELAMPSONIA Castagne in observ. Mycol. II, p. 18,  
1843.

Hecium Arthur in N. Amer. Fl. 7 : 114, 1907.

Physanema Lev. in Ann. Sci. nat. Bot. 3rd. Ser. VIII, p.  
374, 1847.

Podocystia Fr. Summa veget. scand. II, p. 517, 1847.

Polosporium Lev in Ann. Sci. nat. Bot. 3rd ser. VIII p.  
374, 1847.

Type species : Melampsora euphorbiae (Schubert) cast  
Euphorbia cyparissias (Euphorbiaceae).

Pyrenia subcuticular, rarely sub-epidermal, conoid. Ascia  
when present with rudimentary peridium or none, without  
paraphyses, orange yellow; asciospores in chains, globoid and  
verruculose; uredia subepidermal, pulverulent; urediospores  
associated with capitate paraphyses, pedicellate; telia  
subepidermal or subcuticular, crustaceous compacted laterally  
into firm layer, often confluent, at first pale, later  
brownish-black, nonerumpent; teliospores in a single layer,  
adhering laterally, 1-celled, prismatic, walls coloured;  
promycelium external, 4-celled.

The genus includes both heteroecious and autoecious  
rusts. In the heteroecious species the telia with the  
exception of a single species usually occur on woody dicots  
such as Saxifraga, Ribes, Corydalis, Marculella and others  
and ascia on Conifers like Larix, Tsuga, Abies and Pseudotsuga.

Pyrenia and telia in some species of Melampsora  
show variation in position in relation to the epidermis. They  
are both subcuticular and subepidermal in origin. These

features which are employed as important distinguishing characters in rust taxonomy show variation in Melanospora. Next to telia, pycnia are very conservative to variation and offer a good basis for diagnosis. The only exceptions cited were those of Havenalia and Melanospora. These two genera show a range of variation from subcuticular to subepidermal condition. Especially in Havenalia the teliospores may be 1-celled (Haplopora yanalia) or 2-celled (Pleurohavelia) but still the species are placed under the one genus taking a broad view of the variation and above all to maintain a well-established procedure among the workers of rust fungi.

When the species of Melanospora, so far known, are considered, the following facts become manifest.

1. Species having a part of their life cycle on conifers show subcuticular pycnia.
2. Species having their complete life cycles on dicots alone have subepidermal pycnia.

Former group may include Melanospora farlowi (Arth.) J. J. Davis on Rauha canadensis formerly placed under a separate genus Necium, of which pycnial stage has not been found. There are differences enough to separate species with subcuticular pycnia into a distinct genus but

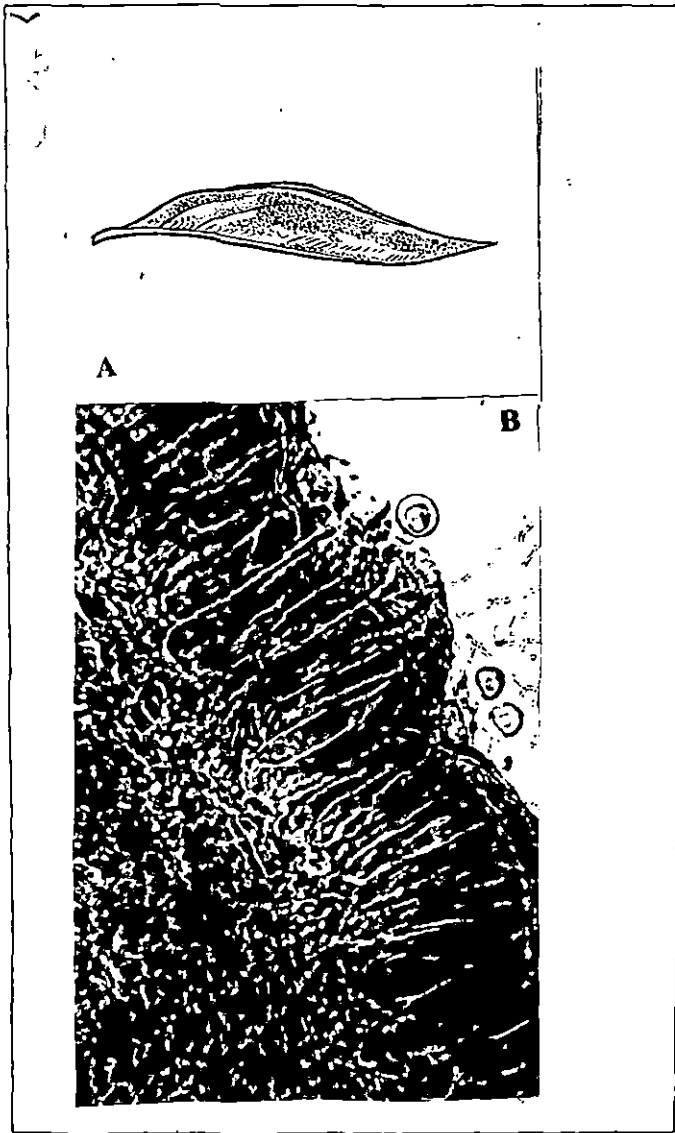


Fig. 27. Melampsora hypericorum - A. Infected leaf, x4;  
B. Section through a telium showing teliospores, x875.

as already stated, it is proper to take a more conservative view, as in Ravenelin, and desist from doing so, however, for the sake of convenience, two subgenera may be recognised to indicate these differences.

a) Emelanosora for species with subepidermal pycnia, including autoecious species; and

b) Heteromelanosora for species with subcuticular pycnia, being heteroecious rusts with pycnial and aecial stages on conifers.

Malanosora hypericorum Wint. in Rabh., Krypt.  
Fl. Bd. 2, 1(1) : 241 (1882).

( Fig. 27 )

Symptoms-Affected plants distinguished by the orange coloured pustules with which the leaves and stems are covered; lesions appear on both the surfaces of the leaves, reddish crust like rather than pustular.

Causal organism - telia subcuticular, compacted laterally; teliospores reddish-brown, forming flat crusts on the leaves, teliospores closely united, 33 - 49 x 7 - 10  $\mu$ .

Uredia not found.

Habitat - On living leaves of Hypericum hookerianum  
N. & A.

Locality - Three miles near Ghoom, Darjeeling,  
altitude 7,000 ft., West Bengal.

Specimen studied - D48 101, June 2, 1976.

PHRAGMIDIUM Link in Mag. Ges. Naturf. Freunde 7,  
P. P. 30, 1816.

Amelia Arthur, Result Sci. Congr. Bot. Wien, 1905,  
p. 342, 1906.

Arena Fr. Syst. Mycol. 3 : 496, 1832.

Barlea Arthur, Result, Sci. Congr. Internat. Bot.  
wien, 1905, P. 341, 1906.

Epitesa Fr. Syst. Mycol. 3 : 510, 1832.

Lacvthea Lev. Ann. Sci. Nat. 8 : 373, 1847.

Trollomyces Ulbrich, Notizbl. Bot. Gart. Berl. 14:  
141, 1938.

Teloconia Sydow, Ann. Mycol.

Type species : Phragmidium mucronatum (Per.) Schlecht. on  
Rosa sp.

Pyenia subcuticular, flat, without conspicuous  
ostiole paraphyses; ascia caecoid without peridium but  
surrounded by incurved paraphyses; asciospores in chains,  
globoid; uredia subepidermal erumpent, pulverulent and  
paraphysate; paraphyses cylindric and incurved; urediospores  
borne singly on pedicels; telia subepidermal, erumpent,  
black; teliospores one to ten-celled phragmospores, pedicellate,  
reddish-brown, thick-walled wall layer laminate, verrucose or

warty, with two to three lateral gerapores, pedicel hyaline, usually hygroscopic and swelling at the lower portion.

All the species so far known are autoecious on Rosaceae, especially on Rosa and Rubus. The characters of Phragmidium overlap with those of Fraxea and Phragmatelium, also occurring on the Rosaceae, so that it is very difficult sometimes to distinguish them. Further studies are needed to secure a better basis for the separation of these genera.

Fraxea differs from Phragmidium in having smooth teliospores with distinct single apical gerapore in each cell as against verrucose spores of Phragmidium with two to three lateral gerapores in each cell.

The genus Phragmatelium established by Sydow (1921) was based on the occurrence of primary uredia with paraphyses and paraphysate secondary uredia with Phragmidium - like teliospores.

Aecia were unknown in the type but were discovered later in Phragmatelium gysoregan while genera cannot, as a rule, be based on the type of life-cycle, the following combination of characters distinguish Phragmidium from Phragmatelium. Teliospores of Phragmatelium have smooth cell-wall whereas it is verrucose in Phragmidium; teliospores of Phragmatelium germinate immediately at maturity whereas those of Phragmidium are resting spores. The pedicels of Phragmatelium do not swell in water.

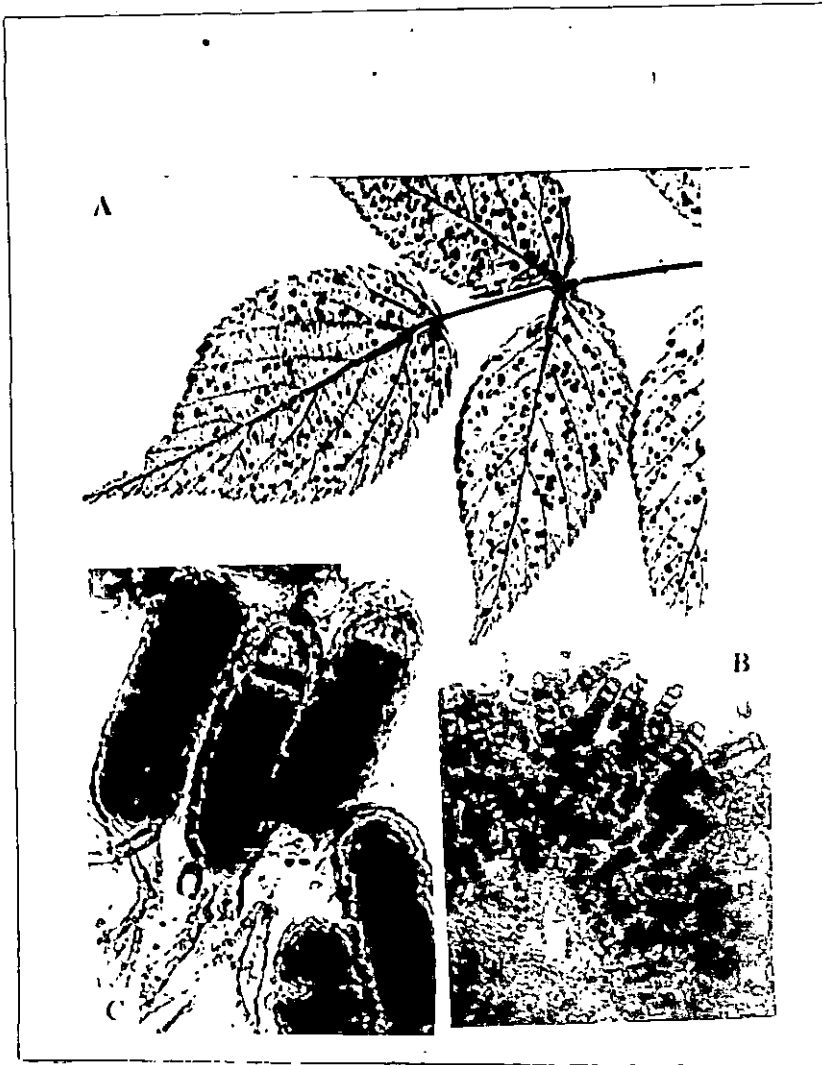


Fig. 28. Phragmidium harclayi - A. Infected leaf, x8;  
B. Section through a telium showing teliospores, x134;  
C. Many celled teliospores, x427.

Phragmidium barclayi Diot., Hedwigia 21 : 264(1830).

( Fig. 23 )

Symptoms-Lesions distributed irregularly on the under surface of the leaves; rustules dark coloured, irregular, powdery 2 - 4 mm diameter, erumpent.

Causal - organism - telia orange coloured, hypophyllous; teliospores on a single pedicel, mature teliospores deep orange and immature teliospores hyaline, pedicel hyaline, 5-7-celled, compound, wall verrucose, 80 - 92 x 22 - 32  $\mu$  hygroscopic.

Uredia not found.

Habitat - On living leaves of Subus rivens,  
Wall.

Locality - Darjeeling, altitude 7,500 ft.,  
West Bengal.

Specimen studied - DGC 172, June 12, 1978.

Phragmidium octoloculare Barclay, Jl. Asiatic Soc.  
Bengal 60(2) : 221 (1891).

( Fig. 29 )

Symptoms-Lesions distributed irregularly throughout

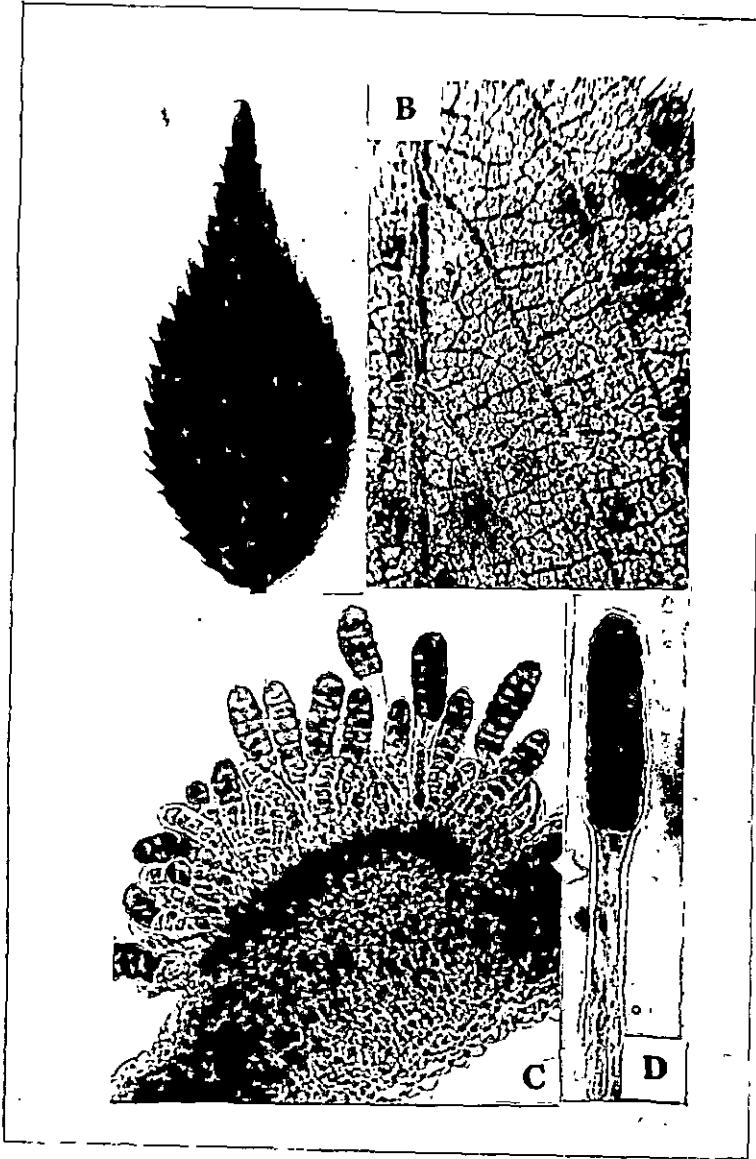


Fig. 29. *Phragmidium octolocularis* - A. Infected leaf, x4;  
B. Portion of a leaf showing pustules, x200;  
C. Section through a telium showing teliospores, x100;  
D. Many-celled teliospore, x300.

the lower surface of the leaves; perithecia dark-coloured, irregular in outline, 3-5 mm diameter, eruptent.

Causal - organism - telia chocolate coloured, hypophyllous; teliospores many-celled, stalked, wall chocolate coloured, verrucose, pedicel hyaline and enlarged towards the base, 92 - 115 x 23 - 26  $\mu$ .

Uredia not found.

Habitat - On living leaves of Rubus roseifolius Smith.

Locality - Jalapahar, Darjeeling, altitude 7,000 ft., West Bengal.

Specimen studied - DCC 60, June 7, 1974.

PHRAGMOTELIUM Sydow in Ann. Mycol. 19 : p. 167, 1921.

Pycnia subcuticular, conoid, without conspicuous ostiolar paraphyses; primary uredia (uredinoid aecia) subepidermal, aparaphysate, secondary uredia subepidermal, with peripheral incurved paraphyses; urediospores borne singly on pedicels; telia subepidermal, black, eruptent; teliospores pedicellate, 2-6-celled or more (phragmospores), smooth, reddish-brown, with 2 to 3 lateral germ pores in each cell; pedicel hyaline, not swelling in water; spores germinating



Fig. 30. Phragmotelium mysorensis - A. Infected leaves, x8;  
B. Teliospores, x300.

Immediately at maturity without any resting period.

The genus was established to accommodate species with aparaphysate primary uredia (uredinoid aecia) in place of caenoid aecia usually found in Phragmidium. That this is not a very distinguishing feature became evident by the discovery of caenoid aecia in Phragmatelium mysorensis, which in other respects was indistinguishable from other species of Phragmatelium so far known, as already pointed out under Phragmidium, the teliospore characters offer the clue to their separation.

Phragmatelium mysorensis Thirum. & Mundk., Proc.

Indian Acad. Sci. Sect. B., 15 : 191 (1942).

( Fig. 30 )

Symptoms-Lesions distributed irregularly on the under surface of the leaves; anastyles solitary, minute, 1mm diameter, round, erumpent, black, not powdery.

Causal - organism - telia hypophyllous, black; teliospores cylindrical, apex round with apical papilla, wall brown, smooth-walled, 3  $\mu$  thick, pedicels hyaline, non-hygroscopic, 4 - 6 septate, 78 - 112  $\times$  24 - 27  $\mu$ .

Habitat - On living leaves of Rubus lasiocarpus, Sm.

Locality - Sukhiapokri, Darjeeling, altitude 6,000 ft.,  
West Bengal.

Specimens studied - DGC 173, July 2, 1978.

PUCCINIA Persoon in (Deps Meth. Fung. p.33, 1797).

Syn. Meth. Fung. p. 225, 1801).

Allodius Arth. in Result. Sci. Congr. Internat. Bot.  
Wien, 1905. p. 345, 1906.

Bullaria D.C. in Flore France, 2 : 226, 1805.

Corenetalium Sydow in Ann. Mycol. 19 : 174, 1921.

Eutomyces Thuom. in Joura. Sci, Math. Phys. Nat.  
Lisbon, 6 : 239, 1876.

Dicranosia S. F. Gray in Nat. Arr. Brit. Pl. I, p.541,  
1821.

Erioparacium Reuter ex Leville in Ann. Sci. Nat.  
Bot. III Ser 5 : 249, 1846.

Jackya Dubak in ost Bot. 3. 1 : 42, 1902.

Lentinia Juol in Bih, Svensk. vetens. Akad. Handl.  
23, Afd. 3, No. 10 p. 15, 1897.

Letonuccinia Rostrup in plantopatologi, p. 268, 1902.

Lindrothia Syd. in Ann. Mycol. 20 : 119, 1922.

Linkiella Syd. in Ann. Mycol. 19 : 173, 1921.

Lyaspora Arth. in Result Sci. Congr. Internat. Bot.  
Wien, 1905, p. 340, 1906.

Micronuccinia Rostrup in Plantopatologi, p. 226, 1902.

Peristemma Syd. in Ann. Mycol. 20 : 118, 1922.

Persooniella Syd. in Ann. Mycol. 20 : 116, 1922.

Pleomeria Syd. in Ann. Mycol. 12 : 171, 1921.

Polionella Syd. in Ann. Mycol. 20 : 122, 1922.

Pseudonectinia Hohnel apud weese in Mitt. Bot. Lab.

Tech. Hochsch. wien, II, p. 41, 1925.

Puccinidia H. Mayr. in waldingen Nordamerika, p. 337,  
1829.

Rostrupia Lagerh. in J. Bot. Paris, 3 : 188, 1839.

Schroeterella Sydow in Ann. Mycol. 20 : 172, 1922.

Selenotellium Syd. in Ann. Mycol. 19 : 172, 1921.

Solenodonta Castagne in Cat. Pl. Marseille, 202, 1845.

Trillia Syd. in Ann. Mycol. 20 : 121, 1922.

Type species : Puccinia graminis Pers.

Puccinia subepidermal, cupulate, ostiolate, with ostiolar paraphyses. Aecia subepidermal or evanescent; aeciospores produced in chains, angularly globose or spherical. Uredia subepidermal, with or without paraphyses; urediospores produced singly on pedicels. Telia subepidermal, mostly replacing the uredia when they are present; teliospores 2-celled, pedicellate, reddish-brown to pale-yellow in colour and rarely tending to be almost hyaline; septum horizontal, rarely oblique and vertical; germ-pore single in each cell, usually apical in the top cell and lateral in the lower one; teliospores germinating after a period of rest or immediately promycelium external, typically 4-celled, or 2-celled, or irregular.

The genus includes several species of great economic importance which cause serious damage to cereal, vegetables, ornamental and other plants. It includes both autoecious and heteroecious forms which show great variability in the type of life cycle. The various species show intergrading characters in the colour and resting type of teliospores as well as the extent of development of peridium within the aecium. Teliospores in some species are thin-walled, and hyaline while those of others are deep reddish-brown and are resting spores.

The occurrence of the mesospores in rather large numbers in some cases has resulted in some of the species of Puccinia being mistaken for Uromyces. Even so, several cases of teliospores with more than 2-cells have been recorded in species of Puccinia. This feature should not be given undue importance if they occur associated with normal 2-celled teliospores typical of Puccinia. Some of these teratological phenomena have been cited by Arthur et al. The genus Roestelia Lagerh shows this type of variation and possesses more than two-celled teliospores in association with 2-celled ones. Dietel recognises this as a valid genus, but considering the range of variability, it is best to treat it as a synonym of Puccinia.

There is a complete intergradation between Puccinia and Dicranidium, so that the separation of the genera showing oblique separation, laterally disposed germ pores and other intermediate characters, is only arbitrary.

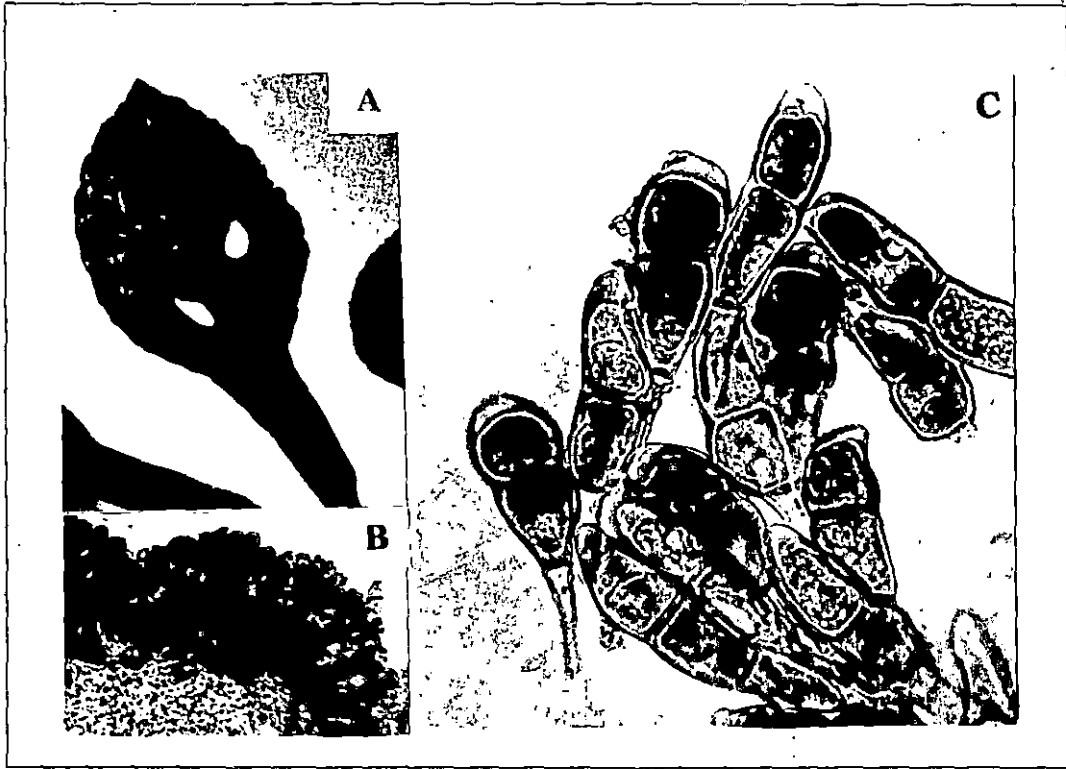


Fig. 31. Puccinia sinuata - A. Infected leaf, x4; B. Section through a telium, x175; C. Two-celled teliospores, x455.

The number and disposition of the gerapores separate Puccinia from Cumminsella and Stereostromum, being two and lateral in Cumminsella and 4 to 5 in Stereostromum. The subcuticular nature of the pyrenium differentiates Sorataea and Uropyxis from the subepidermal condition present in Puccinia.

The occurrence of a stockade of peridia surrounding the telium is the only differentiating characters of Hivogia.

Puccinia ainslieana Syd. in Sydow P. & H., Monographia  
Uredinearum 1 : 6 (1902).

( Fig. 31 )

Symptoms-Lesions distributed irregularly on the under surface of the leaves; rustules brownish, circular, numerous, erumpent, 1 - 2 mm diameter.

Causal - organism - telia 198 - 208  $\mu$  diameter; teliospores dark-brown, smooth, 2-celled, top cell blunt, 49 - 66 x 13 - 16  $\mu$ , pedicel hyaline.

Uredia, pyrenia and aecia not found.

Habitat - On living leaves of Ainsliea  
pteropoda, D. C.

Locality - Sinchal, Darjeeling, altitude 7,000ft.,  
West Bengal.

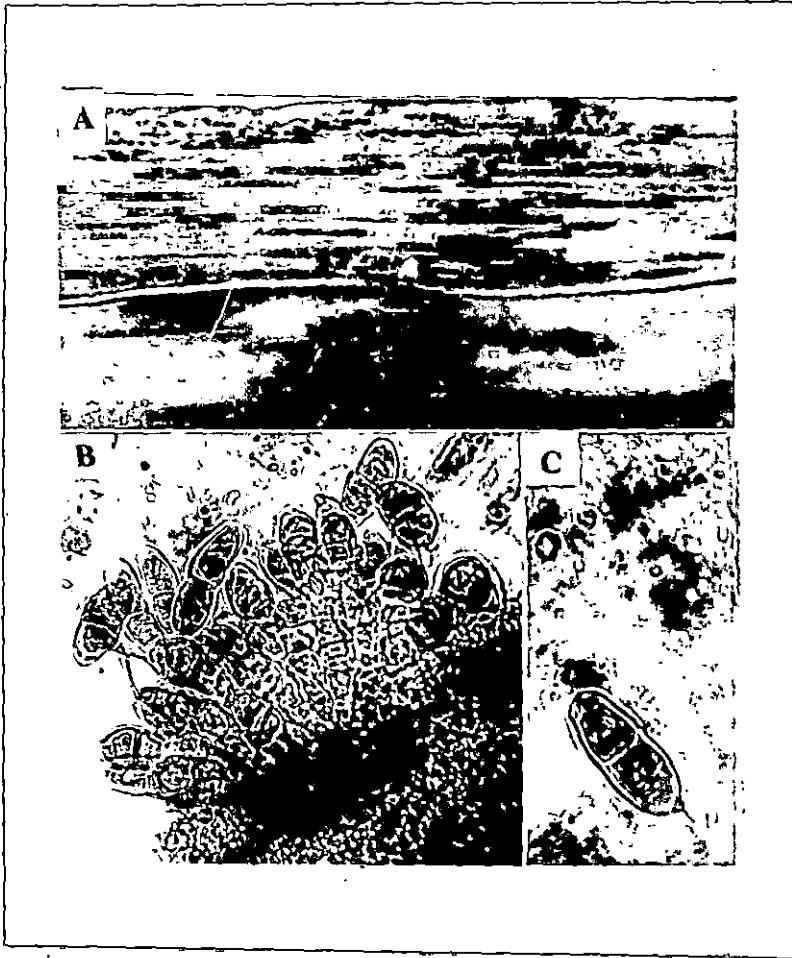


Fig. 32. *Puccinia arundinariae* - A. Infected leaf, x4; B. Section through a telium showing teliospores, x457; C. A teliospore, x571.

Specimen studied - DGC 151, June 12, 1977.

Puccinia arundinariae Schw., Schr. Nat. Ges. Leipzig  
1 : 72 (1822).

( Fig. 32 )

Symptoms - Lesions distributed throughout both the  
surfaces of the leaves; rustules light brown, irregular, linear  
shaped, numerous, erumpent.

Causal - organism - telia flat, hypophyllous;  
teliospores pedicellate, 2-celled, mostly ellipsoidal or oblong-  
ellipsoidal, wall 3  $\mu$  thick, 7  $\mu$  apically, pedicels hyaline,  
26 - 49 x 20 - 23  $\mu$ .

Uredia, aecia and pycnia not found.

Habitat - On living leaves of Arundinaria  
intermedia Muro.

Locality - Near Sinchal Lake, Darjeeling,  
altitude 6,800 ft., West Bengal.

Specimen studied - DGC 84, March 12, 1975.



Fig. 33. Puccinia carlicia - A. Infected leaf,  $\times 5$ ;  
B. Section through a telium showing teliospores,  $\times 365$ ;  
C. Teliospores,  $\times 283$ .

Puccinia caricis (Schum.) Schroter, Jahresb. Schles.  
Ges. Vaterl. Cult. 103, 1873.

( Fig. 33 )

Symptoms-lesions dark-brown, rounded, distributed irregularly on the lower surface of the leaves; rustules solitary, distinct, erumpent, 0.5 mm diameter.

Causal - organism - telia hyaline; teliospores 2-celled, thick walled, smooth, 40 - 56 x 13 - 16  $\mu$ , constricted in the middle, apical cell prolonged, pedicel short and hyaline.

Uredia, aecia and ascia not found.

Habitat - On living leaves of Carex crucifera,  
Wahl.

Locality - Darjeeling, altitude 6,800 ft.,  
West Bengal.

Specimen studied - DGC 64, April 7, 1975.

Puccinia chlorophytæ sp. nov.

( Fig. 34 )

Symptoms-lesions confined to the leafsheath and leafblade, typically brown colour, scattered irregularly

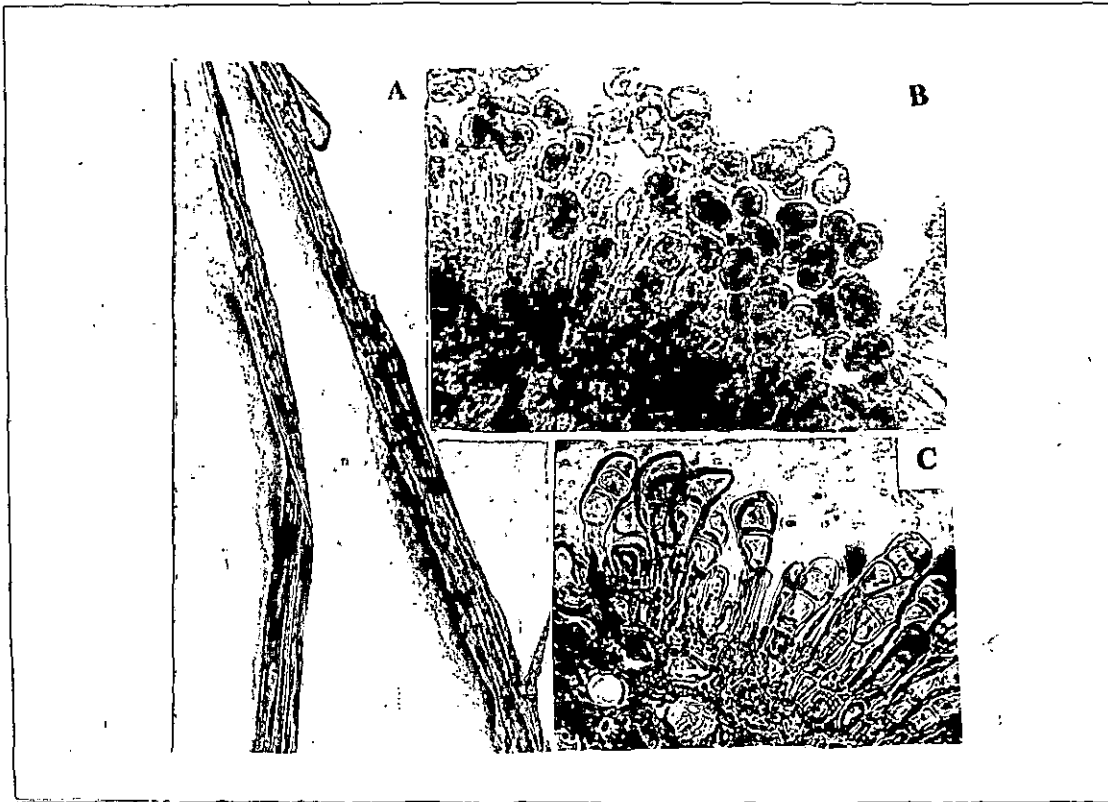


Fig. 34. Puccinia chlorophytae - A. Infected leaf, x8; B. Section through a telium, x333; C. Section through a telium showing teliospores, x389.

on both the surfaces of leafblade; rustules oval, slightly erumpent with age, solitary but with severity of infection they coalesce forming patches.

Causal - organism - telia orange coloured, with ruptured epidermis; teliospores 2-celled, 33 - 49 x 20 - 23  $\mu$ , pedicel persistent, 33 - 49 x 7  $\mu$ .

Uredia, aecia and sacra not found.

Etymology - From the name of the host.

Habitat - On living leaves of Chlorophyton sp.

Type Locality - Tukver, Darjeeling, altitude 6,000ft., West Bengal.

Type specimen studied - DGC 56 (IMI 217598), Leg. B.B. Dewan, December 14, 1974.

Note : No species of Puccinia has been described on this host genus. So the collection is proposed as a new species.

Puccinia fagopyri Barclay, Jl. Bot. 261(1980)

( Fig. 35 )

Symptoms-Lesions distributed irregularly on

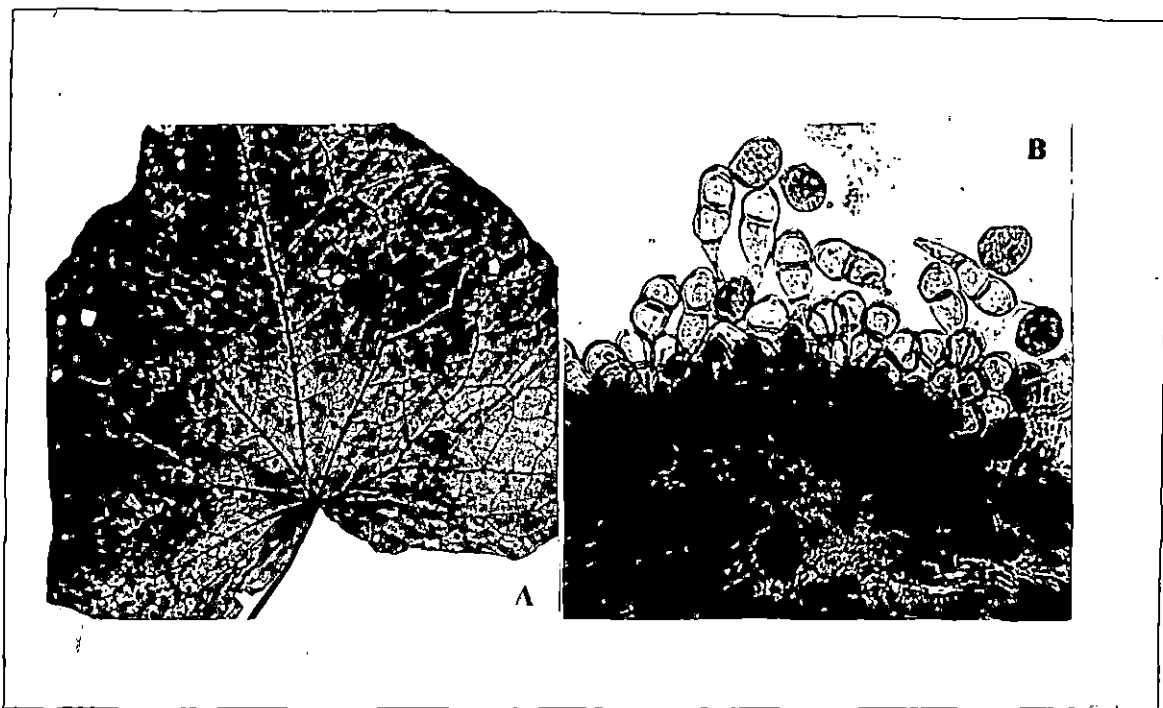


Fig. 35. Puccinia fagopyri - A. Infected leaf, x ;  
B. Section through a telium showing teliospores, x258.

the under surface of the leaves; anastomoses minute, circular, brown, crumpled.

Causal - organism - telia dark brown, hypophyllous; teliospores dark-brown, smooth, 2-celled, top cell blunt, 26 - 36 x 13 - 15  $\mu$ .

Uredia, pyrenia and aecia not found.

Habitat - On living leaves of Fagopyrum  
dibotrys (D. Don) Hara.

Locality - Darjeeling, altitude 6,800 ft.,  
West Bengal.

Specimen studied - DGC 76, June 12, 1975.

Puccinia ceratii - sylvatici Krast., Enum.

Fung. Lapp. or. : 220 (1866).

( Fig. 35 )

Symptoms-lesions distributed irregularly on the under surface of the leafblade and petiole but with severity of infection they coalesce and leaves becoming curled; anastomoses large, brown, crumpled.

Causal - organism - telia dark-brown, scattered;

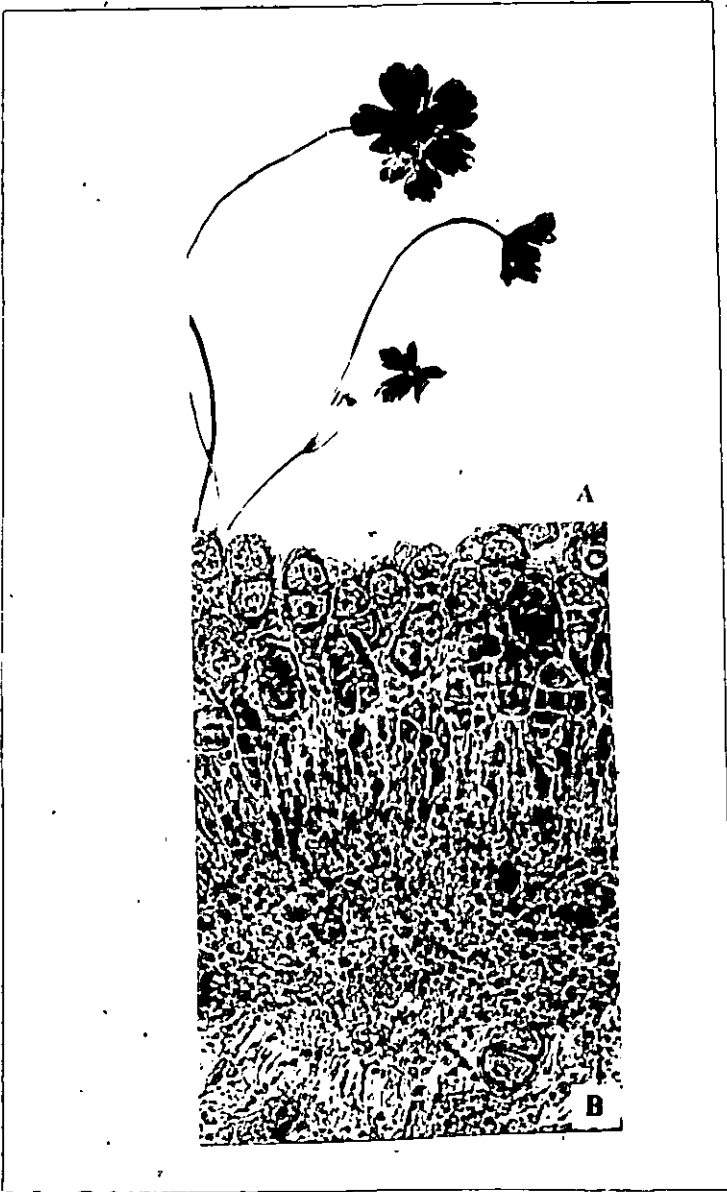


Fig. 36. Puccinia maranii-silvatici  
A. Infected leaf, st; B. Section  
through a telium showing teliospores,  
x367.

teliospores dark-brown, smooth, pedicellate, pedicels hyaline, 2-celled, 26 - 33 x 16 - 20  $\mu$ .

Uredia, pycnia and aecia not found.

Habitat - On living leaves and petiole of Geranium neealense Sw.

Locality - Darjeeling, altitude 6,800 ft., West Bengal.

Specimen studied - DCC 146, June 25, 1977.

Puccinia lauricola (Thurm.) Comb. nov. Karnalia lauricola (Thurm) Thurm., Mycologia, 41 : 97, 1949.

( Fig. 37 )

Symptoms-Lesions distributed irregularly on the under surface of the leaves; pustules mostly solitary and some coalescing together, 1 - 2 mm diameter.

Causal - organism - telia hypophyllous, on hypertrophied spot; teliospores 2-celled, thick-walled, oblong, golden yellow colour, apical cell pointed, 64 - 75  $\mu$

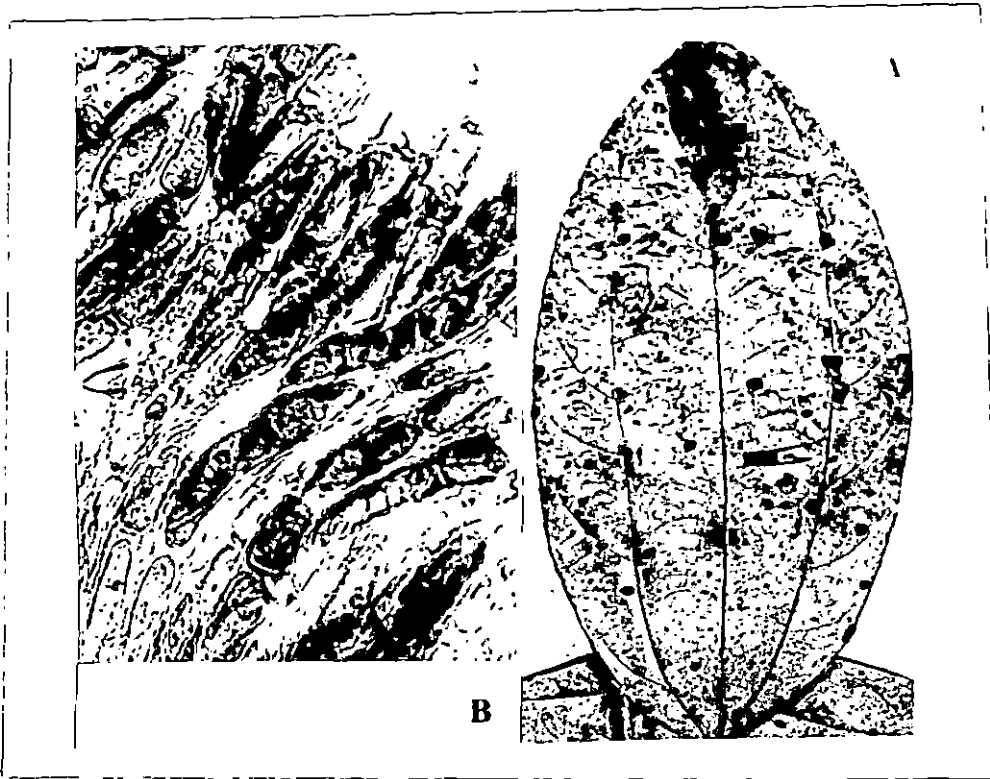


Fig. 37. Puccinia lauricola - A. Infected leaf, x2;  
B. Section through a telium showing teliospores, x500.

14 - 23  $\mu$ , stalk long, slender, thin-walled, wall smooth, 2 - 3  $\mu$  thick, apex thick, pedicels hyaline upto 300  $\mu$  long.

Uredia, avenia and acacia not found.

Habitat - On living leaves of Cinnamomum  
caudatum, Nees.

Locality - Three miles, Darjeeling, altitude  
7,000ft., West Bengal.

Specimen studied - DGC 179, May 12, 1979.

Puccinia menthae Pers., Syn. Meth. Fung.  
227 (1801).

( Fig. 39 )

Symptoms-lesions distributed irregularly on  
the under surface of the leaves; anastomae minute, brown,  
circular, 0.5 - 1 mm diameter, erumpent.

Causal organism - telia chocolate coloured,  
hypophyllous; teliospores chocolate coloured, 2-celled,  
smooth-walled, oblong to ovate, 23 - 26 x 20  $\mu$ , pedicels  
persistent, apex conical, constricted at the septum.

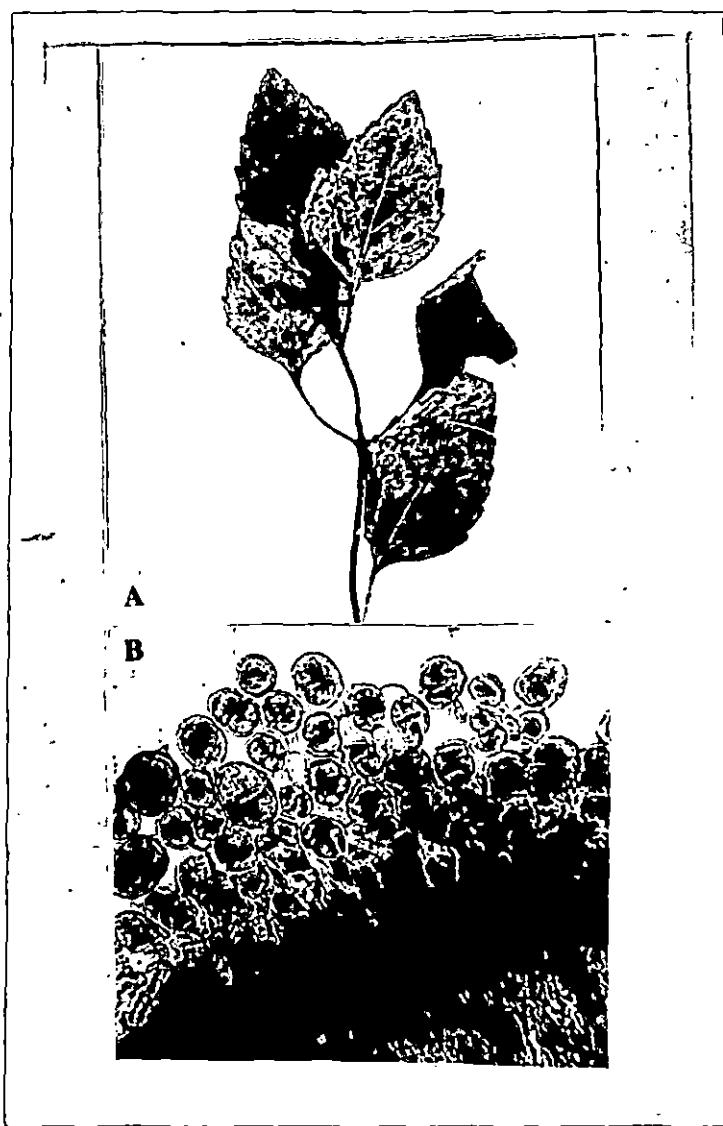


Fig. 38. Puccinia menthae - A. Infected leaves, x1;  
B. Section through a telium showing teliospores, x280.

Uredia, pycnia and aecia not found.

Habitat - On living leaves of Calamita umbrosa  
Benth.

Locality - Mongoo, Darjeeling, altitude 6,000ft.,  
West Bengal.

Specimen studied - DCC 86, June 15, 1975.

Puccinia notochaetae sp. nov.

( Fig. 39 )

Symptoms-Lesions distributed irregularly on the  
under surface of the leaves; rustules brown, isolated,  
very minute, 0.5 - 1 mm diameter.

Causal - organism - telia hyaline, scattered;  
teliospores 2-celled, smooth walled, 31 - 41 x 10 - 17  $\mu$ ,  
pedicel hyaline.

Uredia, pycnia and aecia not found.

Etymology - From the name of the host.

Habitat - On living leaves of Notochaeta sp.

Type Locality - Three miles, Darjeeling, altitude  
7,000 ft., West Bengal.

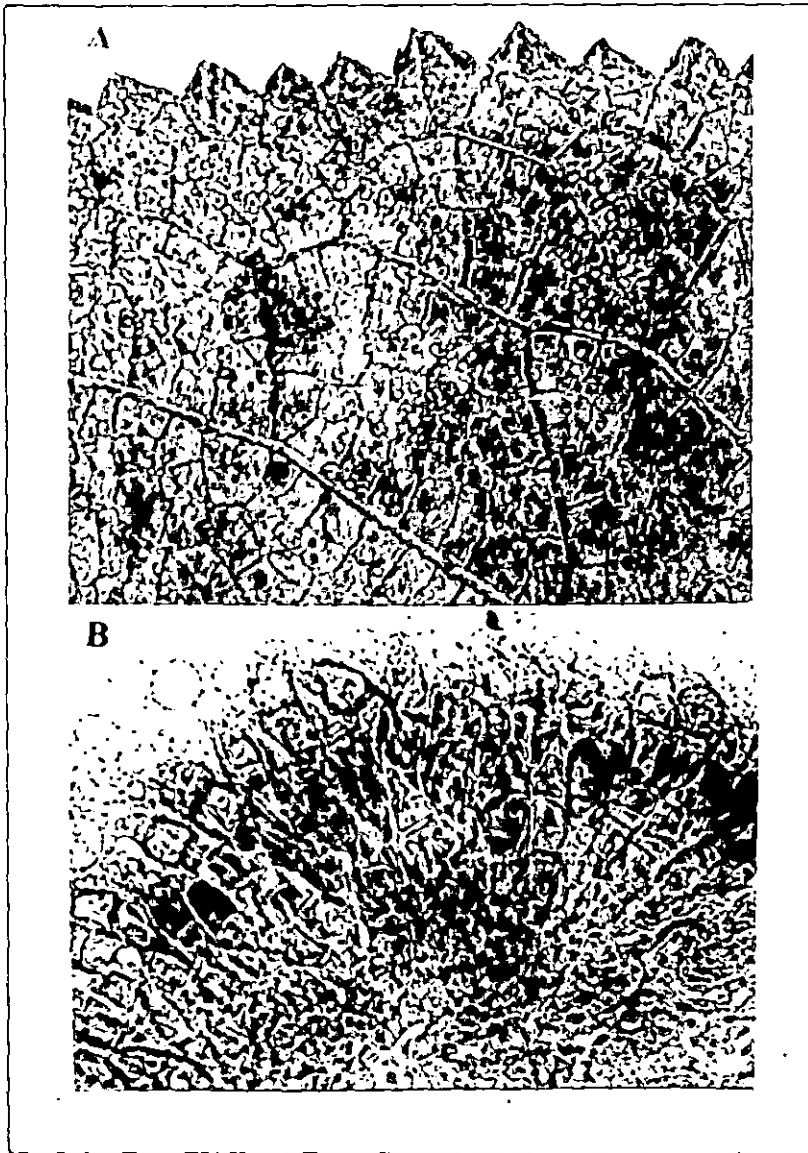


Fig. 39. *Puccinia notochaete* - A. A portion of the leaf showing distribution of lesions, x $\frac{1}{2}$ ; B. Section through a telium showing teliospores, x106.

Type specimen studied - DGC 181, (IMI 292415), Leg.

B.B. Dewan, December 3, 1979.

Note : No species of Puccinia has been described on this host genus. So the collection is proposed as a new species.

Puccinia qanathan (Diet.) Niyabe, Joura. Sapporo Agric. Coll. 2(3) : 106 (1906).

( Fig. 40 )

Symptoms-Lesions distributed irregularly on the under surface of the leaves; oostules solitary, minute, erumpent, brown, 0.5 - 1 mm diameter.

Causal - organism - telia hypophyllous, scattered; teliospores 2-celled, bright golden, 40 - 50 x 22 - 37  $\mu$ , pedicels hyaline, slender.

Uredia, pyrenia and aecia not found.

Habitat - On living leaves of Qanatha sp.

Locality - Three miles, Darjeeling, altitude 7,000 ft., West Bengal.

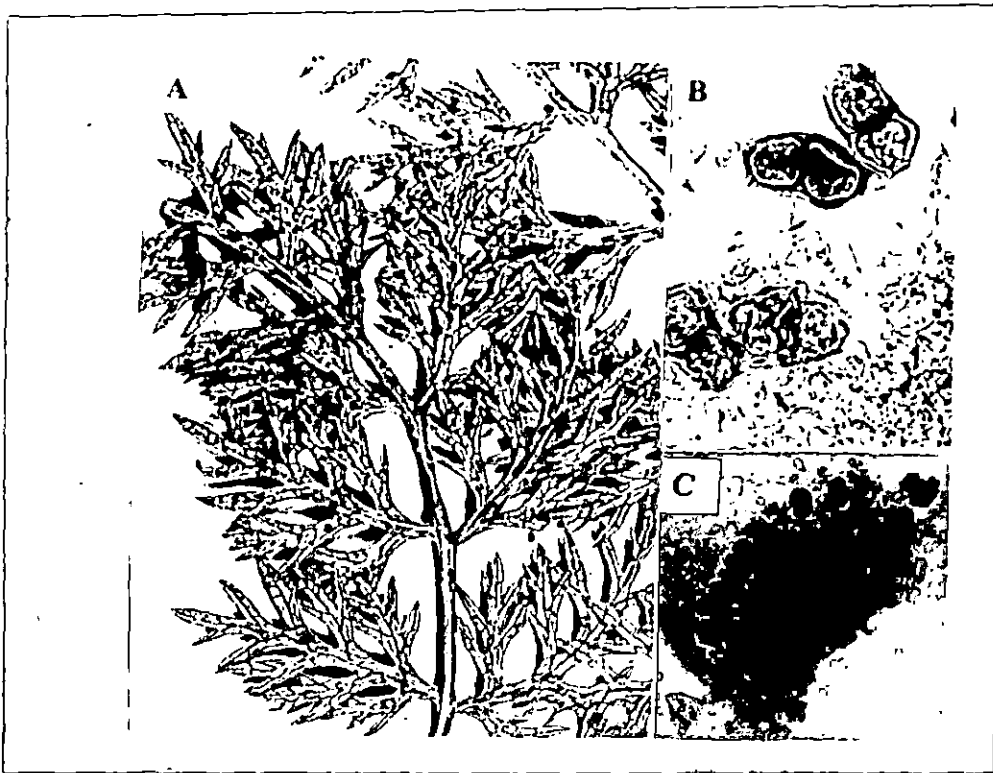


Fig. 40. *Puccinia oenanthes* - A. Infected leaves,  $\times 28$ ;  
B. Teliospores,  $\times 333$ ; C. Section through a telium,  $\times 66$ .

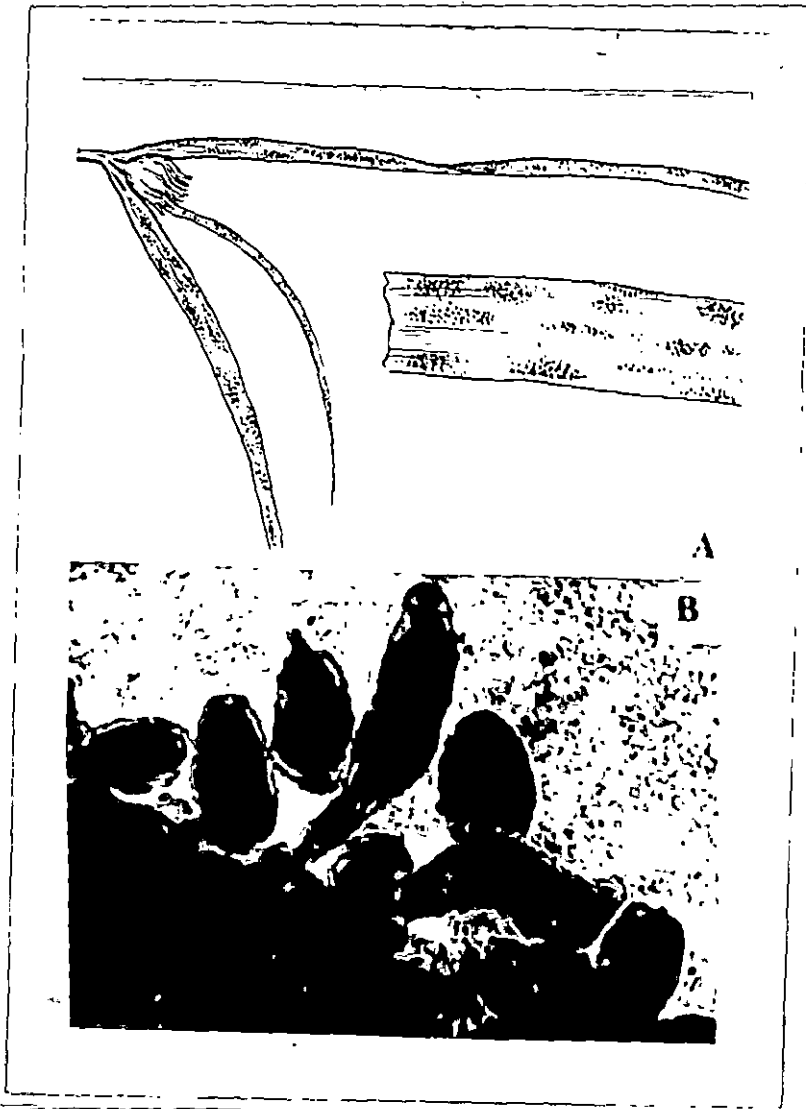


Fig. 41. *Puccinia rosagalliana* - A. Infected leaves and a portion of a leaf showing the distribution of pustules, x1; B. Section through a mixed sorus showing uredospores and teliospores, x1177.

Specimen studied - DGC 182, August 19, 1979.

Puccinia romagnoliana Walre & Sacc., Annis. Mycol.,  
1 : 220, 1903.

( Fig. 41 )

Symptoms-Lesions distributed on the under surface of the leaves, yellow to orange coloured; rustules round, 0.5 - 1 mm diameter.

Conial - organia - uredia hypophyllous, brown; uredospores single-celled, stalked, round, echinulate, 16 - 19  $\mu$  diameter; telia like uredia; teliospores 2-celled, oblong, apex conical, smooth-walled, 26 - 36 x 16 - 20  $\mu$ ; pedicel deciduous.

Pythia and ascia not found.

Habitat - On living leaves of Cyperus rotundus L.

Locality - Ging, Darjeeling, altitude 6,000ft.,  
West Bengal.

Specimen studied - DGC 98, June 12, 1975.

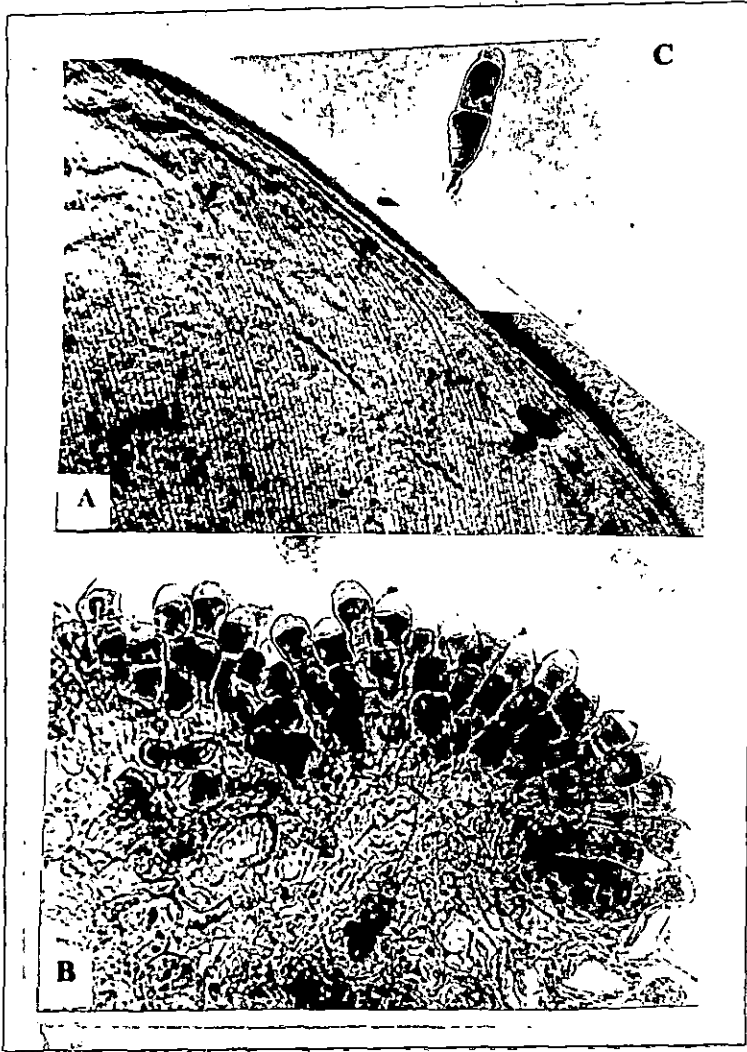


Fig. 42. Puccinia roseae - A. Portion of the infected leaf, x1;  
B. Section through a telium showing teliospores, x400;  
C. Teliospore, x667.

Puccinia rosaceae Barclay. Descript. List. Ured.  
Sima II : 237 (1889).

( Fig. 42 )

Symptoms-Lesions confined to the under surface of the leafblade, older lesions blackish-brown with ruptured epidermis; perithecia solitary, distinct, orange coloured, lenticular to irregular, slightly erumpent with age, scattered irregularly.

Causal - organisms - telia brown, hypophyllous, scattered; teliospores yellowish-brown, 2-celled, thick-walled, apex convex, slightly constricted at the septum, 20 - 40 x 10 - 13  $\mu$ , pedicellate, pedicels hyaline.

Uredia, aecia and ascia not found.

Habitat - On living leaves of Cauloia lutea Royle; Glohis Hookeri Clarke; Hedychium scuminatum Roscoe.

Locality - Darjeeling, altitude 6,800 ft., West Bengal.

Specimens studied - DGC 32, DGC 33, DGC 34, Sept. 15 & 20, 1974.

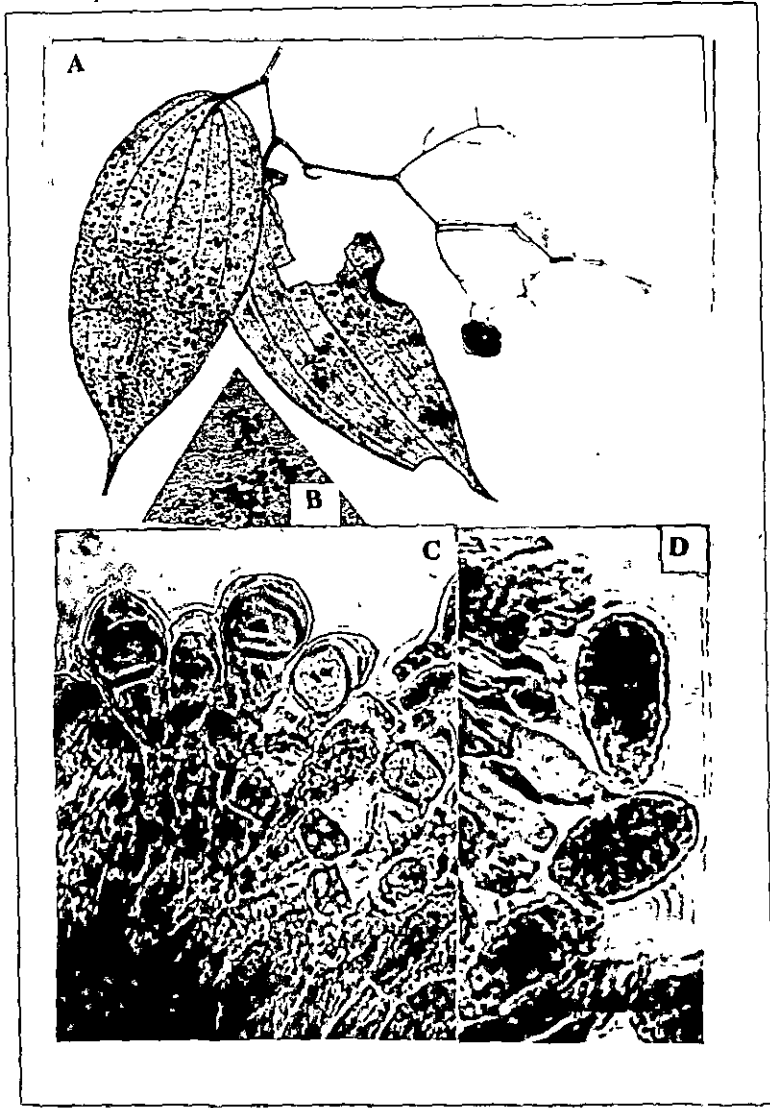


Fig. 43. *Puccinia smilacinae* - A. Infected leaves,  $\times 4$ ;  
 B. Portion of a leaf showing pustules,  $\times 4$ ;  
 C. Section through a sorus showing teliospores,  $\times 472$ ;  
 D. Uredospores,  $\times 536$ .

Puccinia salicicola H. & P. Sydow, Annals mycol.  
12 : 106 (1914).

( Fig. 43 )

Symptoms-Lesions distributed irregularly on the under surface of the leaves; perithecia dark-brown, minute, coalescing, scattered irregularly, erumpent.

Conidia - asexual - uredia brown, scattered;  
uredospores brown, oval, echinulate, 20 - 23  $\mu$  diameter;  
telia hypophyllous; teliospores ellipsoidal, 2-celled, smooth, 33 - 40 x 13 - 16  $\mu$ , slightly constricted at the septum, apex pointed, pedicel hyaline.

Pyrenia and ascia not found.

Habitat - On living leaves of Salicicola fusca,  
Wall.

Locality - Siachal, Darjeeling, altitude 7,000ft.,  
West Bengal.

Specimen studied - DGC 58, June 6, 1971.

UROBYCES Link in Mag. Ges. Naturf. Freunde, Berlin,  
2 : p. 28, 1816.

Alveomyces Bubuk in Ann. Natur. (Mus.) Hofmus, wien,  
28p. 190, 1914.

SPOROBIUM S. F. Gray, Nat. Arr. Brit. Pl. 1, p. 541, 1821.

Capitularia Rabenh, Bot. St. 2 : 493, 1851.

Dicblanys H. & P. Ann. Mycol. 17 : 105, 1920.

Graveola Syd. Ann. Mycol. 19 : 173, 1921.

Mantotolium Syd. Ann. Mycol. 22 : 124, 1922.

Klebania Arth. Result Sci. Congr. Internat. Bot. wien,  
1905, p. 345, 1906.

Molsania Syd. Ann. Mycol. 19 : 171, 1921.

Migredo Roussel, Fl. Calvados. p., 47, 1806.

Ontotolium Syd. Ann. Mycol. 19 : 174, 1921.

Pucciniella Fuckel Symb. Mycol., p. 60, 1869.

Schroeteriaster Magnus, Ber. Dtsch. Bot. Ges., 12 : 334,  
1893.

Pucciniola Marchand, Bijdr. Nat. Wet., 4 : 47, 1829.

Talentospora Arth. Bull. Torry Bot. cl. 48 : 38, 1921.

Talospora Arth. Result Sci, Congr Internat. Bot. wien,  
1905. p. 346, 1906.

Uromyces elements in Genera of Fungi. p. 98, 1909.

Uromycesia (Schroeter) Arth. Result Sci Congr Internat.  
Bot wien, 1905 p. 345, 1906.

Type species : Uromyces appendiculatus (Pers.) Link  
(Leguminosae).

Pyrenia subepidermal, flask shaped, with ostiolar paraphyses, Aecia subepidermal, cupulate, erumpent, peridiate; aeciospores developed in chains; epispore smooth or variously sculptured; uredia subepidermal, with or without paraphyses; urediospores borne singly on pedicels with distinct or indistinct germ pores; telia subepidermal, erumpent or non-erumpent, compactly grouped; teliospores 1-celled, pedicellate, ovate-ellipsoid or obconical; wall thick, coloured pale yellow to reddish-brown, with an apical germ pore, often hygroscopic, swelling considerably.

The genus differs from Puccinia in being one-celled. As already stated under Puccinia, the mesospores of the latter may be mistaken for Uromyces. As understood at present, teliospores of Uromyces are thick-walled, and subhyaline or coloured. But there is intergrading of characters with thin-walled forms, so that the separation of the genera like Polistelia becomes arbitrary, species of the genera Scopelia, Marvalia, Trochodinium and other were originally placed under Uromyces before their differentiating characters were understood. Scopelia Marvalia and some other genera do not possess apical germ pores, but their prozycolium is the prolongation of the teliospores apex. The genus Haploxyxis though having one-celled Uromyces-like teliospores, has three layered walls and two lateral germ pores like those of Uromyces.

The genus Dichlamys Syd. was founded by Sydow for Uromyces-like species possessing hygroscopic exospore layer in the teliospores. Thirumalachar pointed out that it is only a specific difference and should not be used to separate genera. Species in several other genera like Puccinia alli-cepulae, Uromyces amorphae and other possess exospores which swell in water upto 15  $\mu$ , so that this character is of specific significance only. Thirumalachar therefore merged Dichlamys with Uromyces.

The genus Schwaeteriaster was founded by Magnus on Rumex alpinus with uredia and telia. The telia were stated to be in-non-erumpent lenticular crusts somewhat similar to Phakansara. The genus has been recognised by the Sydow, Dietel and others. However, Mains (1934) who studied the type found that each teliospore was subtended by basal cell or pedicel and hence merged Schwaeteriaster, as a synonym of Uromyces. However, since pycnia and aecia were unknown, for the genus, their discovery was necessary before accepting this transfer proposed by Mains.

The pycnia and aecial stages were discovered by Gaumann (1947). The aecial stages of Schwaeteriaster alpinus, the type of the genus, was found on Ranunculus montanus, the pycnia being subepidermal, and the aecia cupulate and peridiate. Gaumann rightly remarks that it is a member of the Pucciniaceae, for had it been a member of the

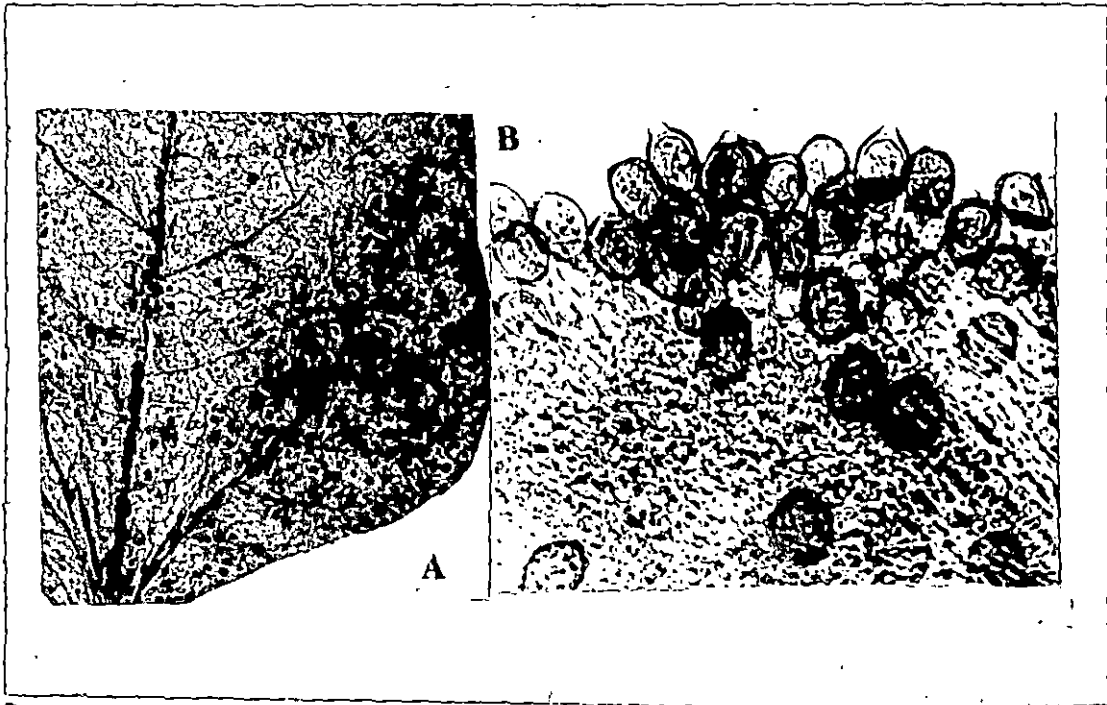


Fig. 44. Uromyces appendiculatus - A. Portion of a leaf showing infectist areas, x4; B. Section through a teliosorus showing teliospores, x285.

Helampseraceae, the asexual stage would have occurred on Larix and other Conifers. It therefore seems proper to consider Schroeteriaster as a synonym of Uromyces.

Uromyces appendiculatus Link, Observer, 2 : 28,  
1816.

( Fig. 44 )

Symptoms-lesions distributed on the under surface of the leaves; pustules compact, black, 3 - 4 mm diameter, circular.

Causal - organism - telia amphigenous, brown, scattered; teliospores 1-celled, sub-globose, hyaline papilla at the apex, smooth-walled, chestnut brown, 26 - 30 x 20 - 23  $\mu$ , pedicel hyaline, short.

Uredia not found.

Habitat - On living leaves of Phaseolus vulgaris Linn.

Locality - Darjeeling, altitude 6,800 ft.,  
West Bengal.

Specimen studied - DGC 82, June 25, 1975.

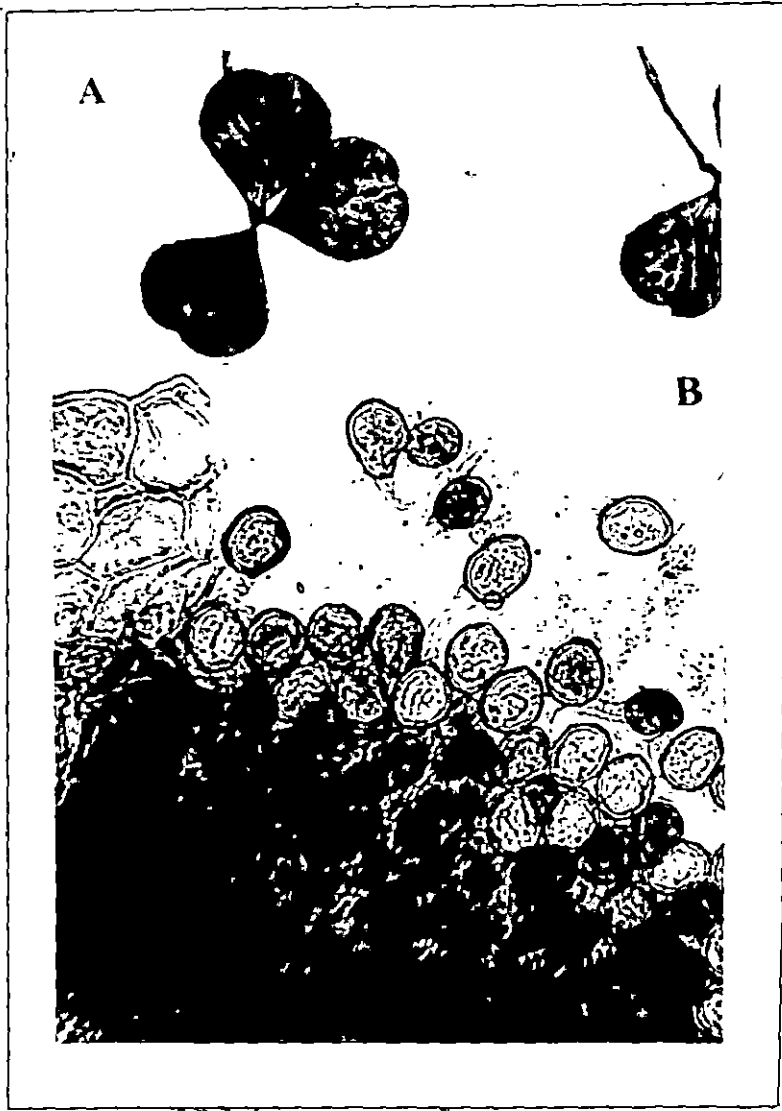


Fig. 45. Uranomyces trifolii - A. Infected leaves, x4;  
B. Section through a telium showing teliospores, x100.

Uromyces trifolii (R.A. Hedw. ex DC.) Fuckel, Synb.  
Myc. : 63 (1870).

( Fig. 45 )

Symptoms-Lesions distributed irregularly on both the surfaces of the leaves; perithecia solitary, 1 - 2 mm diameter, dark-brown.

Casual - organisms - telia brown, scattered; teliospores brown, 1-celled, smooth and thick-walled, 17 - 23  $\mu$  diameter, stalked, hyaline papilla at the apex, stalk almost equal to the spore length.

Uredia not found.

Habitat - On living leaves of Trifolium renouxi L.

Locality - Darjeeling, altitude 6,800ft., West Bengal.

Specimen studied - DGC 75, June 14, 1975.

ARCIDIUM Persoon in Gmel Syst. Nat. 2, P. 1472, 1791

Syn. Meth, Fung. P. 204, 1801.

Monosporidium Barclay in J. Asiatic Soc Bengal

56, P. 367, 1887.

Type species : Genus based on a concept and not a type species. A. herbaridis Pers. was chosen as lectotype by Clements and Shear.

Pycnia subepidermal, flask-shaped, rarely subcuticular, usually with ostiolar paraphyses; aecia at first immersed, closed cylindrical or urceolate, dehiscent at the apex, firm or evanescent, not infrequently causing more or less hypertrophy of the affected parts, peridium usually well developed, 1-celled thick, white or yellowish with entire, incised or lacerate margin; erect or revolute. Spores arising in catenulations from the hymenium at the base of aecial cup, angularly globoid with smooth, verrucose or echinulate walls.

This form-genus includes those species whose perfect state, viz., telia are unknown. In Aecidium on two species of Euphorbia and two of Androsace, Barclay (1887) noted the formation of a single sporidium-like structure at the apex of the germ tube without any strigmata. He therefore established this genus Monosporidium with two species for accommodating these rusts. Sydow (1924) have recognised the genus though Dietel (1923) has reduced it to synonymy. There is no indication of a promycelium-like structure in the germinating spores. Aeciospores of Uromyces hobaoni also germinate by a 1-septate germ tube and both the cells develop whip-like branches which appear to have been misconstrued by Barclay and others as strigmata formed from a 2-celled promycelium. Monosporidium may be treated as a synonymy of Aecidium.

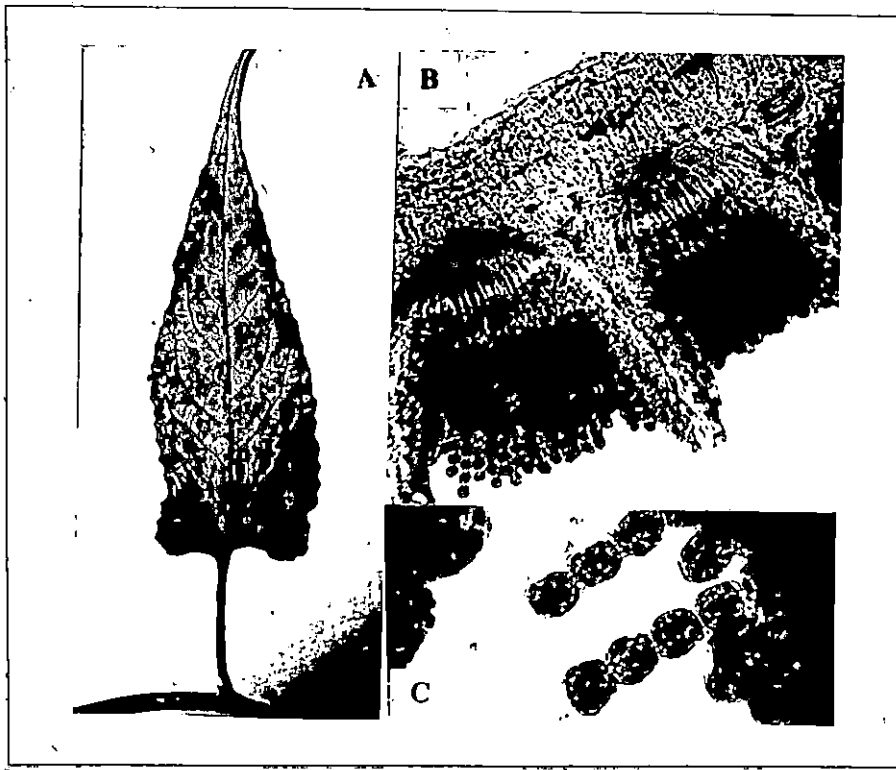


Fig. 46. Accidium flavescens - A. Infected leaf, x7;  
B. Section through aecia showing asciospores, x133;  
C. Asciospores in chain, x400.

Ascidium flavescens Barclay, Jl. Asiatic Soc. Bengal  
30(2) : 226 (1891).

( Fig. 46 )

Symptoms-lesions distributed on the under surface of  
the leaves. Postules yellowish.

Causal - organism - ascium colourless, ascial cup  
partly within leaf tissue and partly projects above it,  
peridium light coloured, 231 - 297  $\mu$  diameter; asciospores  
in chains, smooth, 13 - 16  $\mu$  diameter.

Habitat - On living leaves of Samocia scandens, Wall.

Locality - Darjeeling, altitude 6,800ft., West  
Bengal.

Specimen studied - DBC 144, June 12, 1977.

Ascidium violae Schum., Enum. Pl. Sacll. 2 : 234 (1903).

( Fig. 47 )

Symptoms-lesions somewhat raised and blister-like  
and cause distortion of growth on leaves and petiole and may  
sometimes covering portions of the petiole and stalks of the  
flower; postules yellowish, irregular, 6 - 9 mm diameter.

Causal - organism - ascia embedded in the spongy

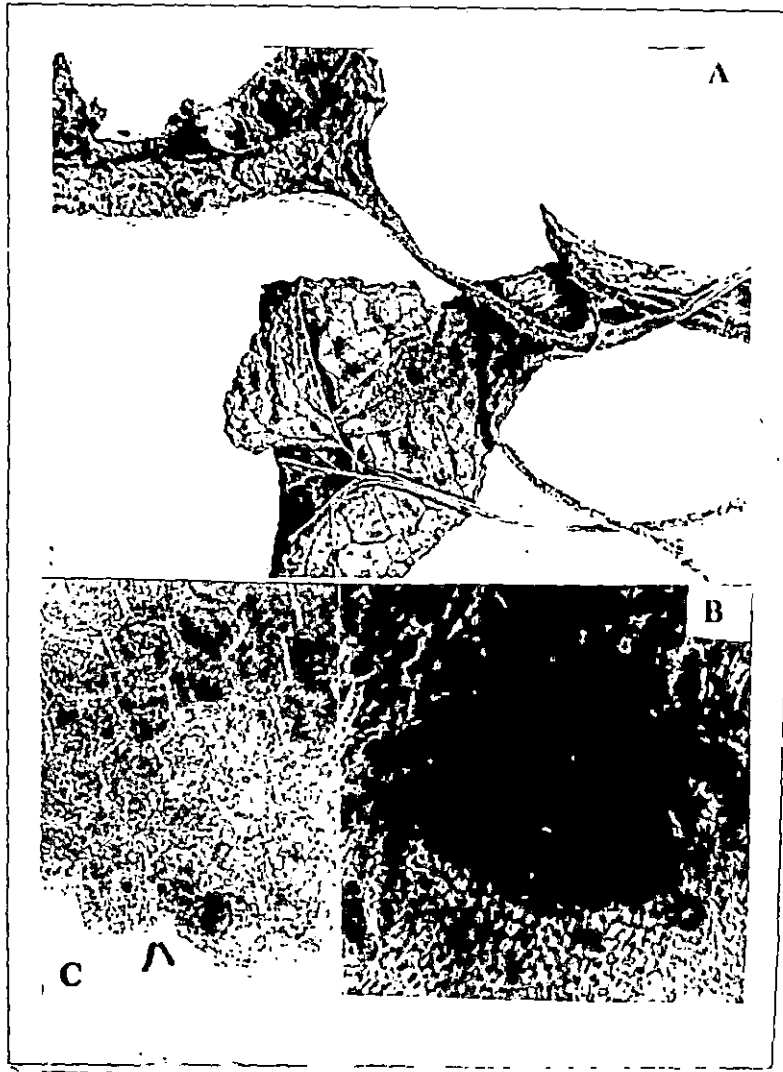


Fig. 47. Accidium violae - A. Infected leaves,  $\times 4$ ;  
B. Section through an aecium showing aeciospores,  $\times 133$ ;  
C. Aeciospores in chain,  $\times 533$ .

mesophyll, break through the lower epidermis, peridium long, white cylindrical, asciospores smooth, spherical, 13 - 16  $\mu$  diameter.

Habitat - On living leaves and petioles and stalks of the flower of viola zamboni, Wall.

Locality - Birch Hill, Darjeeling, altitude 7,000ft., West Bengal.

Specimen studied - DGC 139, May 15, 1977.

DARLUCA Cast. Cat. Plant. Mans. Suppl. 53, 1851.

Pyrenidia uredicola, black brown forming a crust, gregarious rarely single, pyrenidial walls uniting, giving a stromatic appearance; spores bicelled, ellipsoid or fusoid to oblong; parasitic on rust fungi chiefly on uredia.

Derluca filum (Biv.) Cast., Cat. cl. Marseille. Suppl. p. 58, 1851.

( Fig. 48 )

Symptoms-Lesions distributed throughout the upper surface of the leaves; perithecia light-brown, irregular, erumpent.

Causal - organism - pyrenidia black, spherical,

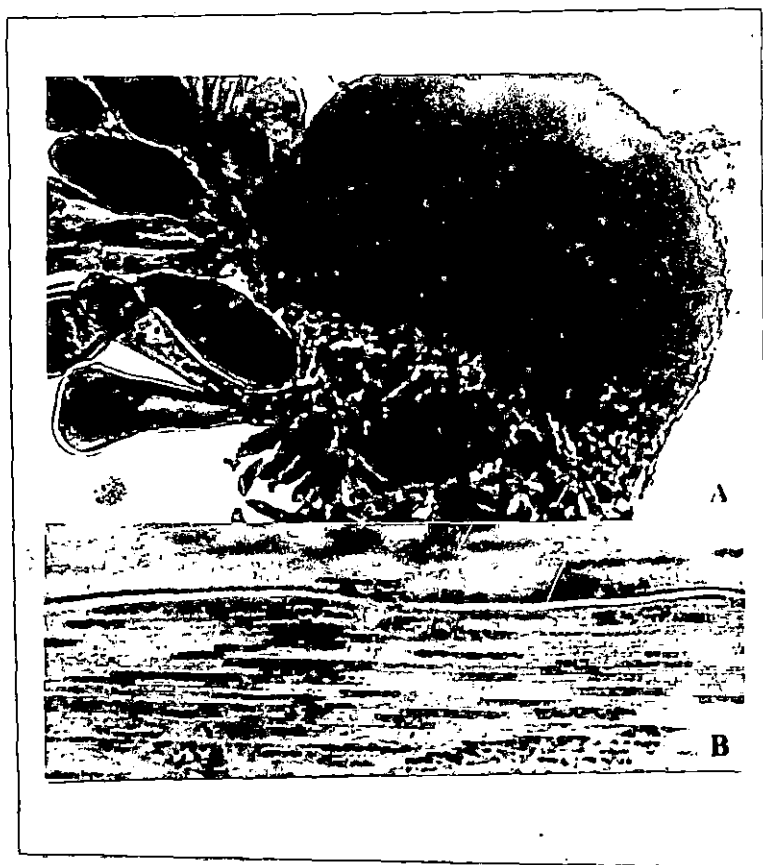


Fig. 48. Darluca filum - A. Pycnidium with uredospores, and 2-celled conidia, x742; B. Portion of an infected leaf, x $\frac{1}{2}$ .

ostiolate, located in rust sori, 23 - 33 x 13 - 20  $\mu$ ;  
conidia hyaline, 2-celled, ellipsoid, tipped with mucous  
or bristle like appendages at both ends, 10 - 13 x 3  $\mu$ ;  
parasitic on rust fungi chiefly on urediospores; urediospores  
1-celled, spiny outer wall, 30 - 33  $\mu$  diameter.

Habitat - On uredia of Puccinia arundinaria  
Schw. on living leaves of Arundinaria  
intermedia Murr.

Locality - Birch Hill, Darjeeling, altitude  
6,800 ft., West Bengal.

Specimen studied - DGC 65, March 14, 1975.

COLLETOTRICHUM Cda. - in Sturm, Deutschl. Crypt. Fl.  
3, 3 : 41 (1831).

Ascervuli disc-shaped or cushion shaped, spines  
or setae at the edge or among the conidiophore; conidia  
hyaline, 1-celled, ovoid or oblong.

Colletotrichum linduthianum (Sacc. & Magn.) Bri.  
& Cav., Fungi Paras. 50 (1839).

( Fig. 49 )

Symptoms - Characteristic spotting on the pods; spots  
black depressed with reddish or yellow raised margin,  
circular but coalesce, they vary in size; infected tissue

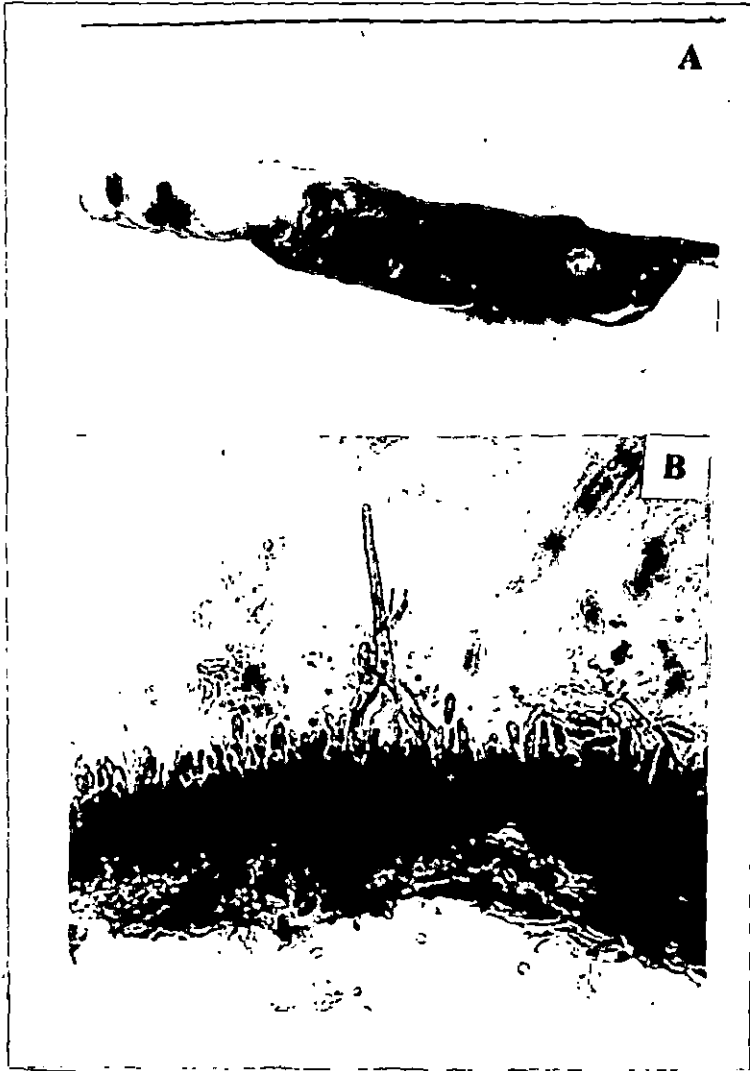


Fig. 49. Colletotrichum lindemuthianum - A. Infected pod, x1;  
B. Section through an acervulus showing conidia,  
conidiophores and seta, x300.

dries up leading to the depression of the spots.

Causal organism - ascervuli disc - shaped to cushion shaped, waxy subepidermal, typically with dark pointed septate setae among the conidiophores; conidiophores short, simple, hyaline, elongate; conidia one-celled, ovoid, hyaline, thin-walled, 10  $\mu$  length and 3  $\mu$  breadth.

Habitat - On pods of Phaseolus vulgaris Linn.

Locality - Darjeeling, altitude 6,800 ft.,  
West Bengal.

Specimen studied - DCC 77, June 12, 1977.

MONOCHAETIA Sacc. in-Sylloge Fungorum XI: 573, 1895.

Ascervuli dark, discoid or cushion shaped, conidia dark several celled with hyaline pointed end cells, with a single appendage.

Monochaetia danzoides (Ooth.) Sacc., Syll.

Fung. 18 : 485 (1906).

( Fig. 5<sup>o</sup> )

Symptoms - The most important symptoms are the appearance of raised stromatic tissue on the discoloured areas of the leaf-blade particularly towards the margin;

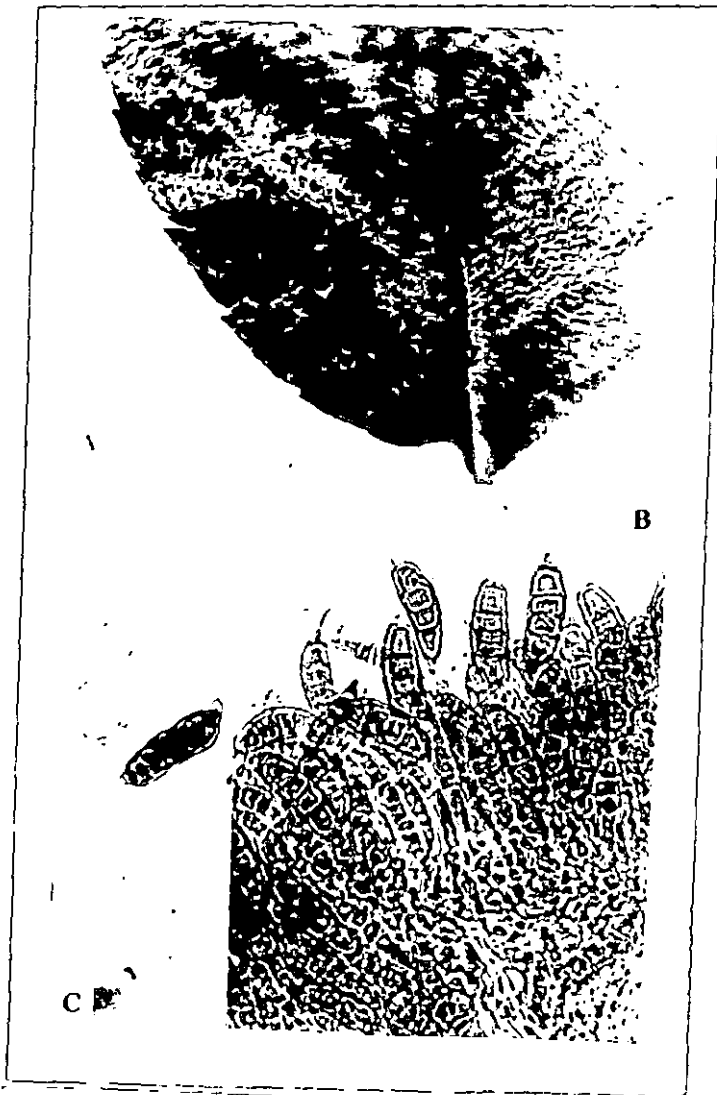


Fig. 50. Monochaetia depauides - A. Portion of a infected leaf, x8; B. Section through a acervulus showing conidia with apical appendages, x600; C. A conidium with single apical appendage, x600.

stromatic tissues dark-brown coloured, superficial and arranged in concentric zones, sometimes irregularly over the spots; infected parts become white in course of tissues.

Conzel - organism - ascervuli dark, discoid to cushion shaped, sub-cutaneous, 264 - 297  $\mu$  diameter; conidiophore slender, slender, simple; conidia dark, several celled with hyaline pointed ends with a single apical appendage, 23 - 26 x 7 - 10  $\mu$ .

Habitat - On living leaves of Rosa moschata Will.

Locality - Darjeeling, altitude 6,800 ft., West Bengal.

Specimen studied - DCC 70, June 15, 1977.

ISARIOPSIS Fresenius; Saccardo in Michelia 2: 33  
1880.

Synnemata dark, composed of loose conidiophores, bearing conidia at or near the tips; conidia dark or pale, 2-or more-celled.

Type species : Ieariopsis alba-rosella (Desm.)  
Saccardo.

Ieariopsis indica Gopinathan Nair, Curr. Sci. 33(1):  
25 (1964) in Herb as Cercospora Jujubae  
Chowdhury.

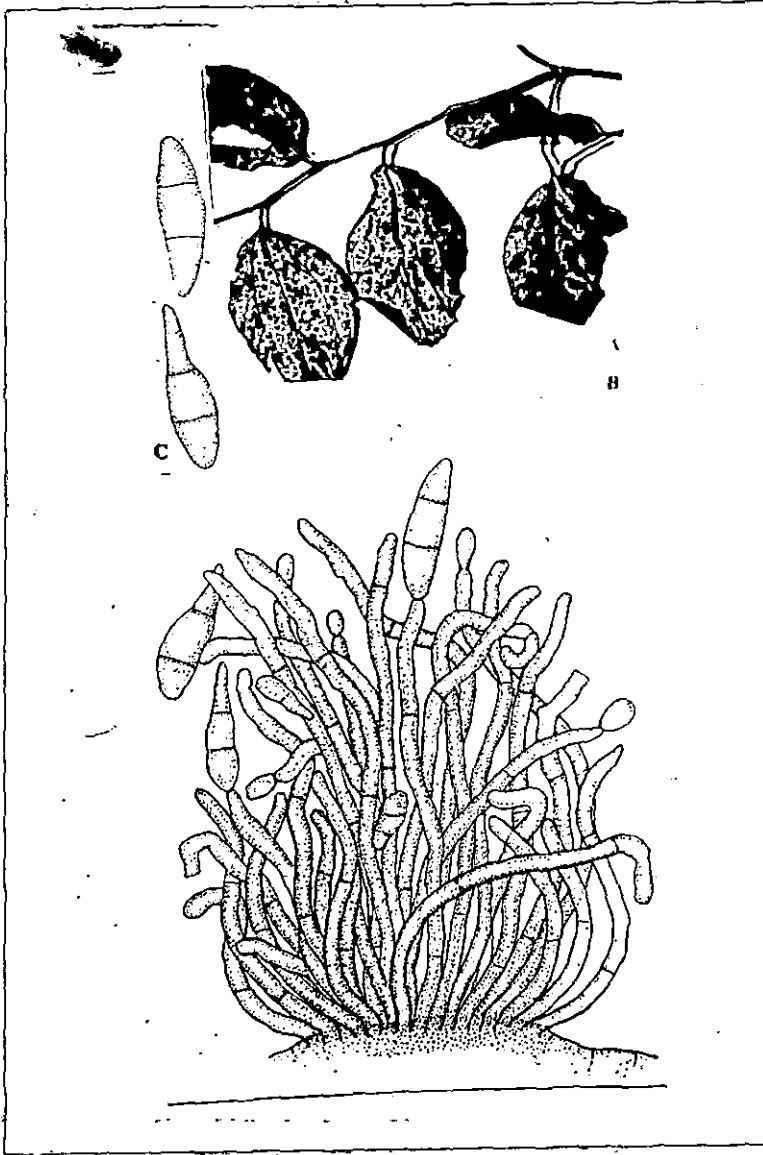


Fig. 51. Isariopsis indica - A. Infected leaf, x4; B. Synnema with conidia, x500; C. Conidia, x580

( Fig. - 8 1 )

Symptoms - The fungus is borne on the under surface of the leaves, black, scattered, powdery, superficial to dense patches.

Causal - organism - synnemata dark, composed of a bundle of parallel, septate hyphae and loose conidiophores bearing conidia at or near coiled, cylindrical to obclavate, often curved, tapering towards the tip, 25 - 36 x 7  $\mu$ .

Habitat - On living leaves of Zizyphus jujuba  
Lank.

Locality - Jalpaiguri, West Bengal.

Specimen studied - DGC 96, February 12, 1976.

SUMMARY

Fifty one species of fungi have been collected, preserved, studied and described from different parts of North Bengal. Of them, twenty two belong to the Ascomycetes, twenty five to the Basidiomycetes and four to the Deuteromycetes.

Of the Ascomycetous fungi, nineteen belong to the Discomycetes and three to the Pyrenomycetes. Again of the Basidiomycetous fungi, five belong to the family Melampsoraceae, eighteen belong to Pucciniaceae and two to the Urodinales Imperfecti.

Nineteen discomycetous fungi belong to the thirteen genera are : Peziza (P. cerea, P. domicalliana, P. schinziana, P. nataraii); Tricharina (T. silva, T. crotaea); Scutellinia (S. kerkuelensis, S. scutellata, S. pennsylvanica); Scottellia (S. vivida); Aleuria (A. aurantia); Ascohelus (A. scutigenus, Geozosium (G. cohaerens, G. fallax, G. nigratum, G. sphagnumophilum); Trichozosium (T. farlowii); Eudoniella (E. acicularia); Pseudopeziza (Pa. rubina).

Three Pyrenomycetes fungi belonging to the two genera are : Phyllachora (P. graminis); Heliola (H. citricol, H. thomasiana).

Twenty five basidiomycetous fungi belonging to the ten genera are : Colosporium (C. hietiae, C. campoculias, C. myriactidia, C. plectranthi); Melampsora (M. hypericarius); Phragmidium (P. barclayi, P. octoloculare); Phragmotellium

(P. mysorensis); Puccinia (P. aialliae, P. arundinariae,  
P. caricis, P. chlorophytarum, P. fazeoyri, P. gerasii-sylvatici,  
P. lauricola, P. menthae, P. notochaetae, P. psoraleae, P.  
romagnoliana, P. rosaceae, P. smilacinae); Uromyces (U.  
appendiculatus, U. trifolii); Aecidium (A. flavescens, A.  
violae).

Four deuteromycetous fungi are : Darlucia (D.  
filum); Colletotrichum (C. lindemuthianum); Monochaetia  
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Puccinia ainslieae Syd.

Senecia scandens, Wall.

Accidium flavescens Barclay

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Eudoniella acicularis

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# FUNGI OF EASTERN HIMALAYAS (INDIA)

by

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## Summary

Two not yet recorded fungi have been collected and described from Eastern Himalayas (India). They are:

1. *Coleosporium bletiae* Diet.
2. *Trichoglossum farlowii* (Cooke) Durand.

This paper deals with two new fungi collected from different parts of Eastern Himalayas (India) at an altitudinal range of 7,000 to 7,500 ft. They are described and illustrated below.

### 1. *Coleosporium bletiae* Diet.

The fungus infects different species of ground orchids (*Habenaria densa* Wall; *Herminium augustifolium* Benth; *Satyrium nepalense* Don Prode; *Anthogonium gracile* Lindl. Lesions are confined to the leafsheath, leafblade and stem but principally on the under surface of the leafblade (Fig. 1 A). They appear in the form of very small typically orange coloured oval to lenticular pustules, slightly erumpent with age, scattered irregularly on the under surface of the leafblade. The *pustules* are solitary and distinct during early infection but with severity of infection they coalesce forming circular patches (1.5 mm to 2 mm) around a central light yellowish zone. Leaf margins often curl with the virulence of infection. Older lesions are blackish-brown with ruptured epidermis (Fig. 1 B) clinging to the pustules in the form of white flakes.

The *teleutospores* are laterally united and form one-celled thick subcuticular crusts (Fig. 1 C). Mature teleutospores give rise to basidiospores (Fig. 1 D).

Specimens examined:



Fig. 1. A-D. *Coleosporium bletiae*. A. Portion of infected leaf,  $\times 1$ ; B. Section of a lesion showing ruptured epidermis,  $\times 200$ ; C. Section through a teleutosorus showing laterally united one-celled teleutospores  $\times 900$ ; D. Mature teleutospores producing basidiospores,  $\times 900$ ; E-H. *Trichoglossum farlowii*. E. Asci with ascospores,  $\times 500$ ; F. Setae and paraphyses,  $\times 400$ ; G. Ascophores,  $\times 1-1/2$ ; H. Seven-septate ascospore,  $\times 1400$ .

Host: *Habenaria densa* Wall.

Locality: Birch Hill, Darjeeling (India), July 18, 1972, Alt. 7,500 ft. leg. B.B. Dewan, DGC 1 (IMI 172606).

Host: *Herminium augustifolium* Benth.

Locality: Birch Hill, Darjeeling (India), July 18, 1972, Alt. 7,500 ft. leg. B.B. Dewan, DGC 2 (IMI 172607).

Host: *Satyrium nepalense* Don Prode.

Locality: Birch Hill, Darjeeling (India), July 25, 1972, Alt. 7000 ft. leg. B.B. Dewan, DGC 3 (IMI 172608).

Host: *Anthogonium gracile* Lindl.

Locality: Birch Hill, Darjeeling (India), August 10, 1972, Alt. 7,500 ft. leg. B.B. Dewan, DGC 4 (IMI 172609).

This is the first report of *C. bletiae* on ground orchids from India.

## 2. *Trichoglossum farlowii* (Cooke) Durand.

*Ascophores* solitary, or clustered, two or three together, 2.5 cm to 5.5 cm high (Fig. 1 G). Ascigerous portion lanceolate, not sharply distinguished from the stem, brownish-black, 1.2-2.2 cm long, often flexuous, rarely somewhat compressed.

The *asci* are many, clavate, sessile, 8-spored,  $112-152 \mu \times 14-18 \mu$  (Fig. 1 E).

The *ascospores* are crowded, clavate-cylindric, multiseriate in the ascus, brownish,  $90-97 \mu \times 3.6$  to  $7.2 \mu$  1-(5)-7 septate (Fig. 1 H).

The *paraphyses* cylindric, curved to circinate at the somewhat thickened tips (Fig. 1 F).

The *setae* are acicular, somewhat narrowed, dark-brown (Fig. 1 F).

Specimen studied:

Habitat: On soil in moist shady palce.

Locality: Birch Hill, Darjeeling (India), August 12, 1972, Alt. 7000 ft. leg. B.B. Dewan, DGC 5.

Thanks are due to the Director, Commonwealth Mycological Institute, Kew, England and to Dr. Mulder of the same institution for their help in identifying the fungi.

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SOME DISCOMYCETES OF EASTERN HIMALAYAS

A. K. KAR AND B. B. DEWAN

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INDIAN PHYTOPATHOLOGY, Vol. XXVIII, No. 2, June 1975, pp. 296-297

## Some Discomycetes of Eastern Himalayas

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This paper deals with four Discomycetes collected from different parts of Eastern Himalayas. Structural details of the specimens were studied from freehand sections of both fresh and preserved (4 per cent formalin) materials stained with lactophenol cotton blue. Specimens are preserved in Darjeeling Govt. College Botanical Herbarium, Darjeeling (DGC).

### 1. *Geoglossum sphaguophilum* Ehrenb. ex Wallr. Sglv. Myc. Ber. 30. 1818.

Ascocarp solitary, rarely clustered, gregarious, 3.5—5.5 cm high ascigerous portion black, about one third the total length of the ascocarp, compressed 1—1.5 cm long, 2—3 mm thick, slightly acute, not sharply delimited from the stem; stem brownish-black, slender, 1.6 to 4 cm long; asci stout, clavate-lanceolate, narrowly-rounded apex, pore blue in iodine, measuring  $161-181.5 \mu \times 16.5 \mu$ , 8-spored; ascospores fascicled, brown, slightly curved, 4—7-septate,  $59-66 \mu \times 3 \mu$ , paraphyses numerous, slightly longer than asci, septate, tip thickened, cells swollen giving moniliform appearance.

*Habitat* : On soil.

*Locality* : Birch hill (altitude 7000 ft) (Darjeeling).

Specimens examined : July 20, 1973; DGC 41, DGC 41a.

### 2. *Geoglossum fallax* Durand, Ann. Myc. 6 : 428. 1908.

Ascocarp solitary, 2—7 cm high, umber brown; ascigerous portion one fifth to one half the total length of the ascocarp, lanceolate—obtuse; stem elongated and slender, slightly thickened upward; asci clavate-cylindric with narrowed apex,  $148.5-165 \mu \times 13.2-16.5 \mu$ , 8-spored; ascospores multiseriate in the ascus, straight, 11-septate,  $96-102 \mu \times 7 \mu$ ; paraphyses entirely hyaline, septate, apex ellipsoid to globose.

*Habitat* : On loamy soil along slopes.

*Locality* : Darjeeling (altitude 6, 800 ft).

Specimens examined : July 23, 1973, DGC 49; July 27, 1973, DGC 49a.

### 3. *Neottiella vivida* (Nylander) Dennis Ed. 1 : 28.

Ascocarp 6—10 mm in diameter, sessile, disc deep pink, flat with undulating margin, outer surface downy; hymenium blue-green in iodine, asci  $214-247 \mu \times 10-13.2 \mu$ ; ascospores uniseriate, elliptic-cylindric,  $13.2-16.5 \mu \times 7 \mu$ , containing one large oil drop, wall with warts; paraphyses aseptate, projecting above the asci, tip upto  $7 \mu$  thick.

*Habitat* : On sandy soil along with mosses and grasses.

*Locality* : Victoria falls (altitude 6,000 ft) Darjeeling.

Specimen examined : July 22, 1973, DGC 45a.

4. *Aleuria aurantia* (Fries) Fuckel, Symb. Myc. 325. 1869.

Ascocarp gregarious, short stipitate (laterally), at first cup-shaped becoming flattened with maturity, sometimes splitting along the margin, diameter 1.5 to 4 cm; hymenium bright orange, flesh thin, fragile, turning green in iodine; asci  $132\text{--}181\mu \times 13\mu$ ; ascospores elliptical, ornamented with a coarse reticulum,  $13.2 \times 10\mu$ , containing two oil drops; paraphyses clavate, projecting above the asci, apical portion swollen, deeply pigmented with orange granules,  $6.6\mu$  thick.

*Habitat* : On bare sandy soil.

*Locality* : Mongpoo (altitude 3,500 ft).

Specimen examined : July 8, 1973, DGC 42.

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FUNGI OF EASTERN HIMALAYA—II

A. K. KAR AND B. B. DEWAN

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## Fungi of Eastern Himalaya—II

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During a survey of Fungi of Eastern Himalaya, the authors recorded two discomycetous fungi. They are: *Peziza domiciliana* Cooke and *Peziza echinospora* Karst.

1. *Peziza domiciliana* Cooke, Gardener's chronicle 41: 793 (1877)

*Apothecia* gregarious, usually short-stipitate, at first cupulate, soon becoming revolute with age leaving a depression in the centre, at first rounded, soon becoming irregular and often decidedly angular in outline, externally white, margin entire or occasionally splitting, reaching a diameter of 10 cm; *hymenium* at first concave, becoming plane or convex distinctly umbilicate, at first white becoming dingy buff, thick, irregular, *asci* cylindrical to subcylindric reaching a length of 214—244  $\mu$  and a diameter of 10—13  $\mu$ , *ascus* tip blued in Melzer's reagent; *ascospores* ellipsoid hyaline, 1-seriate, without oil globules, smooth-walled, 7X 13 $\mu$ ; *paraphyses* slender, filiform, septate, slightly enlarged above.

Habitat : On plaster with mosses about 6" from the soil.

Locality : Birch Hill (altitude 6,800 ft) Darjeeling.

Specimen examined : November 7, 1973; DGC 60.

2. *Peziza echinospora* Karst, Myc. Fenn. I, P. 54 (1871)

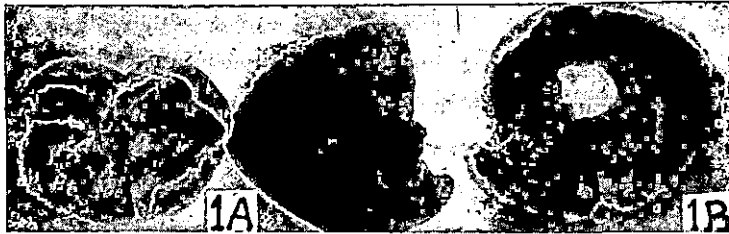


Fig. 1. Apothecia. A. *Peziza domiciliana* XI. B. *Peziza echinospora* XI

*Apothecia* gregarious, occasionally caespitose, usually rather large, upto 8 cm diameter; disc concave, undulate, smooth, brown to dark brown; receptacle cup-shaped, sometimes becoming contorted to almost *Otidea*-like by mutual pressure, broadly sessile, margin often crenate, outer surface paler than disc, often whitish, scurfy to furfuraceous; the outermost surface layer of the excipular tissue composed of interwoven, septate, short-celled hyphae; the lower pseudoparenchymatous layer thick, of large subglobose or polygonal cells, separated from the upper pseudoparenchymatous tissue by a layer of compact *textura intricata* or *textura epidermoidea*; the upper pseudoparenchymatous layer thick, of large subangular or polygonal, thin-walled subhymenium of compact angular or lobed and sinuate cells 8—15 $\mu$  diameter; *hymenium* about 280  $\mu$  thick, *asci* cylindrical slightly narrower below, apex blued in Melzer's reagent, 8-spored, upto 231  $\mu$  long by 13  $\mu$  diameter; *ascospores* uniseriate, hyaline, without oil guttules, ellipsoidal to oblong-ellipsoidal, finely warted, 7X 17  $\mu$ ; *paraphyses* slender, septate, apex subclavate, slightly curved tip swollen reaching a diameter 6.6  $\mu$ .

Habitat : on burnt soil

Locality : Birch Hill (Darjeeling) (altitude 6, 800 ft)

Specimens examined : March 12, 1974, DGC 61; April 8, 1974, DGC 61A

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DISCOMYCETES OF EASTERN HIMALAYAS—II

A. K. KAR AND B. B. DEWAN

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## DISCOMYCETES OF EASTERN HIMALAYAS—II

A. K. KAR<sup>1</sup> AND B. B. DEWAN

ABSTRACT : Four Discomycetous fungi, namely *Peziza petersii*, *P. cerea*, *Tricharia cretea* and *T. gilva* have been collected and described from Eastern Himalayas at an altitude of 7,000 to 7,500 ft.

1. *Peziza petersii* Berkeley and Curtis in Grevillèa 3 : 150 (1875) *Apothecia* scattered to gregarious, upto 7.5 cm., disc regular to (Fig. 1A) contorted, pale brown to pale reddish brown, margin undulate, outer surface much paler than the inner, somewhat scurfy; *asci* cylindrical, slightly narrower towards the base, apex turned blue in Melzer's reagent, 8-spored,  $247 \times 10 \mu$ ; *ascospores* uniseriate,  $13.2 \times 7 \mu$ , ellipsoid to oblong ellipsoid, hyaline, with two large oil globules, covered with minute warts (Fig. 1B); *paraphyses* slender, septate, unbranched, apex distinctly enlarged to about  $7 \mu$ , slightly curved, containing brown granules.

Note : Seaver (1928) designated *P. petersii* as the synonym of *P. pustulata* (Hedw.) Pers. But modern authors have accepted to treat *Peziza pustulata* as a synonym of *Pustularia catinus*.

Habitat : On soil.

Locality : Ghoom (Darjeeling), April 19, 1974, Alt. 7,500 ft. leg. B. B. Dewan, DGC 71 and DGC 71a.

2. *Peziza cerea* Sowerby ex Merat, *Nouvella Flore Paris* 1 : 25 (1821) *Apothecia* short stipitate when young, disc cup-shaped, becoming expanded (Figs. 2A and B) upto 5 cm diam., hymenium yellowish brown, outer surface white, minutely downy to almost scurfy; *asci* subcylindrical,  $182-198 \mu \times 10-13 \mu$ , narrower towards the base, apex blued in Melzer's reagent; *ascospores* uniseriate, hyaline, elliptical, smooth walled, without oil globules,  $10-13 \mu \times 7-10 \mu$ ; *paraphyses* straight, septate, apex enlarged upto  $6.6 \mu$ .

Habitat : On moist soil mixed with coal dust and on waste paper.

Locality : Birch Hill (Darjeeling), June 9, 1974, Alt. 7,000 ft. leg. B. B. Dewan, DGC 74 and DGC 74a.

3. *Tricharia cretea* (Cooke) Boudier, *Hist. Class. Discom. d'Europe* : 58 (1907) *Apothecia* gregarious or more often densely crowded, reaching a diameter (Fig. 3A) of 1.3 cm., margin dentate, externally clothed with pale brown hairs, hymenium concave, reddish brown, outer surface covered with stiff reddish brown septate hairs (Fig. 3C) with swollen base tapering above into a bristle like apex,  $274 \mu$  long (Fig. 3B); *asci* cylindrical, tapering below,  $178 \times 10 \mu$ ; *ascospores* 1-seriate, ellipsoid, hyaline, without oil globule,  $17 \times 10 \mu$ ; *paraphyses* enlarged above, upto  $6.6 \mu$ .

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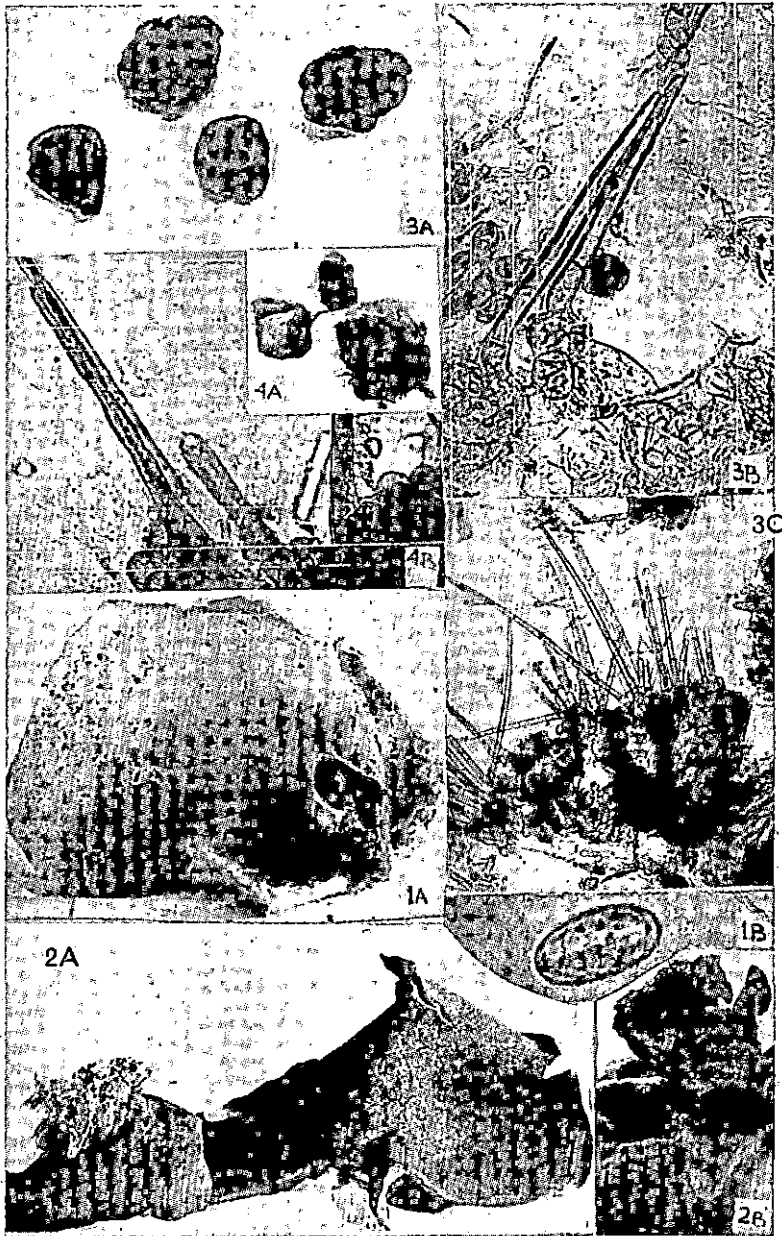


Fig. 1-4. 1A. *Peziza petersii* Apothecium  $\times 2$ ; 1B. *Peziza petersii* Ascospore  $\times 4000$ ; 2A. *Peziza cerea* Apothecia  $\times 2$ , 2B. *Peziza cerea* Apothecium on waste paper  $\times 2$ ; 3A. *Tricharia cretea* Apothecia  $\times 2$ ; 3B. *Tricharia cretea* Hairs  $\times 1276$ ; 3C. *Tricharia cretea* Sectional view of Apothecium showing bunch of Hairs  $\times 250$ ; 4A. *Tricharia gilva* Apothecia  $\times 2$ ; 4B. *Tricharia gilva* Hairs  $\times 1140$ .

Habitat : On plaster of walls.

Locality : Goody Road (Darjeeling), May 24, 1974, Alt. 7,000 ft. leg. B. B. Dewan, DGC 72 and DGC 72a.

4. *Tricharia gilva* Boudier, Icones mycologicae, Livraison 2 (1904) *Apothecia* sessile, disc flat, pale fawn, reaching 7 mm in diameter (Fig. 4A), margin dentate, outer surface covered with septate stiff reddish brown hairs with bulbous base, tapering to a rounded apex (Fig. 4B), upto  $200\mu$ ; *asci* no change in iodine,  $231 \times 13\mu$ ; *ascospores* elliptical, smooth-walled,  $17 \times 10\mu$ ; *paraphyses* slender,  $3.3\mu$  thick.

Habitat : On ground with mosses.

Locality:- Birch Hill (Darjeeling), April 24, 1974, Alt. 7,000 ft. leg. B. B. Dewan, DGC 70 and DGC 70a.

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## RUST FUNGI OF EASTERN HIMALAYAS (INDIA)

by

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### Summary

Seventeen rust fungi recorded for the first time from Eastern Himalayas (India) at an altitudinal range of 350 to 7,500 ft. have been described. They are: *Chaconia butleri* (Syd.) Mains; *Coleosporium campanulae* (Pers.) Lev.; *C. myriactidis* Syd.; *C. plectranthi* Barclay; *Phragmidium octoloculare* Barclay; *Puccinia arundinariae* Schw.; *P. caricis* (Schum.) Rebert; *P. colletiana* Barclay; *P. fagopyri* Barclay; *P. menthae* Pers.; *P. punctata* Link; *P. romagnoliana* Maire et Sacc.; *P. roscoeae* Barclay; *P. urticae* Barclay; *Uromyces appendiculatus* (Pers.) Unger; *U. fabae* (Pers.) de Bary; *U. trifolii* (Hedw. f) Lev.

During a survey of fungi of Eastern Himalayas (India) seventeen rust fungi have been collected for the first time at an altitudinal range of 350 to 7,500 ft.. The specimens have been preserved dry after taking field notes. They have been worked out following standard techniques. The rust fungi are described below.

#### 1. *Chaconia butleri* (Syd.) Mains

*Symptoms:* lesions distributed on the under surface of leaf blade, orange coloured, irregularly scattered; *pustules* solitary, distinct, erumpent, powdery.

*Causal organism: uredospores echinulate, diameter 23.1  $\mu$  to 26.4  $\mu$ ; telia, pycnia and aecia not found.*

*Host: on leaves of Jasminum pubescens Willd.*

*Specimen studied: DGC 63; Sukna, altitude 359 ft.; April 9, 1975.*

## 2. *Coleosporium campanulae* (Pers.) Lev.

*Symptoms: lesions* characterized by orange coloured pustules distributed on the under surface of the leaves; *pustules* solitary distinct, erumpent, with severity of infection coalesce forming patches.

*Causal organism: uredospores ovoid, one-celled in chains, with spiny wall, 16.5  $\mu$  to 19.8  $\mu$  in diameter; teleutospores laterally united forming crust; 39.6  $\mu$  to 52.8  $\mu$   $\times$  16.5  $\mu$ ; internal promycelium in mature spores; pycnia and aecia not found.*

*Host: on leaves of Campanula colorata Wallich.*

*Specimen studied: DGC 123; Darjeeling; altitude 6,800 ft.; Sept. 15, 1976.*

## 3. *Coleosporium myriactidis* Syd.

*Symptoms: lesions* confined to the leaf sheath, principally on the under surface of the leaf blade, appear in the form of small typically orange coloured pustules, erumpent with age, scattered irregularly; *pustules* solitary, but with severity of infection they coalesce forming circular patches.

*Causal organism: uredospores ovoid, one-celled in chains with spiny wall, hyaline, 18  $\mu$  to 22  $\mu$  in diameter; teleutospores laterally united to form sub-circular crusts with internal promycelium 66  $\mu$  to 82  $\mu$   $\times$  16.5  $\mu$  to 20  $\mu$ ; pycnial and aecial stages not found.*

*Host: on leaves of Myriactis nepalensis Less.*

*Specimen studied: DGC 121, Sonada (Darjeeling); altitude 6,600 ft.; Sept. 10, 1976.*

## 4. *Coleosporium plectranthi* Barclay

*Symptoms: lesions* distributed irregularly on the lower surface of leaves; *pustules* solitary, distinct, scattered irregularly, orange coloured, powdery appearance.

*Causal organism:* uredospores one-celled in chains, outer spiny, 15.5  $\mu$  to 26.4  $\mu$  in diameter, hyaline; *teleutospores* crowded laterally within the subepidermal layer forming a crust, promycelium internal, one-celled, hyaline, 85.8  $\mu$  - 99  $\mu$   $\times$  9.9  $\mu$  - 13.2  $\mu$ ; *pycnial* and *aecial* stages not found.

*Host:* on leaves of *Plectranthus* sp.

*Specimen studied:* DGC 85; Darjeeling; altitude 6,800 ft.; SEpt. 25, 1974.

## 5. *Phragmidium octoloculare* Barclay

*Symptoms:* lesions distributed irregularly throughout the lower surface of leaf; *pustules* dark coloured, irregular in outline, 3-5 mm diameter, erumpent.

*Causal organism:* *teleutospores* many-celled, stalked, chocolate coloured, pedicel hyaline and enlarged towards the base; 92.4  $\mu$  - 115  $\mu$   $\times$  23  $\mu$  - 26.4  $\mu$ ; *uredia*, *pycnia* and *aecia* not found.

*Host:* on leaves of *Rubus rosaefolius* Smith.

*Specimen studied:* DGC 60; Jalapahar (Darjeeling); altitude 7,000 ft.; June 7, 1974.

## 6. *Puccinia arundinariae* Schw.

*Symptoms:* lesions distributed throughout both the surfaces of the leaves; *pustules* light brown, irregular, linear shaped, numerous, erumpent.

*Causal organism:* *teleutospores* produced on flat sori, pedicellate, two-celled mostly ellipsoidal or oblong-ellipsoid, wall 3.3  $\mu$  thick, 6.6  $\mu$  apically, pedicels colourless, 36  $\mu$  - 49.5  $\mu$   $\times$  20  $\mu$  - 23  $\mu$ ; Uredial, aecial and pycnial stages not found.

*Host:* on leaves of *Arundinaria intermedia* Muro.

*Specimen studied:* DGC 84; Darjeeling; altitude 6,800 ft.; March 12, 1975.

## 7. *Puccinia caricis* (Schum.) Rebert

*Symptoms:* lesions dark-brown, rounded, distributed irregularly on the lower surface of the leaf; *pustules* solitary, distinct erumpent, 0.5 mm in diameter.

*Causal organism: teleutospores* two-celled, thick-walled pedicel short and hyaline spores smooth, brown,  $49.5 \mu - 56 \mu \times 13.2 \mu - 16.5 \mu$ , constricted in the middle, apical cell prolonged; *uredia pycnia* and *aecia* not found.

*Host:* on leaves of *Carex cruciata* Wall.

*Specimen studied:* DGC 64; Darjeeling; altitu 6,800 ft., April 7, 1975.

#### 8. *Puccinia collettiana* Barclay

*Symptoms: lesions* distributed on the under surface of the leaf; *pustules* solitary, distinct, circular, red, 3-4 mm in diameter.

*Causal organism: aeciospores* in chains within the cup, surrounded by a light coloured peridium, smooth walled, hexagonal when in chain but spherical when free,  $16.5 \mu$  to  $23 \mu$  in diameter; *telial*, *uredial* and *pycnial* stages not found.

*Host: Rubia cordifolia* Linn.

*Specimen studied:* DGC 81; Darjeeling; altitude 6,800 ft., July 25, 1975.

#### 9. *Puccinia fagopyri* Barclay

*Symptoms: lesions* distributed irregularly on the under surface of the leaves; *pustules* minute, circular, brown, erumpent.

*Causal organism: teleutospores* dark-brown, smooth, two-celled, top cell blunt,  $26.4 \mu - 36.3 \mu \times 13 \mu - 16.5 \mu$ ; uredospores oval, brown with a thick echinulose wall, diameter  $16.5 \mu - 23 \mu$ ; *aecial* and *pycnial* stages not found.

*Host:* On leaves of *Fagopyrum dibotrys* (D. Don) Hara.

*Specimen studied:* DGC 76; Darjeeling; altitude 6,800 ft.; June 12, 1975.

#### 10. *Puccinia menthae* Pers.

*Symptoms: lesions* distributed irregularly on the under surface of the leaves; *pustules* minute, brown, circular, 0.5 to 1 mm in diameter, erumpent.

*Causal organism: uredospores* one-celled, spiny outer wall, elliptical, hyaline, 13.2 to  $19.8 \mu$  in diameter; *teleutospores* chocolate coloured,

two-celled, smooth walled oblong to ovate, attached to persistent stalk, both ends of the spores rounded with constriction at the septum,  $23.1 \mu - 26.4 \mu \times 19.8 \mu$ ; *pycnial* and *aecial* stages not found.

*Host*: on leaves of *Calamintha umbrosa* Benth.

*Specimen studied*: DGC 86; Mongpoo; altitude 6,000 ft.; June 15, 1975.

### 11. *Puccinia punctata* Link

*Symptoms*: lesions distributed on the under surface of the leaves, host tissue turning yellowish, lesions elevated and yellowish.

*Causal organism*: *aeciospores* orange-yellow surrounded by a light coloured peridium, borne in chains within the cup, spores when free spherical but while still in the cup are hexagonal,  $13.2 \mu$  to  $16.5 \mu$  in diameter; *uredial*, *telial*, *pycnial* and *aecial* stages not found.

*Host*: on leaves of *Galium* sp.

*Specimen studied*: DGC 80; Darjeeling; altitude 6,800 ft.; June 10, 1975.

### 12. *Puccinia romagnoliana* Maire & Sacc.

*Symptoms*: characteristic development of yellow to orange coloured pustules on the under surface of the leaf; *pustules* round.

*Causal organism*: *uredospores* single-celled, stalked, echinulate,  $16 \mu$  to  $19 \mu$  in diameter; *telial*, *uredial*, and *pycnial* stages not found.

*Host*: on leaves of *Cyperus rotundus* Linn.

*Specimen studied*: DGC 98; Ging (Darjeeling); altitude 6000 ft.; June 12, 1975.

### 13. *Puccinia roscoepae* Barclay

*Symptoms*: lesions confined to the under surface mainly along the margin of the leaf blade, older lesions blackish-brown with ruptured epidermis; *pustules* solitary, distinct, orange coloured lenticular to irregular, slightly erumpent with age, scattered irregularly on the under surface of the leaf blade.

*Causal organism*: *teleutospores* yellowish-orange, two-celled thick-walled, slightly constricted at the septum, pedicellate,  $20 \mu$  to  $40 \mu \times 10 \mu$  to  $13.2 \mu$ ; *uredial*, *pycnial* and *aecial* stages not found.

*Hosts: Cautlevia lutea* Royle; *Globba hookeri* Clarke; *Hedychium acuminatum* Roscoe.

*Specimens studied:* DGC 32, 33, 34; Birch hill (Darjeeling); altitude 7,500 ft.; Sept. 15, 20, 26, 1974.

#### 14. *Puccinia urticae* Barclay

*Symptoms: lesions* appear on the lower surface of the leaves, slightly elevated, yellowish.

*Causal organism: aecium* colourless 313  $\mu$  - 363  $\mu$  in diameter, aecial cup partly within the leaf tissue and partly projecting above it; peridium light coloured; *aeciospores* borne in chains within the cup, angular, 16.5 - 23  $\mu$  in diameter, colourless, smooth walled; *telial, uredial, and pycnial* stages not found.

*Host:* on leaves of *Urtica parviflora* Roxb.

*Specimen studied:* DGC 61; Darjeeling; altitude 6,800 ft.; Jan. 12, 1975.

#### 15. *Uromyces appendiculatus* (Pers.) Unger

*Symptoms: lesions* appear on the under surface of leaf; pustules compact, black, 3-4 mm in diameter, circular.

*Causal organism: teleutospores* one-celled, subglobose, at the apex which has a hemispherical hyaline papilla, smooth-walled, chestnut brown, stalk about equal to the spore length, 26.4  $\mu$  - 29.7  $\mu$   $\times$  19.8  $\mu$  - 23.1  $\mu$ ; *uredial, pycnial, and aecial* stages not found.

*Host:* on leaves of *Phaseolus vulgaris* Linn.

*Specimen studied:* DGC 82; Darjeeling; altitude 6,800 ft.; June 25, 1975.

#### 16. *Uromyces fabae* (Pers.) de Bary

*Symptoms: lesions* elevated, light yellow, borne on or under surface of leaves; *pustules* light-yellow, rounded.

*Causal organism: aeciospores* surrounded by light coloured short cup-shaped peridium, spores in chains within the cup, hexagonal, smooth-walled, 13  $\mu$  to 16.5  $\mu$  in diameter; *telia, uredia* and *pycnia* not found.

*Host:* on leaves of *Pisum sativum* Linn.

*Specimen studied:* DGC 83; Darjeeling; altitude 6,800 ft.; Jan. 12, 1975.

17. *Uromyces trifolii* (Hedw. f) Lev.

*Symptoms:* lesions distributed irregularly on both surfaces of leaves; pustules solitary, 1-2 mm in diameter, dark-brown.

*Causal organism:* teleospores brown, one-celled, smooth and thick walled, stalked, spores bear apical hyaline papilla, after detachment of spores stalks remain in the sorus, stalks almost equal to the spore length, 16.6  $\mu$  to 23.1  $\mu$  in diameter, *uredia*, *pycnia*, *aecia* not found.

*Host:* on leaves of *Trifolium repens* L.

*Specimens studied:* DGC 75; Darjeeling, altitude 6,800 ft.; June 12, 1975.

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