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 Agaricus exoltatus Berk., A. silvaticus Schaeff., Armanitopsis berkeleyi (Hook. f.) Sacc., A. eriophora (Berk.) Sacc., A. regalis (Berk.) Sacc., Armillaria adnatha Berk., A. dichrocella Berk., A. duplicata Berk., A. horrens Berk., A. multicolor Berk., A. omnituens Berk., Boletus delineus Berk., B. ustalis Berk., B. amadensis Berk., Bulgaria chalybea (Berk. in Herb.) Cooke and Massee, Calocera sphaerobasis Berk., Clitocybe inconcrua Berk., Collybia antityna Berk., C. camptododa Berk., C. nanipes Hook. f. in

Berk., *C. papyraceus* Berk., *C. raphanipes* Berk., *C. rhodella* Berk., *C. stellaticia* Berk., *C. undabunda* Berk., *C. ustipes* Berk., *C. velutipes* (Curt.) Fr., *Coprinus comatus* Fr., *C. hookeri* Berk., *C. vellereus* Berk., *Daedalea emodensis* Berk., *D. stereoides* Fr., *Daldinia vernicosa* (Schw.) Ces. and Not., *Entoloma cystopodum* Berk., *E. goliath* Hook. f., *Exidia bursaeformis* Berk., *Favolus tenerrimus* Berk., *Fistulina hepatica* Fr. *Flammula chrysomyces* Berk., *F. macrocephala* (Berk.) Sacc., *Fomes adamantinus* (Berk.) Sacc., *F. igniarius* (L.) Fr., *F. senex* Nees and Mont., *Galera burkillii* Massee., *G. tenera* (Schaeff.) Fr., *Hirneola cochleata* Fr., *H. delicata* (Fr.) Bres., *Hypholoma castinophyllum* Berk., *Hydnum coralloides* Scop., *H. gilvum* Berk., *Hypocrella semiamplexa* (Berk.) Sacc., *Lycoperdon elongatum* Berk., *Marasmius consocius* Berk., *Merulius lignosus* Berk., *Mycena bicrenata* Berk., *Mycena xanthophylla* Berk., *Naucoria semusea* Berk., *Otidea darjeelingensis* (Berk.) Sacc., *Panus conchatus* Fr., *Paxillus chrysitis* Berk., *Paxillus pinguis* Hook. f., *P. sulphureus* Berk., *Peziza aurantia* Pers., *Pholiota aurivella* (Batsch) Fr., *Pluteus columbinus* Berk., *Polyporus cremoricolor* Berk., *P. cressus* (Pers.) Fr., *P. digitalis* Berk., *Polystictus elongatus* Berk., *P. lignoides* Mont., *P. nilgheriensis* Mont., *Podostroma grossum* (Berk.) Boedijn., *Psathyra calvescens* Berk., *Rhizina zonata* Berk., *Russula emetica* Fr., *Stereum hirsutum* (Willd.) Fr., *Schizophyllum commune*

Fr., Tremella protensa Berk., Tremates colliculosa Berk., Volvaria thwaitesii Hook. f., Keratus cantharelloides Berk., Xylaria tabacina (Klckx.) Berk., Hedothia macratis (Berk.) Sacc.; and F. Currey (1874) on Hexagonia Kurzii Currey, Peziza aurantia Pers., Xylaria tabacina (Klckx.) Berk., Fomes melanoporus Mont.

From 1886 to 1891, A. Barclay (1890, 1891) worked on Aecidium mori Barclay, Pucciniostele clarkiana (Barclay) Diet., Puccinia nitida Barclay, Coleosporium campanulae (Pers.) Lev.; M. C. Cooke (1891) on Bulgaria chalybia (Berk. in Herb) Cooke and Massee. Where as from 1898 to 1912, G. Massee (1898) studied Hydnum coralloides Scop., Galera burkillii (Massee). Workers who worked on the different genera and species of fungi during the period from 1899 to 1925 are : P. Dietel (1899) on Puccinostele clarkiana (Barclay) Diet.; P. Hennings (1901) on Lycoperdon elongatum Berk., Polyporus cremericolor Berk., Stereum hirsutum (Willd.) Fr., S. purpureum Pers.; H. P. Sydow (1902-1924) on Puccinia consenta Berk. and Br., Uredo xanthorrula 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 senex Nees and Mont., Ganoderma lucidum (Leyss) Karst., Polyporus gilvus Schw., P. sacrarbilis Berk., Polystictus elongatus Berk., P. lignoides Mont., P. tabacinus Mont., Stereum hirsutum (Willd.) Fr.; H. P. Sydow and E. J. Butler (1906) on Acanthostoma vattii (Syd. and Butler)., Aecidium mori Barclay., Asterina indica Syd., Cheetothyrium javanicum (Zimm.)

Boedijn., *Coleosporium campanulae* (Pers.) Lev., *Myriangium duriaei* Mont. and Berk., *Nectria cinnabarina* (Tode) Fr., *Phacidium symplocinum* Syd., *Rytisma acerinum* (Pers.) Fr., *Sphaerella rosicola* Ellis. and Everh., *Xylaria tabacina* (Kickx) Berk., *Uromyces commelinae* Cooke., *U. setariae-italicae* (Diet.) Yoshino *Ustilago aperta* Syd. and Butler; H. H. Mann (1906) on *Exobasidium vexans* Massee; H. M. Banker (1906) on *Steccherinum rhois* (Schw.) Banker; P. Dietel (1906) on *Aecidium mori* Barclay; and H. P. Sydow and E. J. Butler (1907) on *Aecidium mori* Barclay., *Puccinia lnavati* Syd., *P. solmsii* P. Henn.; P. Dietel (1907-1910) on *Pucciniostele clarkiana* (Barclay) Diet.; W. McRae (1910) on *Exobasidium vexans* Massee; F. Theissen (1911) on *Fomes senex* Nees and Mont., *Stereum hirsutum* (Willd.) Fr.; H. and P. Sydow and E. J. Butler (1912) on *Aecidium nycei* Syd., *A. vanguariae* Cooke., *Coleosporium campanulae* (Pers.) Lev., *Exobasidium vexans* Massee., *E. pieridis* P. Henn., *E. indicum* Syd. and Butler., *Puccinia gracilenta* Syd. and Butler., *P. nevrandina* Syd., *Pucciniostele clarkiana* (Barclay) Diet., *Uredo dioscoreae* Cooke.; F. Theissen (1912) on *Acanthostoma wattii* (Syd. and Butler)., *Melanopsamma ranjanii* Mitra, A. K.; F. Theissen (1913) on *Asterina indica* Syd., *Fomes senex* Nees. and Mont., *Lloydella bicolor* (Pers.) Hoehnel and Lits., *Polystictus tabacinus* Mont.; C. G. Lloyd (1915) on *Polyporus hookeri* Lloyd., *Polystictus nilgheriensis* Mont.; H. and P. Sydow and E. J. Butler (1916) on *Colletotrichum clerodendri* Diet., *Dinemasporium*

hispidulum (Schrad.) Sacc., Schillarda sessilis Sacc., Septoria rosae Desm., S. tabacina Diet.; T. Petch (1917) on Myriangium duriaei Mont. and Berk.; C. G. Lloyd (1917-1919) on Radinia vermicosa (Schw.) Ces. and deNot.; A. C. Tunstall (1918) on Nectria cinnabarina (Tode) Fr.; E. J. Butler (1918) on Exobasidium vexans Massee., Ustulina zonata (Lev.) Sacc., Uromyces setariae-italicae (diet) Yoshino; A. C. Tunstall (1918) on Ustilina zonata (Lev.) Sacc.; C. G. Lloyd (1928) on Xylaria tabacina (Kickx) Berk.; G. Bresadola (1920) on Hirneola cochleata Fr., H. delicata (Fr.) Bres., Laschia intestinales (Berk.) Bres.; S. R. Bose (1922) Trametes cinata Bose; A. C. Tunstall and S. R. Bose (1922) on Exobasidium vexans Massee., E. cloridis P. Henn., E. indicum Syd. and Butler; A. C. Tunstall (1922) on Ustulina zonata (Lev.) Sacc., A. C. Tunstall (1923) on Nectria cinnabarina (Tode) Fr.; W. A. Murrill (1924) on Stereum hirsutum (Willd.) Fr.; A. C. Tunstall (1925) on Exobasidium vexans Massee., Nectria cinnabarina (Tode) Fr.; T. Petch (1925) on Hydnum ellvum Berk.; (1925).

From (1926 to 1933) A. C. Tunstall (1927) on Exobasidium vexans Massee.; P. Dietel (1928) on Pucciniostele clarkiana (Barclay) Diet.; A. Hafiz Khan (1928) on Coleosporium campanulae (Pers.) Le'v.; A. C. Tunstall (1928) on Nectria cinnabarina (Tode) Fr.; S. R. Bose (1919 - 1928) on Fomes adamantinus (Berk.) Sacc., F. durus (Jungh.) Cunn., F. fastuosus Le'v, F. lignosus Klotzsch., F. melanoporus Mont., F. senex Nees and Mont., Ganoderma lucidum (Leyss) Karsh., G. subtornatum Murrill., Hexagonia Kurzii Currey.,

H. sulcata Berk., *Polyporus circinatus* Fr., *P. gilvus* Schw., *P. hookeri* Lloyd., *P. radiatus* (Sow.) Fr., *P. secernibilis* Berk., *Polystictus licnoides* Mont., *P. nilgheriensis* Mont., *P. tabacinus* Mont., E. J. Butler and G. R. Bisby (1931) on *Chaetothyrium javanicum* (Zimm.) Boedijn., *Diaporthe* (Chorostate) *taxicola* Sacc. and Syd., *Fomes fastuosus* Le'v., *Ganoderma annulare* (Lloyd) Boedijn., *Leucoagaricus excoriatus* (Schaeff. ex Fr.) Singer., *Lenzites unicolor* (Fr.) Cunn., *Nyssopsora thwaitesii* (Berk. and Br.) Syd., *Polyporus agaricus* Berk., *Polystictus elongatus* Berk., *Wynnea gigantea* Berk. and Curt.; H. Sydow and J. H. Mitter (1935) on *Cercospora chenopodii* Fres., *Coleosporium xanthoxyli* Diet. and Syd., *Puccinia congesta* Berk. and Br.; K. B. Boedijn (1934) on *Podostroma grossum* (Berk.) Boedijn.; S. R. Bose (1934) on *Fomes albomarginatus* (Le'v.) Cooke., *F. pinicola* Fr., *F. tricolor* (Murrill) Bres., *Polyporus cuticularis* (Bull.) Fr.; M. Mittra (1935) on *Cephalosporium* spp.; S. R. Bose (1937) on *Polyporus cuticularis* (Bull.) Fr.; B. B. Mundkur (1938) on *Chaetothyrium javanicum* (Zimm.) Boedijn.; H. Sydow (1938) on *Ustilago nepalensis* Liro.; B. B. Mundkur (1939) on *Sphacelotheca clinebrae* Mundk.

During the period from 1942 to 1958, F. J. Seaver 1942 worked on *Wynnea gigantea* Berk. and Curt.; B. B. Mundkur and K.F. Kheswalla (1942) on *Pestalotia elasticola* P. Henn.; A. K. Mitra (1943 & 1944) on *Melanopsamma ranjanii* Mitra, A. K.; B. B. Mundkur and M. J. Thirumalachar (1946) collected and studied *Nyssopsora 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. operta Syd. and Butler., U. rabenhorstiana Kuehn.; P. C. Roy (1948) on Nyssonsora 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. Cunnigham (1950) on Fomes durus (Jungh.) Cunn., Lenzites unicolor (Fr.) Cunn.; B. B. Mundkur and M. J. Thirumalachar (1952) on Spaceloiheca dinebrae Mundk., Ustilage maydis (D.C.) Corda., U. nepalensis Liro., U. operta Syd. and Butler., U. rabenhorstiana Kuchn., U. tuberculiformis Syd.; K. Ramkrishnan and T. S. Ramkrishnan and C. V. Subramanian (1952) on Leucoagaricus excoriatus (Schaeff. ex Fr.) Singer., Stereogloeocystidium spadicium (Fr.) Rick.; K. Bagchi (1953) on Xylaria hypoxylon 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 stercolicola Trav.; and on (1957) on Septoria cestri (Mont.) Sacc.; V. Agnihothrudu and G. C. S. Barua (1957) on Kutilakesonsis macalpineae Agnihothrudu and

Barua.; A. C. Lacy (1958) on Discosia tenzingii Lacy.

Mention may be made of the workers who worked on the fungal flora of this area during 1959 to 1967, they are : N. L. Munjal and B. L. Chona and J. N. Kapoor (1959) worked on Ascochyta rhei Sll. and Sr.; N. L. Munjal and J. N. Kapoor (1960) on Cochliobolus heterostrophus Drechsler; and on (1961) on Hyalosphora polycodii (Pers.) Magn.; J. N. Kapoor and H. S. Gill (1961) on Mycosphaerell minimaculata Cooke, Kapoor and Gill.; P. N. Rao (1962) on Cercospora cruciferarum Sll. and Sv.; M. N. Payak and D. P. Misra (1963) Puccinia coronata var. avena Erikss.; K. S. Thind and Karnail Singh Waraitch (1964) on Pezizs rapanda Pers.; U. P. Singh and M. S. Pavgi (1965) on Stictis bengalensis Singh and Pavgi; N. C. Dube and K. S. Bilgrami (1966) on Postalotia podocarpi Dennis; M. S. Mane, M. M. Payak and B. L. Renfro (1966) on Phaeosphaeria maydis (P. Henn) Mane, Payak and Renfro; S. K. Banerjee (1966) on Oidium sp.; K. S. Thind and S. S. Sattan (1967) on Clavaria inaequata Mein., Clavulinopsis minata (B) Corner., Deflexula subsimplex (P. Henn) Corner; S.B. Chattopadhyay and S. K. Sengupta (1967) on Fusarium solani (Mont.) App. and Wall; J. N. Kapoor and N. L. Munjal (1967) on Heliola rubiella Hansf.; N. N. Ghosh, N. C. Pathak and I. Tewari (1967) on Oudemansiella radicata (Relh. ex Fr.) Singer.

Again during the period from 1968 to 1981, A. K. Kar and K. P. Pal (1968) worked on Ascobolus lignatilis A. and S., Ascophanus striatus Thind, Cash and Singh, Chailmania coprinaroa (Cooke) Boud, C. Stercorea (Pers. ex Fr.), C. thaleholoidea

(Alb. & Schw. ex Fr.) Boud., *Thecotheus pelletieri* (C. & Cr.) Boud.; S. M. Reddy (1969) on *Apiospora montagnei* Sacc., *Valsella cinnabarinum* (Cda.) Seinko. & Benth.; A. K. Kar and M. Mondal (1969) on *Cercospora amoni* Kar & Mondal, *C. bandograensis* Kar & Mondal, *C. diclipterae* Kar & Mondal, *C. divalliae* Kar & Mondal, *C. johnsonii* Kar & Mondal, *C. tiliacorae* Kar & Mondal; K. S. Thind and Harnek Singh (1969) on *Helotium himalayens* Thind & Singh, *Lambertella cryptomeriae* Thind & Singh, *Rustroemia symplocosis* Thind & Singh; K. S. Thind and S. S. Rattan (1970) on *Rustroemia indica* Thind & Singh; K. S. Thind and Harnek Singh (1970) on *Corynetes atropurpureus* (Batsch & Fr.) Dur., *Cudonia lutea* (Peck) Sacc., *Geoglossum affine* (Dur.) Sacc. & Trav., *Microglossum longisporum* Dur., *Spathularia flavidia* var. *longispora* Meins., *Spathularia flavidia* var. *longispora* Meins., *Trichoglossum farlowii* (Cke.) Dur.; A. K. Kar and M. K. Maity (1970) *Melanopsamma sanchalii* Kar & Maity, *Valsaria cryptomeriae* Kar & Maity; A. K. Kar and M. Mondal (1970) on *Cercospora wedeliae* Kar & Mondal; A. K. Kar and K. P. Pal (1970) on *Ciboriopsis brunii* Kar & Pal, *C. carnea* Kar and Pal, *Dasyscyphus nudipes* var. *minor* Dennis, *D. oblongo-ellipticus* Kar and Pal, *Lachnellula himalayensis* Kar and Pal, *Cookeina sulcipes* (Berk.) Kuntze, *C. tricholoma* (Mont.) Kuntze, *Helvella elastica* Bull. ex St. Aman, *H. ephippium* Lév.; and on *Belonopsis graminea* (Karst. Sacc. & Syd.), *Bulgaria inquinans* (Pers. ex Hook.) Fr., *Dasyscyphus fuscescens* (Pers. ex Fr.) Rehm., *Verpatinia spiraeicola* Dennis; and on *Wynnea macrotis*

(Bork.) Bork.; A. K. Kar and M. K. Maity (1970) on Asterina claviflora Kar and Maity, A. drinycarpi Kar and Maity, A. lambolanae Kar and Maity, A. myrsines Kar and Maity, A. zanthoxyli Yamamoto, Aulographum maculare Bork. and Br., Cylindrosporium leucoscentri Keissler, Sarcinella orunicola Pavgi and Singh, Seiridium indicum Pavgi and Singh.; and on (1970) on Asterocystis canparidis Kar and Maity, Gnomonia annandiculata Kar and Maity; M. S. Pavgi and U. P. Singh (1970) on Ampelomyces quisqualis Ces., Aulographum maculare Bork. & Br., Cercospora pulchella T. S. & Ramkrishnan, C. Withanae, H. and P. Sydow, C. oxyphyli Pavgi and Singh, Cylindrosporium leucoscentri Keissler, Pestalotiopsis palmimi Pavgi and Singh., Sarcinella orunicola Pavgi, Seiridium indicum Pavgi and Singh; A. K. Kar and M. K. Maity (1971) on Annandiculella hoveniae Kar and Maity, Asteridiella melissae Kar and Maity, A. ohiana var. major Kar and Maity, A. zanthoxyli Kar and Maity; Irenopsis tenuissima var. major Kar and Maity, and on (1971) on Hyaloxylon bovei var microsporum Miller, H. megalosporum Speg., H. rutilum Tul., and on (1971) on Coccoidea quercicola P. Henn and Shival., Phyllachorella michelice Syd., Phyllachora leeaolatae Kar and Maity; K. S. Thind and Harnek Singh (1971) on Melanopsis bambusae Thind and Singh, Hymenoscyphus subconnilicatus Thind and Singh; K. S. Thind and K. S. Waraitch (1971) on Placoria himalayensis Thind and Waraitch; and on (1971) on Lamprospora lobata (Berk. & Curt.) Seaver, Scutellinia badioharia (Bork. ex Cooke) Kuntz.; D. K. Purohit (1971) on Pestalotia

aeruginea Stey.; H. P. Srivastava (1971) on Coleosporea ratisporo Cain., Leptosphaerulina trifolii (Rostr.) Petr.; A. K. Kar and M. K. Maity (1972) on Appendiculella calostroma (Desm.) V. Hohn., Amatella litseae (P. Henn.) Theiss. Syd., Irenopsis crotonis (Ster. Tehon.) Stev.; J. L. Shreemali (1972) on Ascochyta cyathulae Chona and Munjal; S. Singh and P. S. Pandey (1972) on Melampsoridium irarae Singh and Pande.; T. A. Nagraj and Kendrik Bryce (1972) On Urohendersonia indica Syd.; B. B. Dewan and A. K. Kar (1974) on Coleosporium blatiae Diet., Trichoglossum farlowii (Cooke) Durand; A. K. Kar and B. B. Dewan (1975) on Aleuria aurantia (Fries) Fuckel, Geoglossum fallax Durand, G. sphagnophilum Shrenbex Wallr., Neottiella vivida (Nylander)Dennis; and on (1975) on Peziza cerea (Cooke) Boudier, P. silva Boudier; K. S. Thind and K. S. Waraitch (1975) on Boudiera parvispora; A. K. Kar and B. B. Dewan (1976) on Peziza domicelliana Cooke., P. echinospora Karst.; A. K. Kar and H. C. Chakraborty (1977) on Sphaerosporella brunnea (Alb. and Schw. ex Fr.) Svrand Kub., Sarcoscypha coccinea (Scop. ex Fr.) Lamp., Rhytidhysterium rufulum (Sprong.) Spag., Chlorosplenium aeruginosum (Berk.) Sac.; A. K. Kar and S. K. Gupta (1978) on different species of Xylaria; A. K. Kar and S. N. Ghosh (1978) on different species of ~~Helicle~~; A. K. Kar and B. B. Dewan (1979) on Coleosporium compositae (Pers.) Lev., C. myriactidis Syd., C. plectranthi Barclay, Phragmidium octoloculare Barclay, Puccinia arundinariae Schw., P. caricis (Schum.) Robent., P. cellottiana Barclay., P. fagosyri Barclay., P. menthae Pers., P. punctata Link., P. ranaghaliana Maire et Sacc., P. roseanae Barclay, P.

urticae Barclay, Uromyces appendiculatus (Pers.) Unger, U. fabae (Pers.) de Bary, U. trifolii (Otodw. f.) Lev.; K. S. Waraitch (1980) on different species of Ascochyta and Cheilmania; A. K. Kar and S. K. Gupta (1980) on different species of Phyllachora; A. K. Kar and B. S. Mahapatra (1981) on different species of Colletotrichum.

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 : Investigation on the [redacted] 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-Behar, 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 celophan 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 μ. 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 Heliolaceae at first a good colony was selected, one drop of colloidion 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 int

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 asci.

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 mature 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 Scutellinia (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 ectal 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 Starback (1893) and emended 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 Heliolaceae. The presence of setae on mycelia is a taxonomic character in the delimitation of certain genera, e. g. Heliola.

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, cylindric, clavate, captate, 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 - periphyses. 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 (spermogonia) bearing pycniospores (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 urodia 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 (Doll.) L. ex St.-Amans, Fl.A gen. 530. 1821.

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

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

Scodellinia 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) Boud., Bull. Soc. mycol. Fr. 1 : 101. 1885, emend Le Gal, Discom. Madag. 27. 1953.

Peziza (Dill.) L. ex St.-Aman (Ser. Aleuria Fr.) Sub gen. Pustularia Cooke, Mycograph. 1: 253. 1879.

Peziza (Dill.) L. ex St.-Amans subgen. Aleuria (Fr.) Sacc. (Sect.) Geoscypha (Cooke) Sacc., Bot. Cbl. 18 : 215. 1884.

Geoscypha (Cooke) Lamb., Fl. mycol. Belg., suppl. 1 : 320. 1887.

Phaeopezia (Sacc. ex Sacc. apud vido) Sacc. apud vido subgen. Aleuring Sacc., Bot. Cbl. 18: 218. 1884.

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

Daleomyces Setchel, 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.-Amans.

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 Aleuria(Fr.) Gill. emend, Boud. emend Le Gal (1953, 1959, 1962), Gamundi (1960, 1964), Sevcek & Kubicka (1961), Svrcek (1962 and 1965) and others. But under the current International Code of Botanical Nomenclature the genus Aleuria (Fr.) Gill. cannot be used as it is the later synonym of Aleuria 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 domiciliana

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 petersii

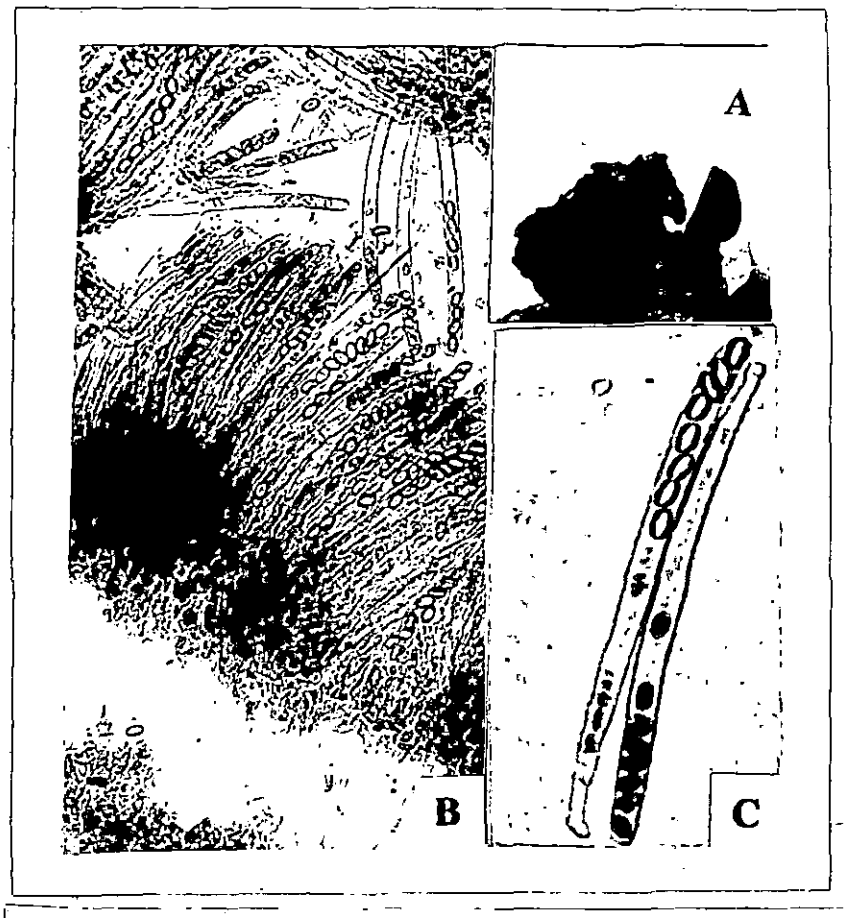

Fig.1. Peziza cerea - A. Apothecium, x½;
B. Vertical section of the hymenium showing asci and ascospores, x184;
C. Asci with ascospores, x388.

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

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

Peziza cerea Bull. ex Mérat, Nouv. Fl. Paris, 2e Ed., 1: 26. 1821; Fr., Syst. mycol. 2 : 62. 1822.

Macroscyphus cereus (Bull. ex Mérat) S.F. Gray, Nat. Arrang. Br. Pl. 1 : 672. 1821.

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

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

Aleuria cerea (Bull. ex Mérat) Gill., Champ. Fr., Discom. 44. 1879.

Pustularia cerea, (Bull. ex Mérat) Rehm in Ber. naturhist. ver. Augsburg 26 : 51. 1881.

Galactinia vesiculisa (Bull. ex st - Amans) Le Gal. f. cerea (Bull. ex Mérat) Svréek in Ceská Mycol. 14 : 210. 1960.

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

(Fig. 1)

Anothecia 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, 182 - 198 x 10 - 13 µ, narrower towards the base, apex blued in Melzer's reagent; ascospores uniseriate, hyaline, ellipsoidal, smooth-walled, without oil globules, 10 - 13 x 7 - 10 µ; paraphyses straight, septate, apex enlarged upto 7 µ.

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

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

Specimen studied - DCC 50; June 9, 1974.

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

Octospora varia Hedw. Descr. 2 : 22. 1788.

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

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

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

(Fig. 2)

Apothecia gregarious, usually short-stipitate, at

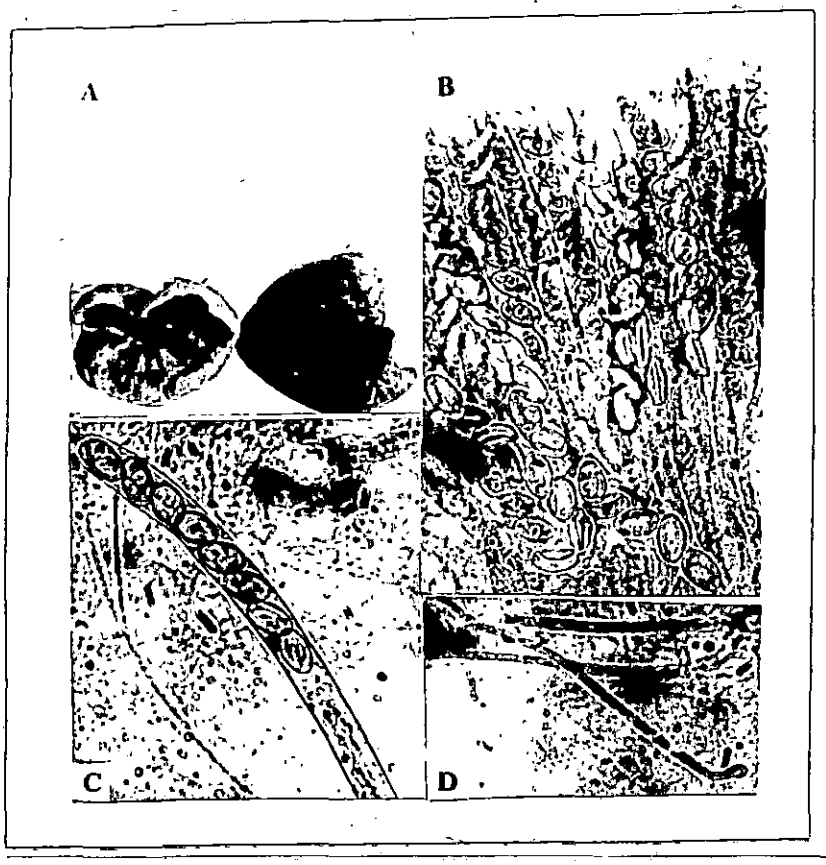

Fig. 2. Peziza domicelliana - A. Apothecia,x½;
B. Vertical section of the hymenium showing asci and ascospores,x461;
C. Ascus with ascospores,x461;
D. Paraphysis,x1500.

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 μ and a diameter of 10 - 13 μ, ascus tip blued in Melzer's reagent; ascospores ellipsoid, hyaline 1 - seriate, without oil globules, smooth-walled, 7-13 μ; paraphyses slender, filiform, septate, slightly enlarged above.

Habitat - On wall plaster with mosses about 6' from the soil.

Locality - Birch Hill, Darjeeling, altitude 6800ft., West Bengal.

Specimen studied - DGC 60; November 7, 1973.

Peziza echinospora Karst., in Not. Sallsk. Fauna et Flora fennica 10 : 115. 1869.

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

Aleuria 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.

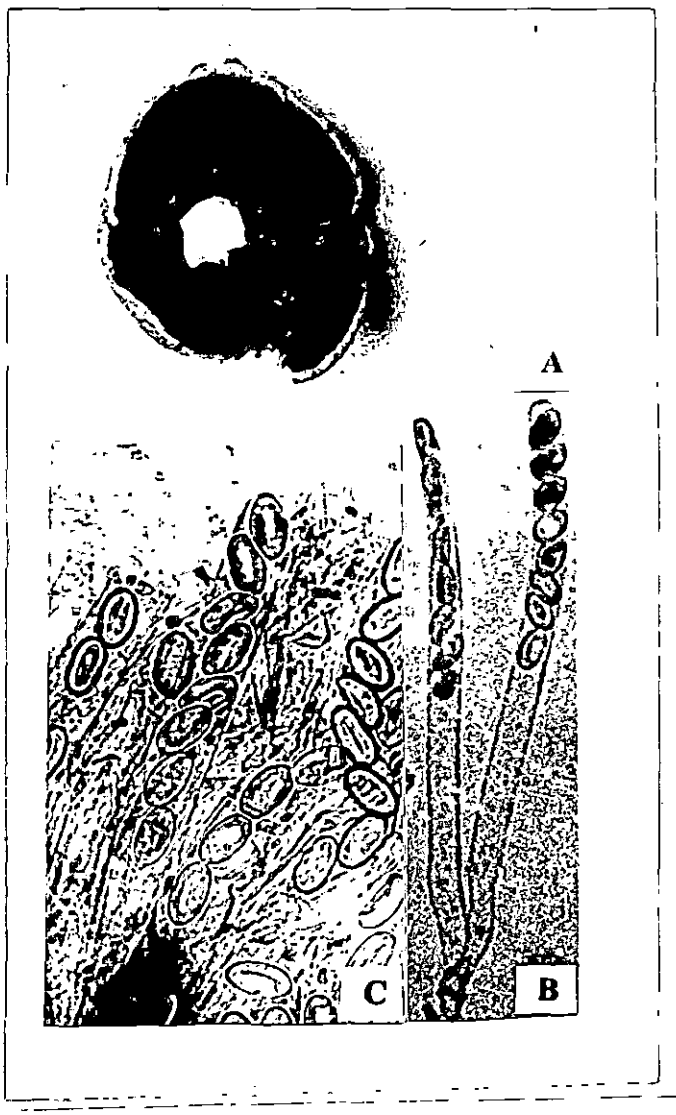

Fig. 3. Peziza echinospora - A. Apothecium,x½;
B. Asci with ascospores,x356;
C. Hymenium showing asci and ascospores,x529.

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

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

(Fig. 3)

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 Otidia - like by mutual pressure, broadly sessile, margin often crenate outer surface paler than the disc, often whitish, scurfy to fururaceous, 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; polygonal, thin-walled subhymenium of compact angular or lobed and slightly narrower below, apex blued in Melzer's reagent, 8-spored, upto 231 µ long by 13 µ diameter; ascospores uniseriate, hyaline, without oil guttules, ellipsoidal to oblong-ellipsoidal, finely warted, 7 x 17 µ; paraphyses slender, septate, apex subclavate, slightly curved tip swollen reaching a diameter 7 µ.

Habitat - On burnt soil.

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

Specimen studied - DGC 37, March 12, 1974.

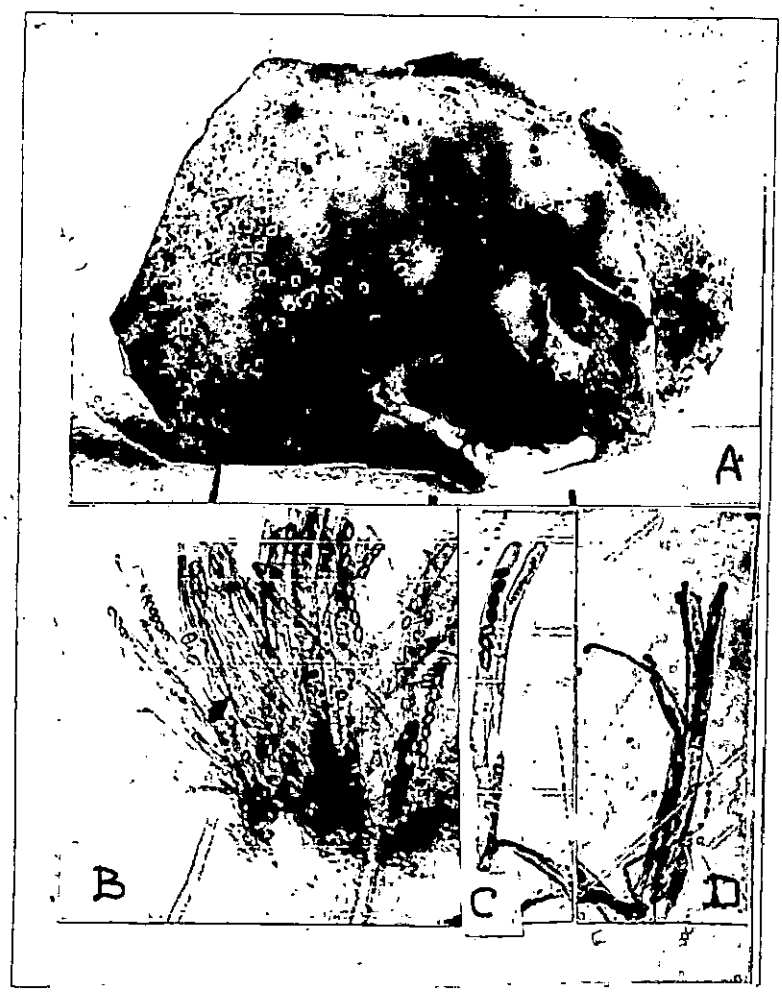

Fig. 4. Peziza petersii - A. Apothecium,x3; B. Hymenium,x162; C. Asci and ascospores,x182; D. Young asci and paraphysis,x182.

Pezizа petersii Berk. in Grevillea 3 : 150 (1875).

Galactinia petersii (Berk.) Le Gal, Discom. Madag. 51. 1953.

Pezizа lumbricalis Cooke in Grevillea 8 : 61. 1879.

Discina lumbricalis (Cooke) Sacc., Syll. Fung. 8 : 101. 1889.

Galactinia sarrazinii Boud. in Bull. Soc. mycol. Fr. 3 : 147. 1887.

(Fig. 4)

Apothecia 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 Melzer's reagent, 8-spored, 247 x 10 µ; ascospores uniseriate, 13.2 x 7 µ, ellipsoid to oblong ellipsoid, hyaline, with two large oil globules, covered with minute warts; paraphyses slender, septate, unbranched, apex distinctly enlarged to about 7 µ, slightly curved, containing brown granules.

Habitat - On soil.

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

Specimen studied - DGC 47, April 19, 1974.

TRICHARINA Eckblad, Nytt Mag, Bot. 16 : 60. 1968.

Apothecia terrestrial, less than 1 cm. in diameter, sessile, scutellate to cupulate, excipulum of two layers, an ental layer of textura intricata, and an ectal 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 slighty enlarged above.

= Tricharia Boudier, Bull. Soc. Mycol. France 1 : 104. 1885, non Tricharia Fee, 1824 (Fee, A.L.A. Essaisur les cryptogames des ecorces exotiques officinales. U. Supplement et revision, Paris. named here as a lichen).

Type : Peziza silva Boud. et Cooke.

Suggested key to the species of Tricharina

a. Apothecia pale fawn, outer surface concolorous, hairs upto 200 µ long ... Tricharina silva

aa. Apothecia white, outer surface reddish brown, hairs upto 300 µ long ... Tricharina crater

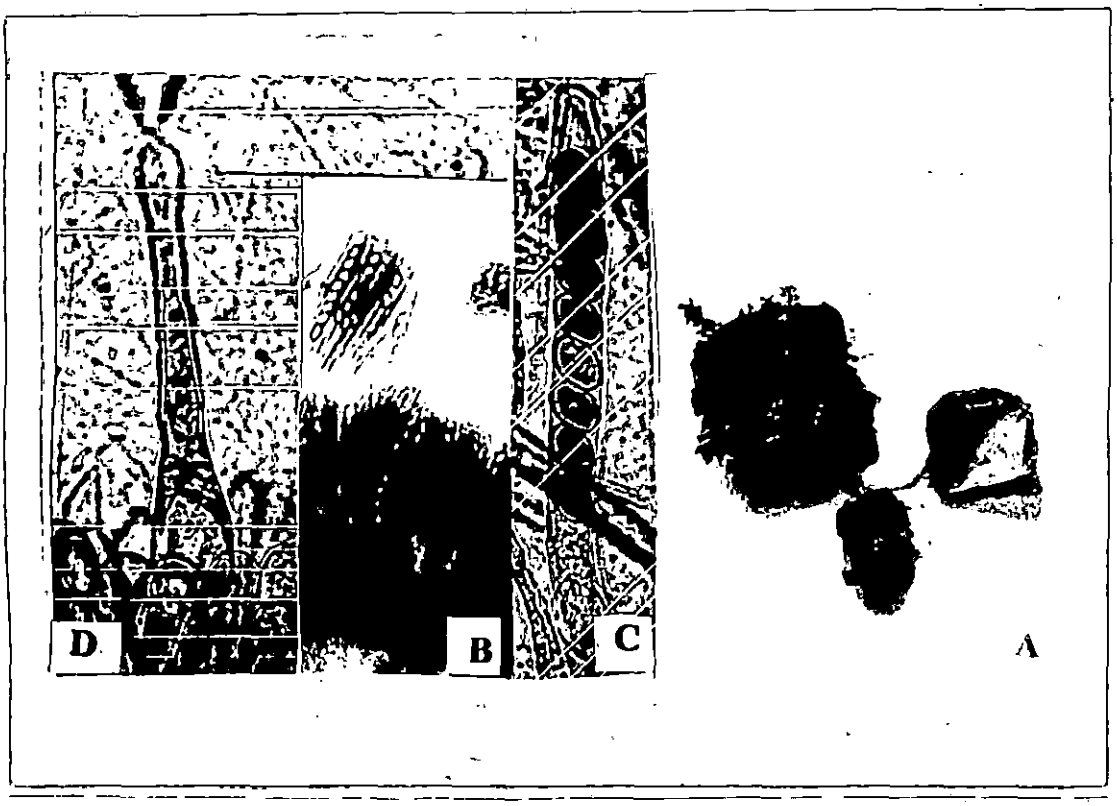

Fig. 6. Trichurina silva - A. Apothecia, x½;
B. Hymenium, x118; C. Ascus with ascospores, x529;
D. Hair, x529.

Tricharina silva Boudier, Icones mycologicae Liveraison 2 (1904).

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

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

Lachnea silva Sacc., Syll. Fung. 8 : 184, 1889.

(Fig. 5)

Apothecia 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 µ, 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 µ; ascospores ellipsoidal, smooth-walled, 17 x 10 µ; paraphyses slender, 3.3 µ thick.

Habitat - On ground with mosses.

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

Specimen studied - DGC 46, April 24, 1974.

Tricharina aretea (Cooke) Boudier, Hist. class. Discom. d'Europe. 68 (1907).

(Fig. 6)

Apothecia gregarious or more often densely crowded,

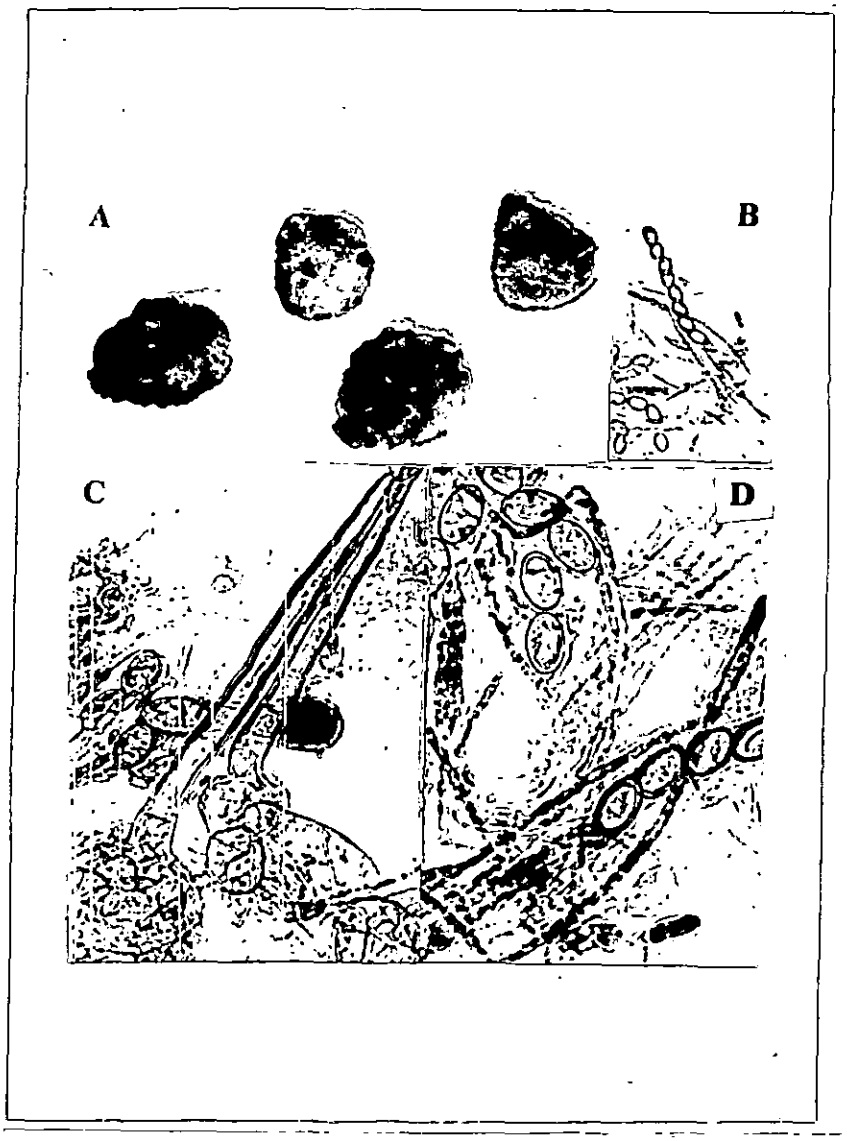

Fig. 6. Tricharina cretea - A. Apothecia,x8; B. Ascospores showing 1-seriate arrangement and paraphyses,x117; C. Hairs showing bulbous base,x470; D. Ascospores and paraphyses,x470.

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 μ long; asci cylindric, tapering below, 178 x 10 μ; ascospores 1 - seriate, ellipsoid, without oil globule, 17 x 10 μ; paraphyses enlarged, above, upto 6.6 μ.

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 Quél., Mem. Soc. Emul. Montbéliard II 5 : 398. 1873.

Ciliaria (Quel.) Boud., Bull. Soc. Myc. Fr. 1 : 105. 1885.

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

Humariella Schröter, Krypt.-Fl. Schles. 3(2):36. 1893.

Patella Wigg., Fl. hols. 106. 1780.

Patella Wigg. ex seaver, N. Am. Cup Fungi.(Operculates) 156. 1928.

Gillet (1879), Saccardo (1889), Phillips (1887), Rehm (1887-1896), and Svrček (1948) described the small operculate discomycetes with conspicuous hairs as the members of a single genus under the name Lachnea, whereas, Morgan(1902) and Seaver (1928) designated them as Patella. Denison (1959) established the validity of the genus Scutellinia (Cooke) Lambotte (=Lilliaria 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 kerguelensis

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

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

Sphaerosporula O. Kuntz, Rev. Gen. Pl. 3(3) : 530.1898.

Stereolachnea von Hohnel, Ann. Myc. 15 : 353. 1917.

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

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, 8-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 carotinoid pigments that turn blue in cone, H_2SO_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.

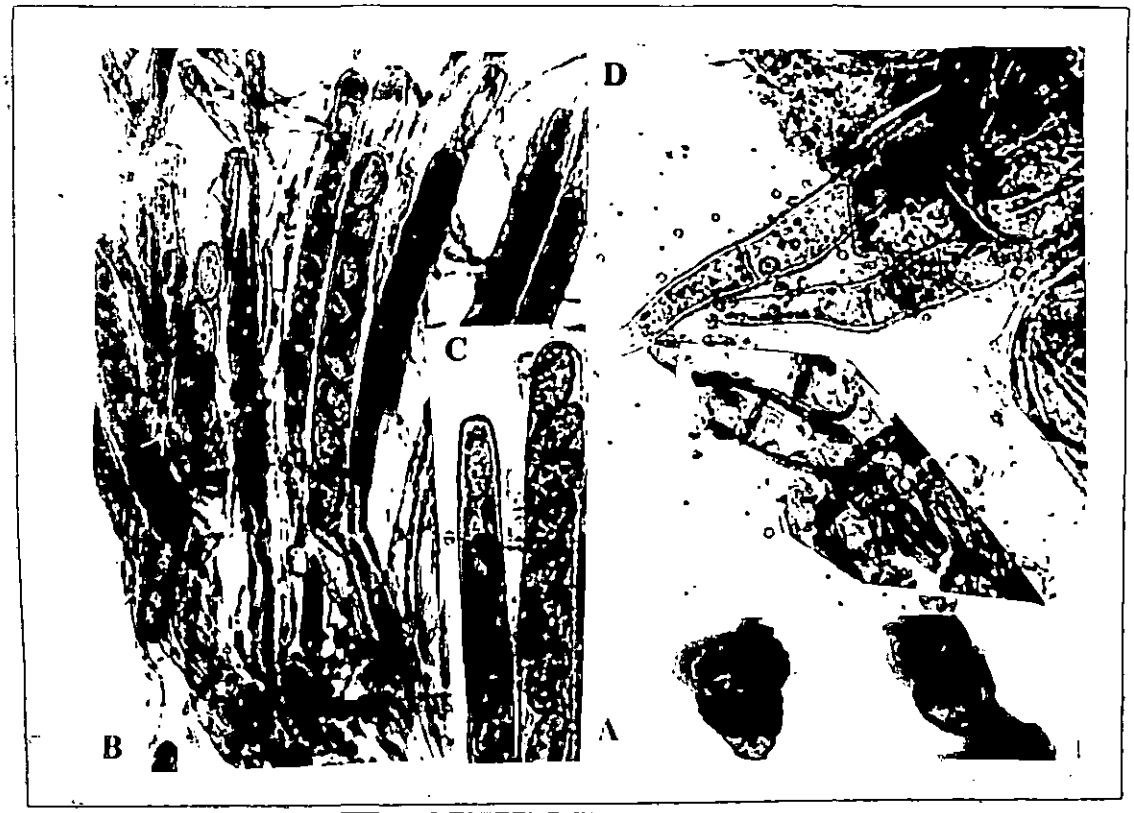

Fig. 7. Scutellinia kerguelensis - A. Apothecia,x½; B. Vertical section of the hymenium showing asci and ascospores,x319; C. Ascospores showing warty surface,x588; D. Hairs showing apex and base,x588.

Scutellinia kerguelensis (Berk.) O. Kuntze Rev. Gen. Pl. 2: 869. 1891.

Patella kerguelensis Berk in Hook. f., Fl. Antare. 2: 451. 1847.

Lachnea kerguelensis (Berk.) Sacc., Syll. Fung. 8 : 176. 1889.

Lachnea nymphorum vel., Monogr. Discom. Boh. 1 : 307. 1934.

Scutellinia nymphorum (vel.) Svrček & Kubička in Česká Mykol. 15 : 63. 1961.

(Fig. 7)

Apothecia scattered to grogarious, sessile, yellow, 1 - 3 mm, outer surface covered with brown short hairs which form a fringe-like border around the margin; rooting 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 μ; 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 μ; 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 : 1181. 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.

Lachnea 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. 3(2) : 37. 1893.

Ciliaria scutellata (L. ex St.-Amans) Boud., Icon. mycol. 2 : pl. 368. 1906; Hist, class. Discom. Eur. 68. 1907.

Patellia scutellata (L. ex St.-Amans) Morgan in J. Mycol. 8 : 187. 1902.

Patellia scutellata (L. ex St.-Amans) Morgan ex Seaver, N. Am Cup Fungi (Operc.) 159. 1928.

Lachnea balnei Stanb. in Bih, K. Svenska Vetensk Akad. Handl. (III) 21(5) : 39. 1895.

Scutellinia scutellata (L. ex St.-Amans) Lamb. f. terricena (Karst.) ex Le Gal in Bull. Soc. mycol Fr. 82 : 31e. 1966.

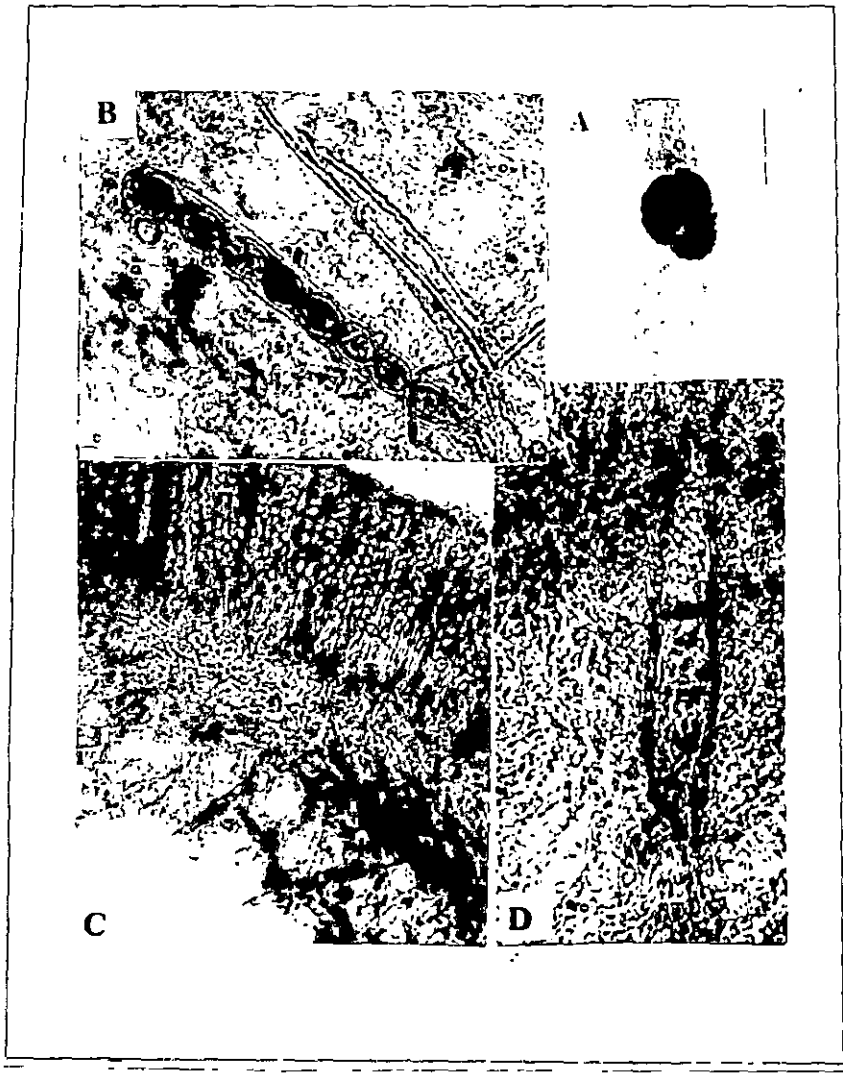

Fig. 8. Scutellinia scutellata - A. Apothecium,x1;
B. Ascus with ascospores and parephyses,x388;
C. Vertical section of the hymenium,x90;
D. Rooting hair,x625.

(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, 238 - 248 x 13 - 17 µ; ascospores 17 - 20 x 3 - 7 u, 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 pennsylvania (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

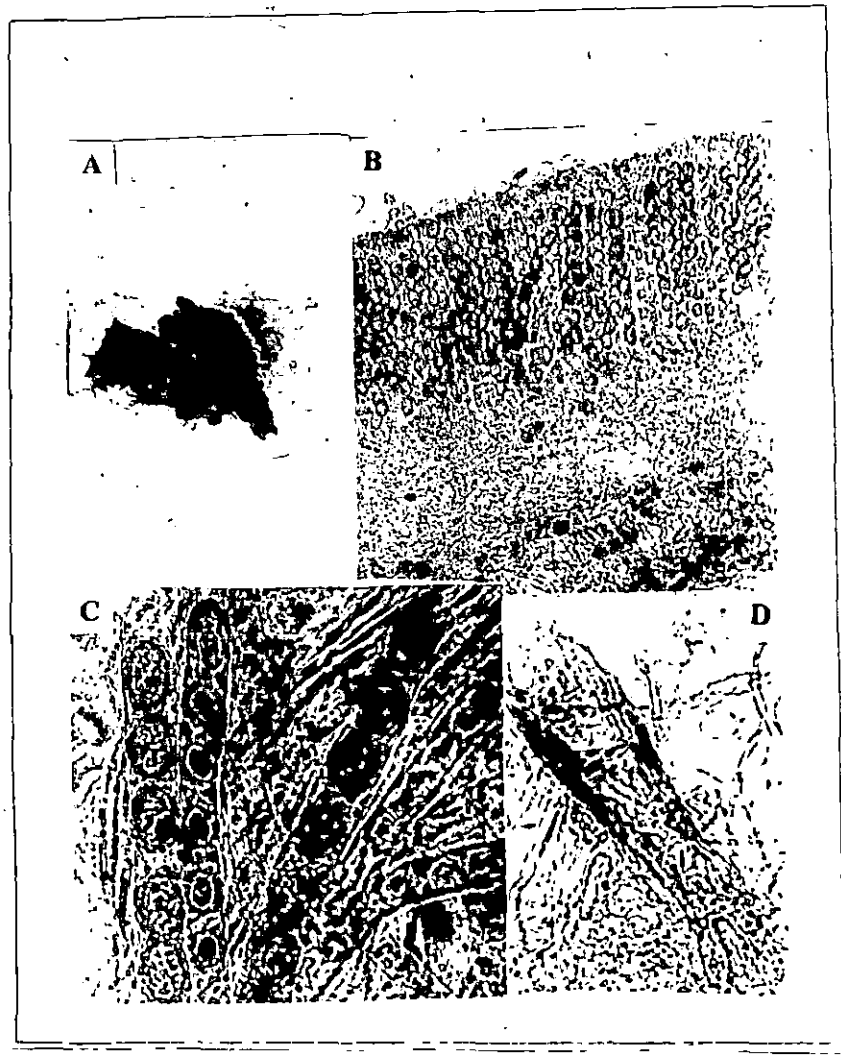

Fig. 9. Scutellinia pennsylvania - A. Apothecium,x½;
B. Vertical section of the hymenium,x110;
C. Asci with ascospores showing ornamentation,x560
D. Rooting hair,x600.

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 µ; ascospores 20 - 24 x 14 - 17 µ, with ornamentations, 17 - 20 x 10 - 14 µ 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 rotton bark of a tree.

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

Specimen studied - DGC 149, July 20, 1977.

NEOTTIELLA (Cooke) Saccard, Syllogo 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 Neottiella falls into two series, one with rough spores and showing affinity with Aleuria, the other

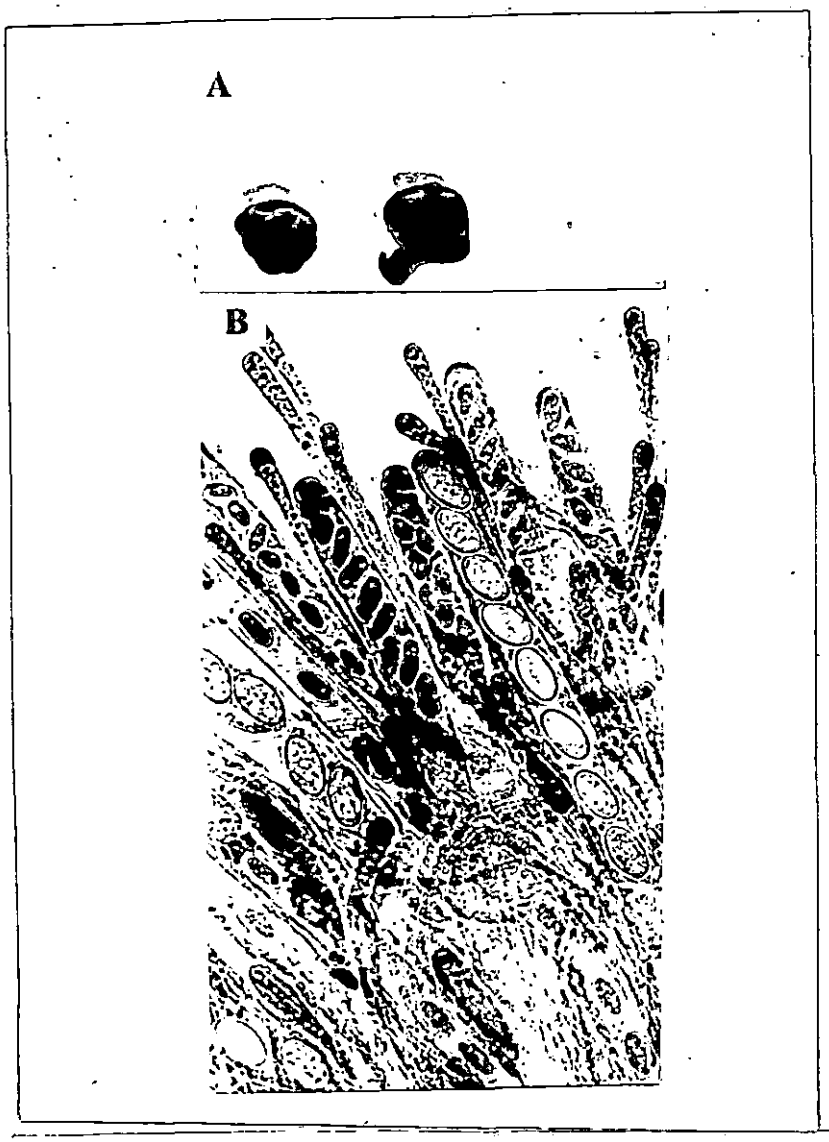

Fig. 10. Neottiella vivida - A. Apothecia, x½;
B. Vertical section of the hymenium showing asci ascospores and paraphyses, x412.

with smooth spores, showing affinity with Chalymmnia on one and Octospora on the other hand.

Lectotype : N. albo-cincta (Berk. & Curt.) Sacc.

= Peziza albo-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 ½ - 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 µ; ascospores uniseriate, elliptic-cylindric, 13 - 17 x 7 µ containing one large oil drop, wall with warts; paraphyses aseptate, projecting above the asci tip upto 7 µ thick.

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

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

Specimen studied - DGC 20, July 22, 1973.

ALEURIA 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) Lamp., Fl. mycol. Belg., Suppl. 1 : 323. 1887.

Type species : Peziza aurantia Pers. ex Hook.

Apothecia 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 blued in Melzer's reagent, 8-spored; ascospores uniseriate, ellipsoidal or oblong ellipsoidal, hyaline, warted 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 (1878) 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. Nassau. ver. Naturk. 23-24 : 325. 1870.

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

Peziza aurantia Pers., ex Hook., Fl. Scot. 2 : 33. 1821.

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

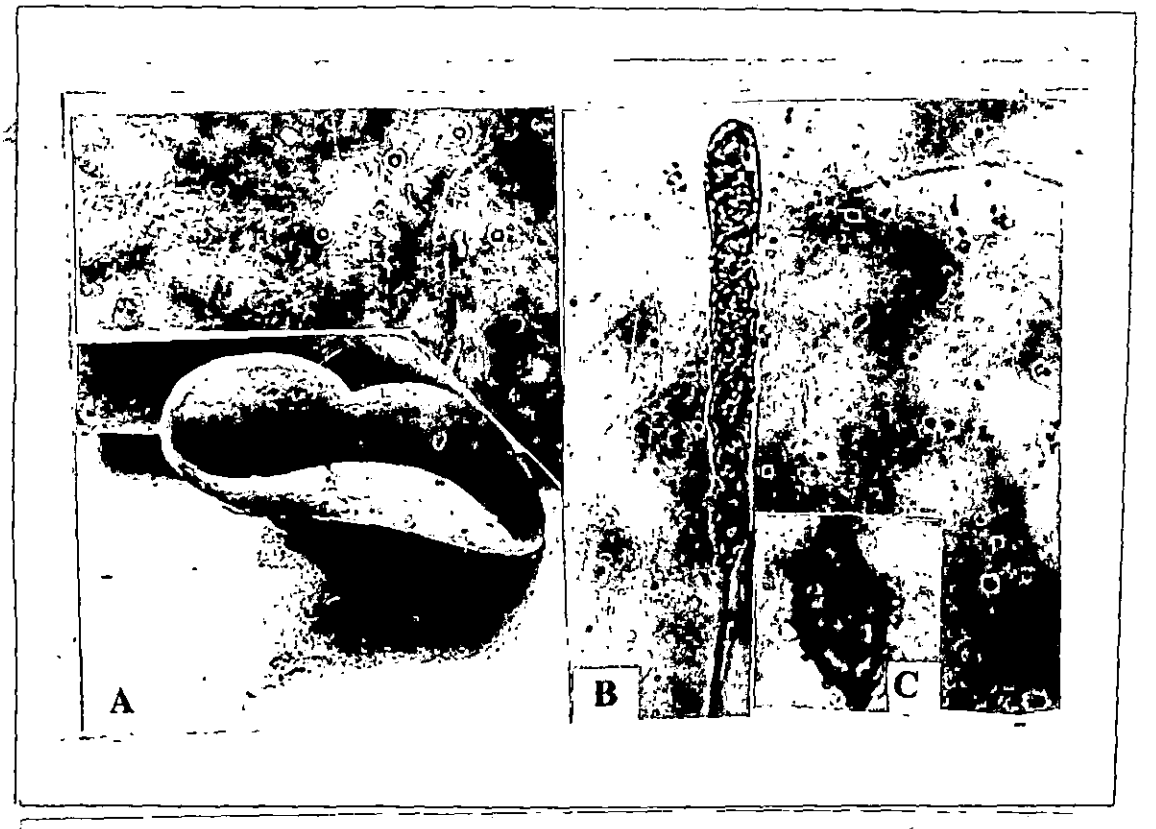

Fig. 11. Aleuria aurantia - A. Apothecium, x½;
B. Ascus with ascospores, x537; C. Ascospore showing reticulation, x1923.

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

Elvella 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.

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

Peziza aurantiaca Pers., Mycol. eur. 1 : 228. 1822.

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

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

Peziza antarctica Speg., Bola 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 stilis Speg., Physis 7 : 13. 1923.

(Fig. II)

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

cells; ectal excipulum 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 µ; ascospores ellipsoid, slightly obliquely uniseriate, ornamented with a coarse reticulum, 13 x 10 µ, containing two oil drops; paraphyses clavate, projecting above the asci, apical portion swollen deeply pigmented with orange granules, 7 µ thick.

Habitat - On bare sandy soil.

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

Specimen studied - DGC 17, July 8, 1973.

ASCOBOLUS Pers. Per Hook., Fl. Scot. 2 : 33. 1821; Fr., Syst. Mycol. 2(1) : 161. 1822.

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

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

Type species : Ascobolus persicoides Pers.

Apothecia superficial or partially immersed, sessile or short stipitate, cupulate, rarely lenticular, smooth, disc concave, plane or convex, soft, fleshy; excipulum 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 characterised 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 Dasybolus (Sacc.) Sacc. was created by Saccardo (1893) 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).

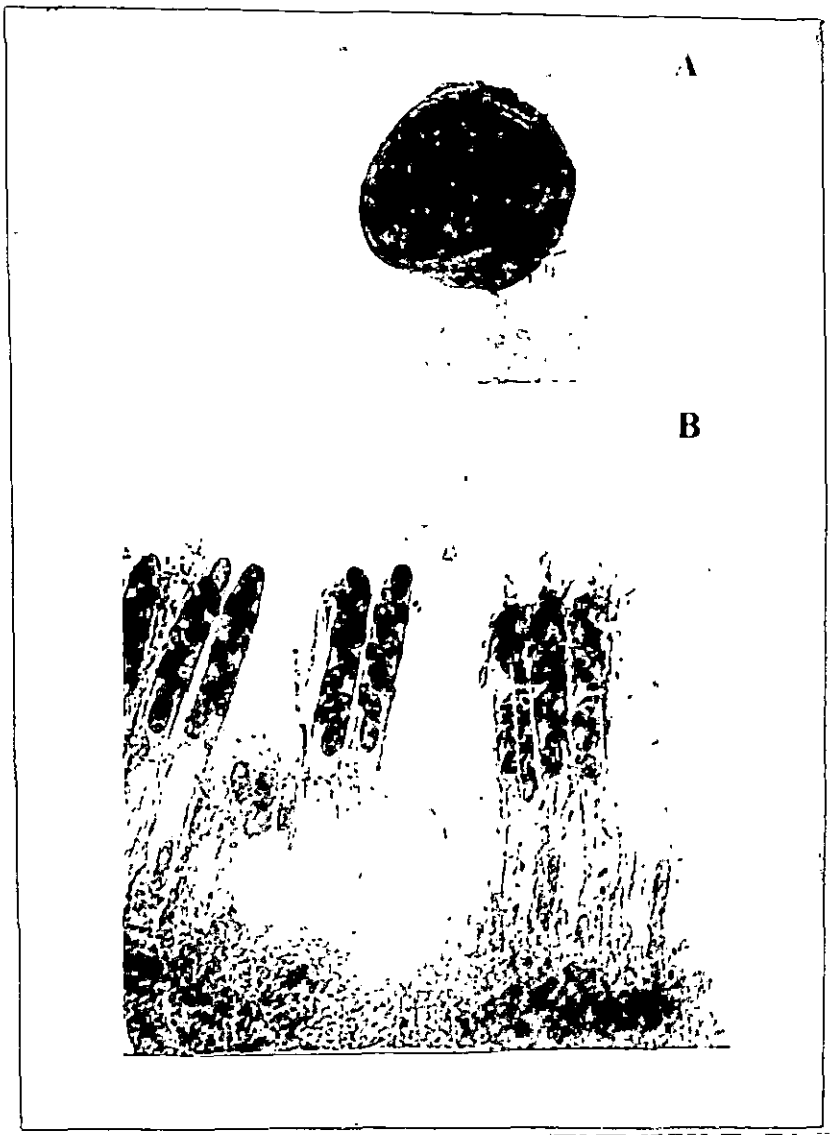

Fig. 12. Ascobolus scatigenus - A. Apothecium, x½; B. Vertical section of the hymenium showing asci and ascospores, x300.

Ascobolus scatigenus (Berk.) Brumm. Persoonia (Suppl.) 1:1-260. 1967.

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

Ascobolus leiocarpus Berk. & Broome, J. Linn. Soc. (Bot.) 14 : 103. 1873.

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

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

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

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

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

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

Ascobolus magnificus Dodge, Mycologia 4 : 218. 1912.

Papulospora 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 medullary excipulum and ectal excipulum not distinguishable and of textura

globulosa; asci cylindrical, operculate, blued in Melzer's reagent, 8-spored, 198 - 215 x 20 - 23 µ; ascospores irregularly biseriate 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 µ; paraphyses slender, septate, unbranched, 7 µ in diameter at the apices.

Habitat - On cow dung.
Locality - Malda, altitude 300 ft., West Bengal.
Specimen studied - DGC 118; July 2, 1976.

GEOGLOSSUM Pers. ex Fr., Syst. Myc. 1 : 487. 1821.
Gloeoglossum Durand, Ann. Myc. 6 : 418. 1908.

Lectotype species : Geoglossum glabrum Pers. ex Fr.

Ascocarps 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 allover 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,

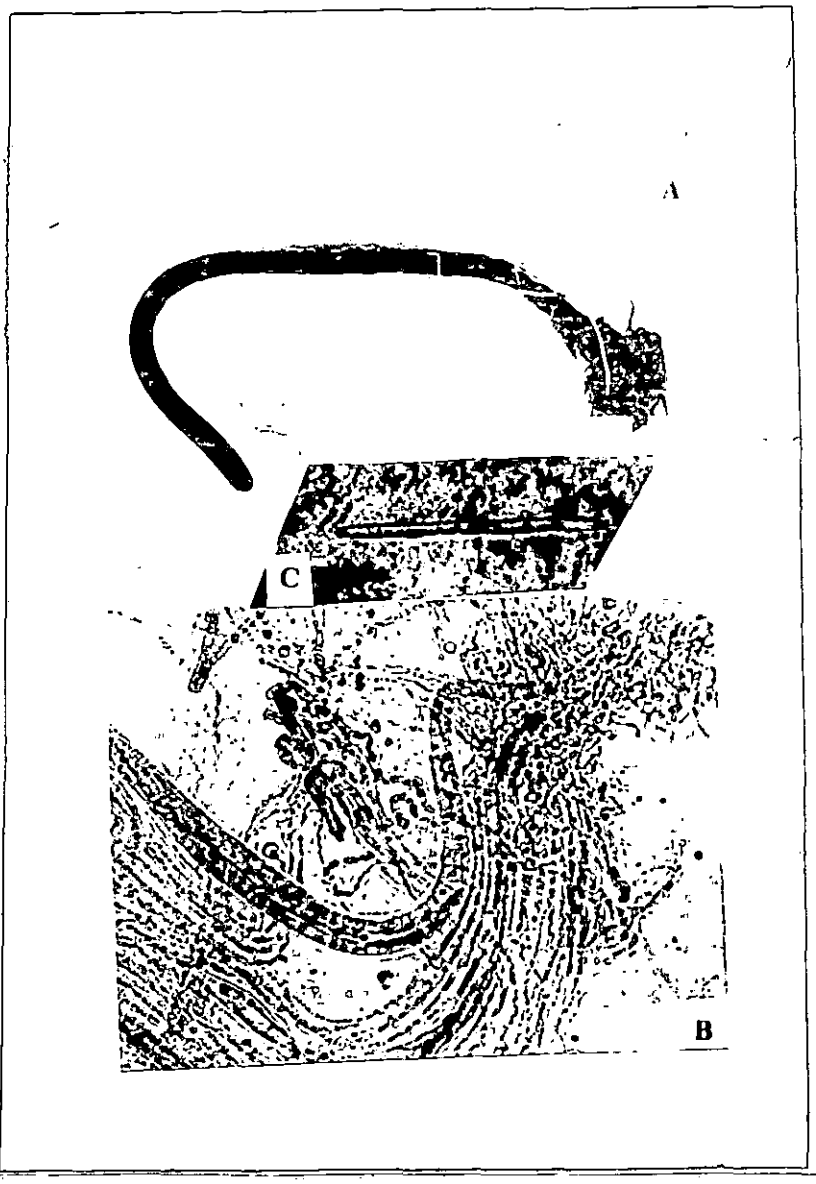

Fig. 13. Geoglossum cohaerens - A. Ascophore, x1; B. Vertical section of the hymenium showing asceus, x562; C. Ascospore, x380.

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 nigritum

Cells of the paraphyses swollen giving moniliform appearance, spores 4-7 septate ... Geoglossum sphagnophilum

Geoglossum cohaerens Durand, Ann. Myc. 6 : 430. 1908.

(Fig. 13)

Ascophores clavate, clustured, 3.5 - 4.5 cm, black; fertile portion about one half the total length, terrete or compressed; asci clavate, reaching a length of

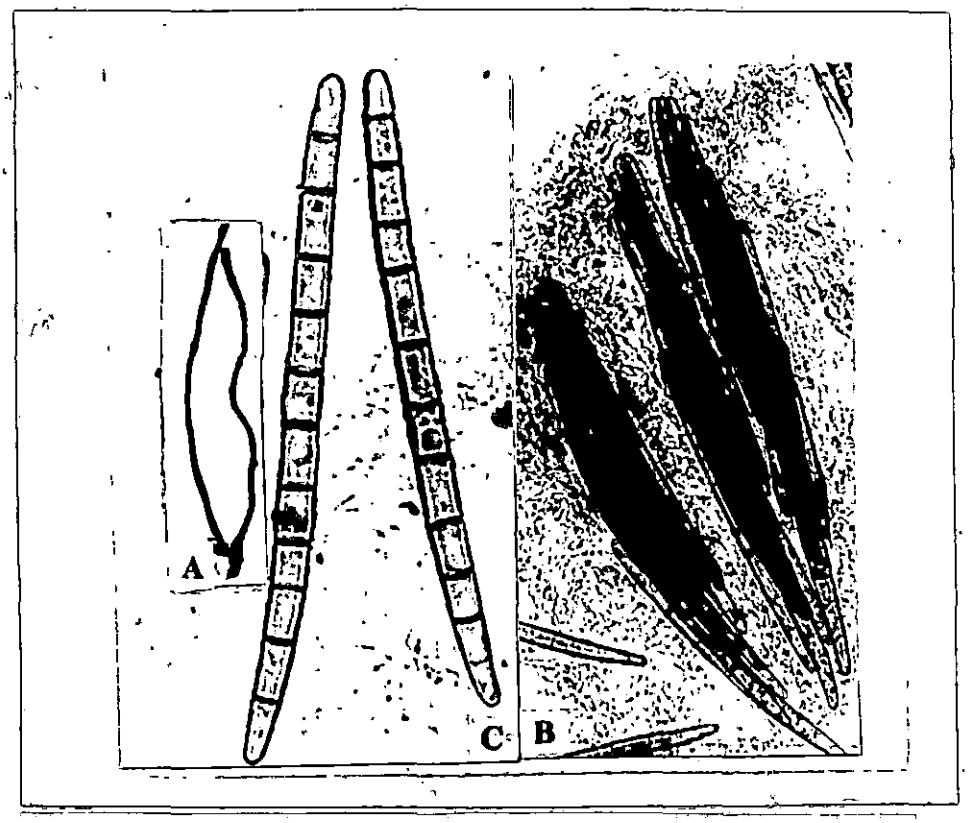

Fig. 14. Geoglossum fallax - A. Ascophore,x½; B. Asci,x467; C. Ascospores,x850.

148.5 - 165 x 12 - 15 µ, 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 µ; 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)

Ascophore 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 µ, 8-spored; ascospores multiseriate in the ascus, straight, 11-septate, 96 - 102 x 7 µ; paraphyses entirely hyaline, septate, apex ellipsoid to globose.

Habitat - On loamy soil along slopes.

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

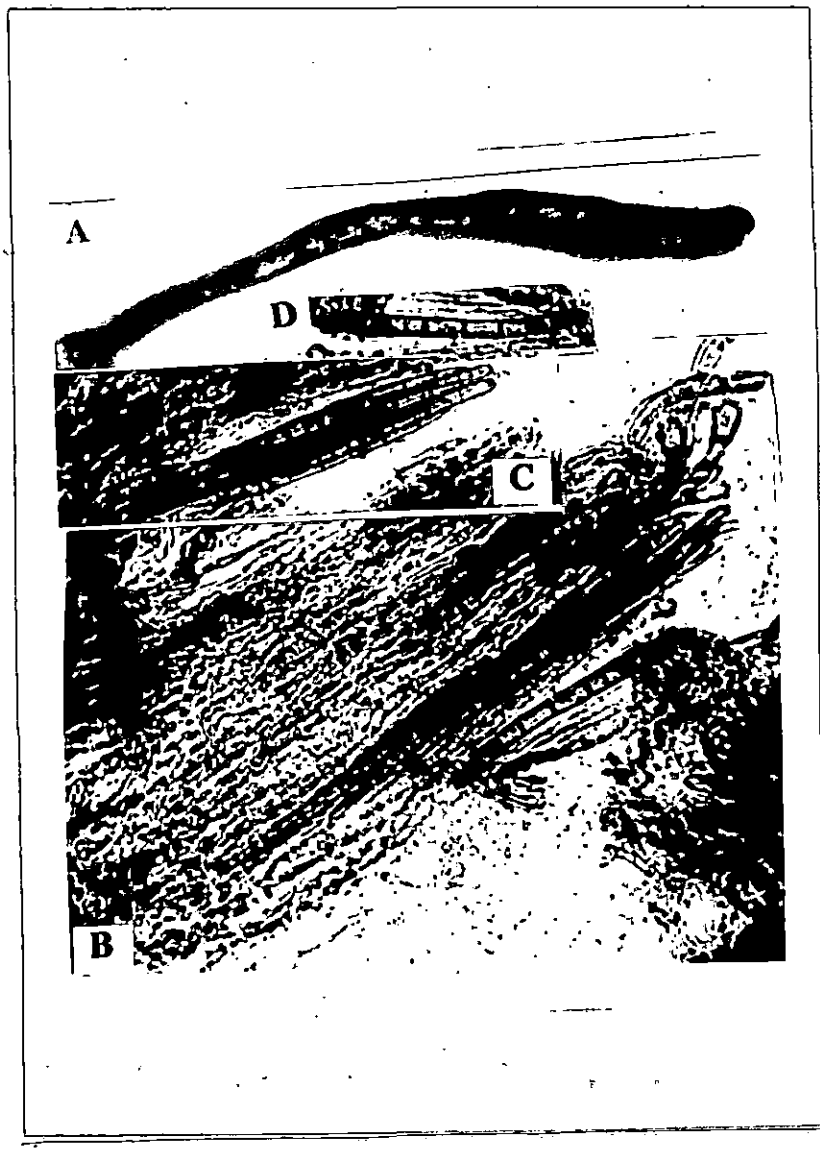

Fig. 15. Geoglossum nigritum - A. Ascophore,x1; B. Vertical section of the ascocarp showing asci and paraphyses,x410; C. Ascus,x410; D. 7-septate ascospore,x410.

Specimen studied - DGC 24, July 23, 1973.

Geoglossum nigritum (Pers.) Cooke, Mycographia 205.1878.

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 - 166 x 16 μ, 8-spored; ascospores in parallel fascicle in the ascus, clavate, 7-septate, 83 - 89x7μ; paraphyses rather longer than the asci, cylindric, septate, apex of the terminal cell more or less curved, swollen, diameter 7 μ.

Habitat - On wet soil amongst mosses.

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

Specimen studied - DGC 114, August 8, 1970.

Geoglossum sphagnophilum Ehrenb. ex Wallr. Sylv. Myc. Ber. 30. 1818.

Clavaria cephaloideoides 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.

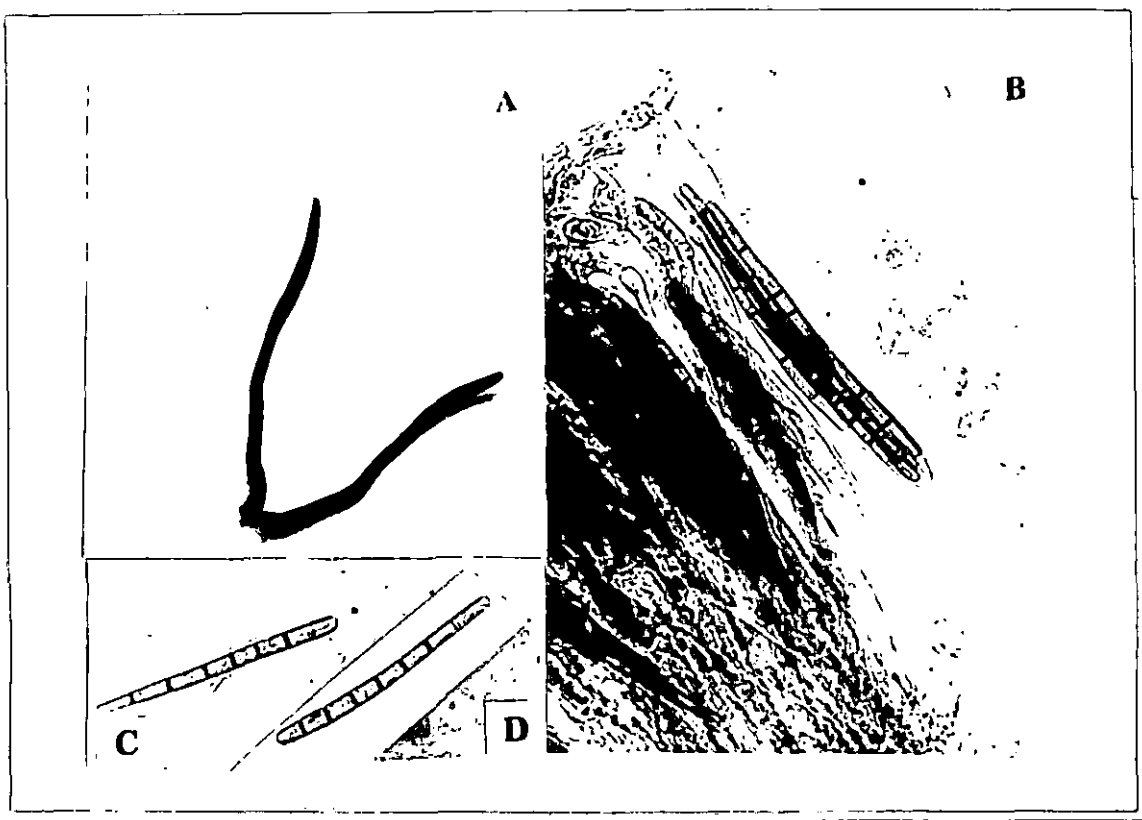

Fig. 16. Geoglossum sphagnophilum - A. Ascophore,x1; B. Vertical section of the ascocarp showing asci and paraphyses,x353; C. 6-septate ascospore,x533; D. 7-septate ascospore,x533.

(Fig . 16)

Ascophore: solitary, rarely clustured, grogarious 3.6 - 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 - 188 x 17 µ, 8-spored; ascospores fasicled, brown, slightly curved, 4 - 7 - septate, 59 - 66 x 3 µ; paraphyses numerous, slightly longer than the asci, septate, tip thickened, cells swollen giving moniliform appearance.

Habitat - On soil.

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

Specimen studied - DGC 16, July 20, 1973.

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

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

Ascophores: erect, tall, clavate to capitate, 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;

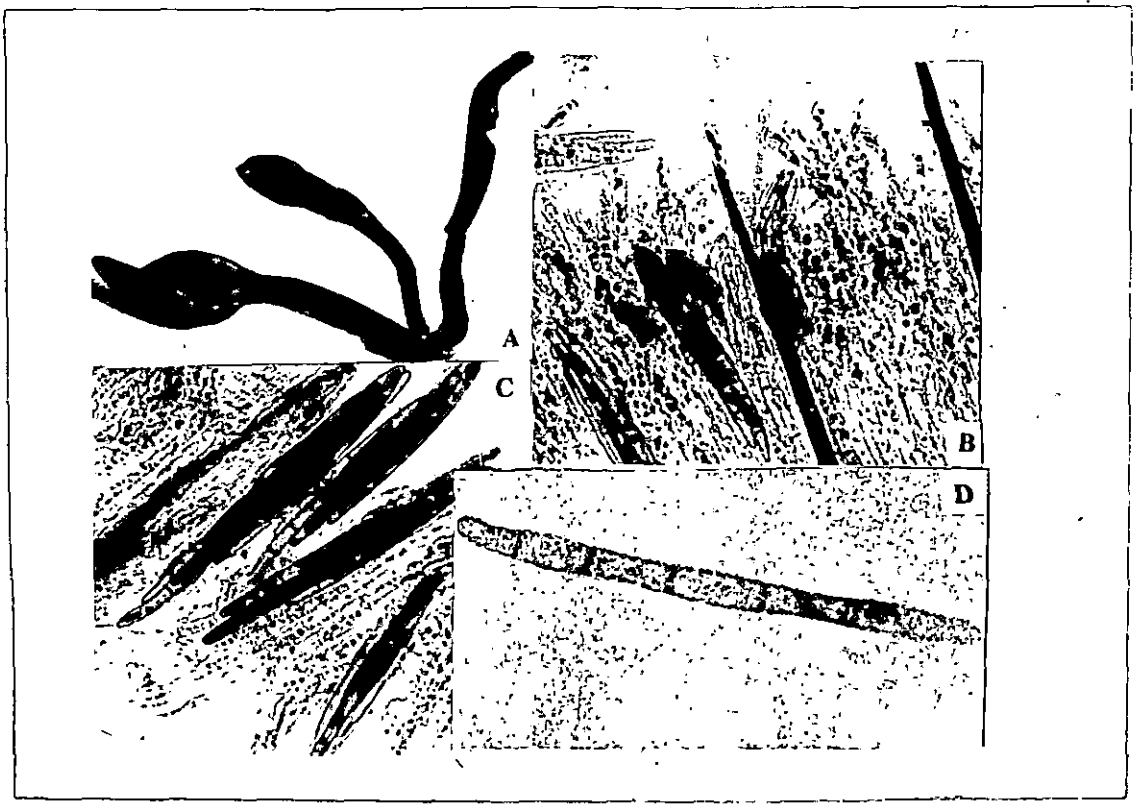

Fig. 17. Trichoglossum farlowii - A. Ascophore, x⅔;
B. Vertical section of the hymenium showing
setae, x177; C. Asci, x384; D. Ascospore (5-septate), x778.

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

Habitat - On ground.

The genus Trichoglossum, erected by Boudier (1885), 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 : 438. 1908.

Geoglossum farlowii Cooke, Grevillea 11 : 107. 1883.

Geoglossum velutipes Peck, Ann. Rep. N. Y. State Mus., 28 : 65. 1876.

(Fig. 17)

Ascophore solitary or clustured, 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 3.2 cm long, often flexuous, rarely somewhat compressed asci are many, clavate, sessile, 8-spored, 112-152 x 14-18 μ; ascospores crowded, clavate-cylindric, multiseriate in the ascus, brownish, 90 - 97 x 4 - 7 μ, 1-(5)-7 septate; paraphyses cylindric, 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 21 : 103. 1882.

Type species : Cudoniella acicularis (Bull. ex Fr.) Schroet in Cohn, Kryptog.-Fl. Schles. 3(2) : 21. 1893.

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.

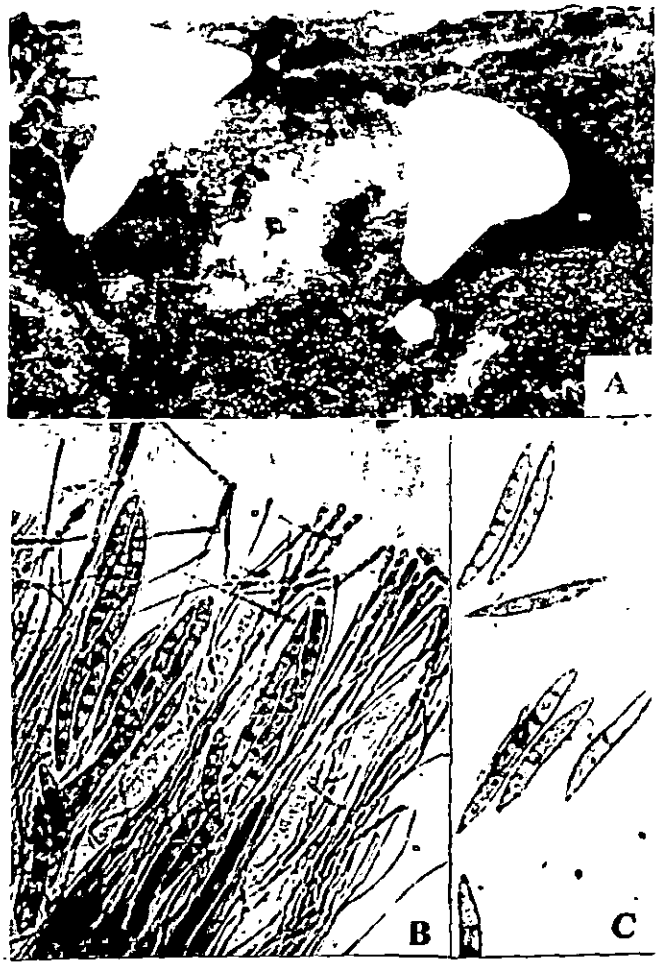

Fig. 18. Cudoniella acicularis - A. Apothecia,x8; B. Vertical section of the hymenium showing asci, ascospores and paraphyses,x680; C. Ascospores,x80(

Cudoniella acicularis (Bulliard ex Fries) Schroeter apud cohn, Krypt. Flora Schles. 3(2) : 21 (1893).

(Fig. 1 8)

Apothecia gregarious, superficial, with short, smooth, cylindrical stalks, disc convex; hymenium bright yellow, 0.3 mm - 1 cm diameter; stem 1-2 mm length, lighter colour than hymenium; asci cylindric, 178 - 188 x 10 µ, apex somewhat conical, 8-spored; ascospores biseriate, narrow with pointed ends, no appendages, 23 - 29 x 7 µ; 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.

PSEUDOPEZIZA FUCKEL? Symb. Myc. 290. 1869.

Drepanopeziza (Kolb.) Rehm. Ann. Myc. 15 : 332. 1917.

Pseudopeziza subg. Drepanopeziza Kolb. Zeitsch. Planzenker. 16 : 76. 1906.

Type species : Ascobolus trifolii Bev.-Bern.

Apothecia erumpent, usually on living leaves,

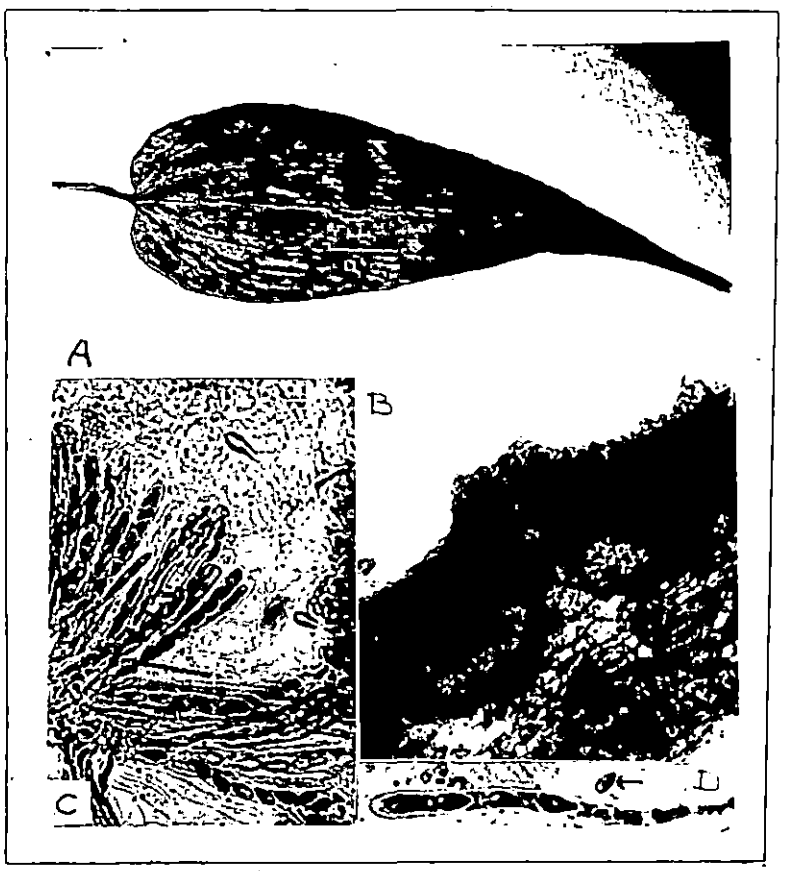

Fig. 10. Pseudopeziza rubiae - A. Leaf of Rubia cordifolia bearing apothecia,x½; B. Vertical section of the leaf through the apothecia,x147; C. Asci with ascospores,x334; D. Ascus with ascospores,x625.

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.

Pseudopezizа rubiae T.S, and K. Ramakr., 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 μ; ascospores oval, 7 - 10 x 3 μ, 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 Nitschke ap. Fuckel Symb. myc., p. 216. 1869.

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

Pseudomelasmia P. Henn., Hedwigia 41 : 115. 1902.

Discomycopsella P. Henn., Hedwigia 41 : 146. 1902.

Diplospora Clem., Gen. Fung., p. 27. 1909.

Metachora Syd. et Butl., Ann. Myc. 9 : 400. 1911.

Trabutiella Theiss. et Syd., Ann. Myc. 12 : 180. 1912.

Endophyllachora Rehm, Phil. Journ. Sci. 7 : 197. 1913.

Catacaum Theiss. et Syd., Ann. Myc. 12 : 280. 1914.

Phaeotrabutiella Theiss. et Syd., Ann. Myc. 13 : 360. 1915.

Clypeostigma V. Höhn., Sitzber. K. Akad. Wiss. Wien, math.-nat. Kl., 1. Abt. 123 : 565. 1919.

Halstedia Stevens, Bot. Gaz. 69 : 253. 1920.

Clypeotrabutia Seav. et. chard., Scient. Surv. Porto Rico virg. 1 el. 8/1, Bot. p. 60. 1926.

Endotrabutia chard., Journ. Agr. Porto Rico. 14 : 270. 1930. teste Petrak (1951).

Phaeotrabutia Gaveco, Caldasia (columbia) 1 : 77. 1941.

Tolediella Viegas, Bragantia 3 : 128. 1943, teste Petrak (1951)

Type species : Phyllachora graminis (Pers.) Fck

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 (cinfertae) 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 subsquent 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. 18.1796.

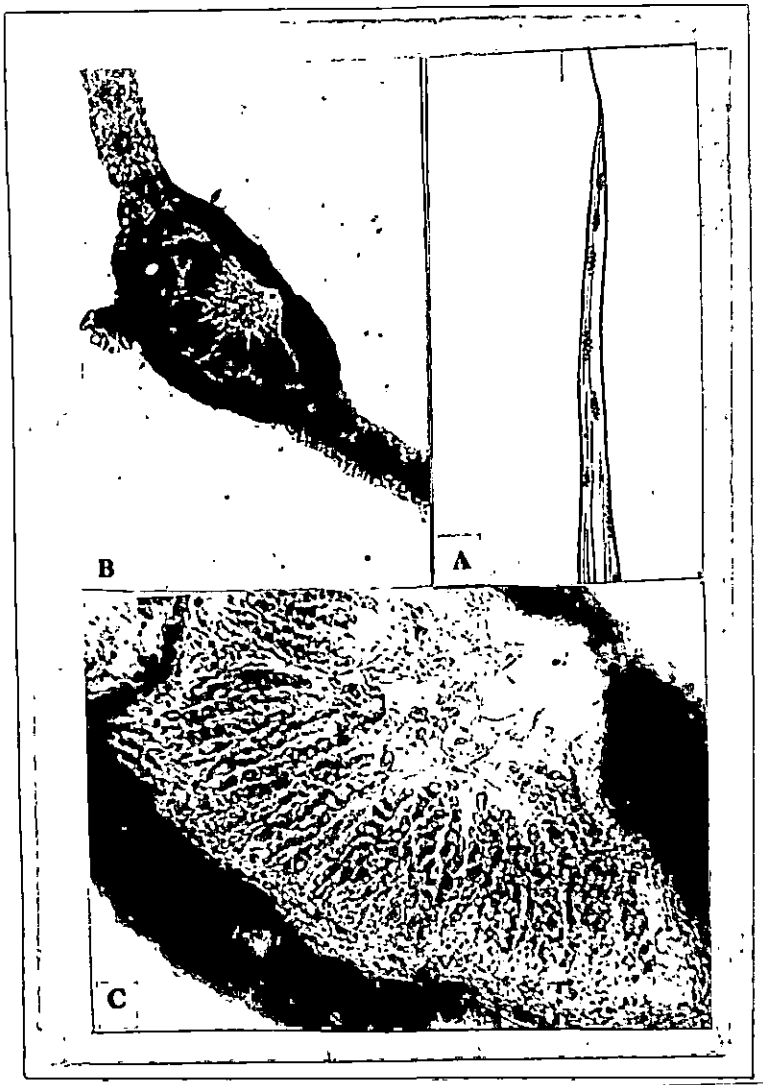

Fig. 20. Phyllachora graminis - A. Leaf showing stromata,x1; B. Vertical section of the leaf showing perithecium,x139; C. Vertical section of the perithecium showing asci and ascospores,x310.

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

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

Phyllachora bromi Fckl., Symb. myc., p. 216. 1869.

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

Phyllachora graminis fa. hystricis Rehm, Ascom., Nr. 1917.

Phyllachora agrostidis Orton, N. Y. State Mus. Bull., 243/44:92.1923.

Phyllachora molleae Dearn et House, N. Y. State Mus. Bull., 266/67. 1925.

Phyllachora cinnae 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, osteolate, deeply embedded extending upto the lower epidermis, 280 - 297 μ diameter; asci many, lining the bases and sides of the perithecia, clavate, thin-walled, 8-spored, 60 - 75 x 10 - 12 μ and intermingled with many thread-like hyaline, paraphyses;

ascospores biseriate, ellipsoid, thin-walled, hyaline 13 - 17 x 7 - 10 µ.

Habitat - On living leaves of Eragrostis nigra, 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 : 519. 1823, Proparte.

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

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

Conturea 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

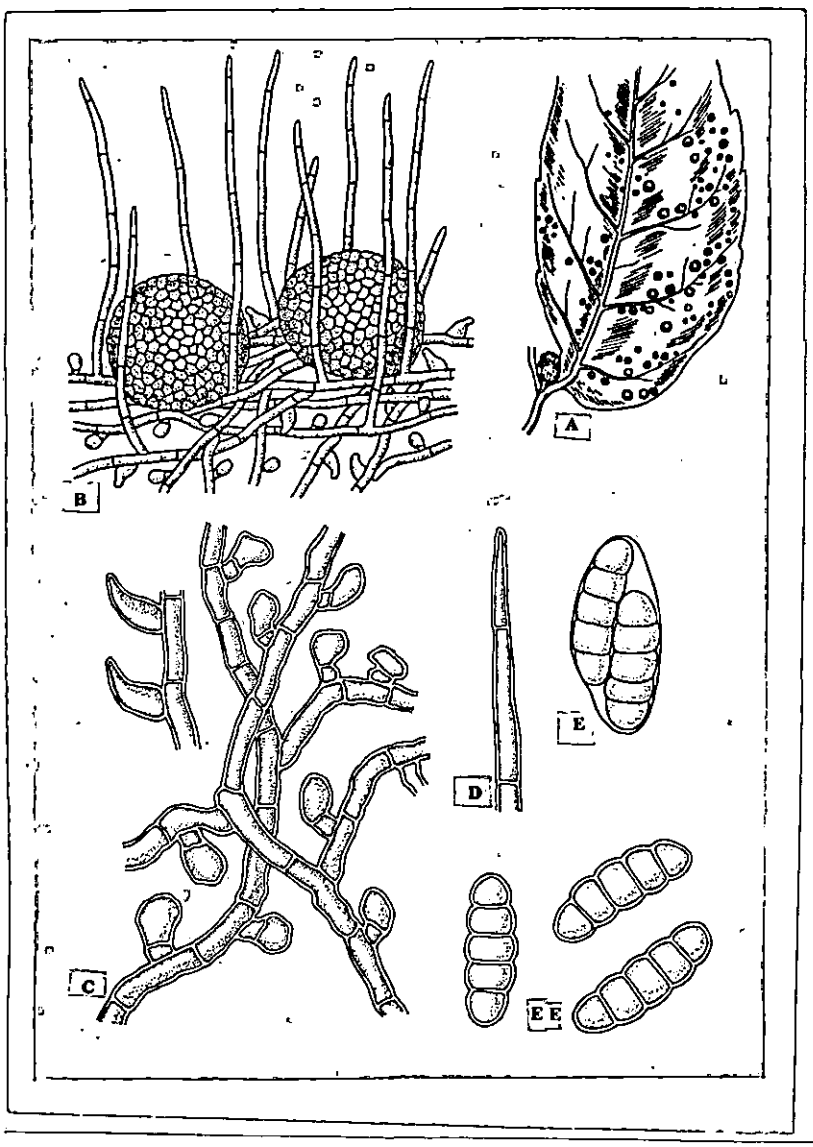

Fig. 21. Meliola thomasiana - A. Leaf showing perithecia,x½;
B. Perithecia hypopodia and mycelial setae,x100;
C. Capitate hypopodia and mucronate hypopodia,x500;
D. Mycelial setae,x500; E. Ascus with ascospores,x570;
EE. Ascospores,x570.

angle, which produces both capitate and mucronate hyphopodia; capitate hyphopodia 2-celled, alternately or oppositely arranged, straight, bent, antrorse or retrorse; mucronate 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. Hansford (1961) accepted this.

Meliola atticola Syd., Ann. Mycol. 15 : 183. 1917.

(Fig. 2)

Fungus borne on the upper surface and lower

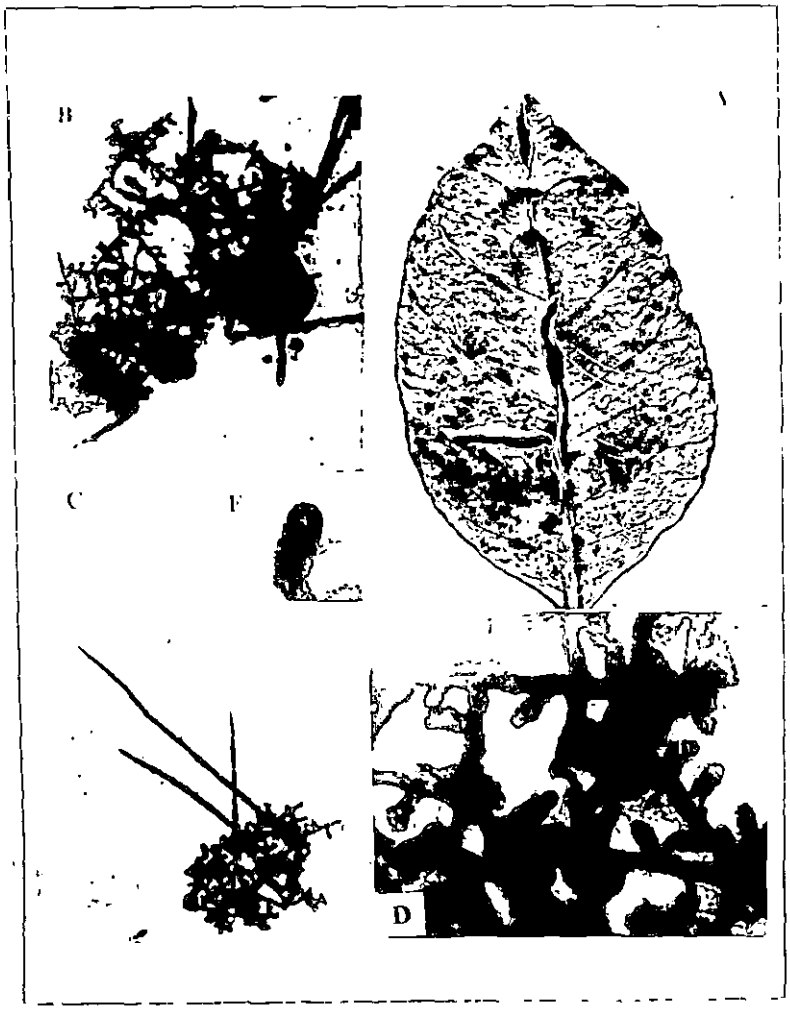

Fig. 22. Meliola citricola - A. Leaf showing perithecia,x½;
B. Perithecium hypopodia,x200; C. Mycelial seta,x300;
D. Capitate and mucronate hypopodia,x450;
E. Ascospore,x550.

surface of the leaf; spots black, scattered, round, superficial composed of brown, septate branched hyphae; the hypopodia are of two types : capitate hypopodia and mucronate hypopodia, the capitate hypopodia many, brown, straight or bent and the mucronate hypopodia rare, brown; the mycelial setae scattered, encircling the perithecia, stiff, straight 300 - 360 x 7 u; the perithecia many, black, seated in the mycelial colony, rounded, 132 - 220 µ diameter; asci sessile 46 - 52 x 20 - 26µ; ascospores 4-septate, smooth-walled, brown, 36 - 40 x 13 - 17 µ.

Habitat - On living leaves of Citrus sp.

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

Specimen studied - DGC 171, June 20, 1973.

Meliola thomasiana Sacc.-in Bull. Soc. Broteriana 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; hypopodia two types : capitate hypopodia and mucronate hypopodia; capitate hypopodia many, brown, straight or bent and mucronate hypopodia rare, brown; mycelial setae scattered, encircling the perithecia, stiff, straight, 231 - 379 x 10 - 13 µ; perithecia many, black, seated in the mycelial colony, rounded, 165 - 214 µ

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

Habitat - On living leaves of Elatostema sp.

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

Specimen studied - DCC 140, July 12, 1977.

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

Sphaeria Bot. Zur Kenntniss ... coniomycetenund cryptomyceten.

Stichospora Dietel in Englor's Bot. jb. 27 : 566,1899.

Synoecea Arthur in North Amer. Fl. 7. 661, 1924.

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

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

Fig. 23. Coleosporium blitae - A. Infected leaf, x½;
B. Mature teleutospores producing basidiospore, x900;
C. Section through a teliosorus showing laterally
united one-celled teliospores, x900.

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 strigmata.

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. Strigmata are of unequal length, bearing sporidia above the surface of sorus.

Coleosporium bletiae Diet. Hedwigia 37 : 216, 1898.

(Fig . 23)

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

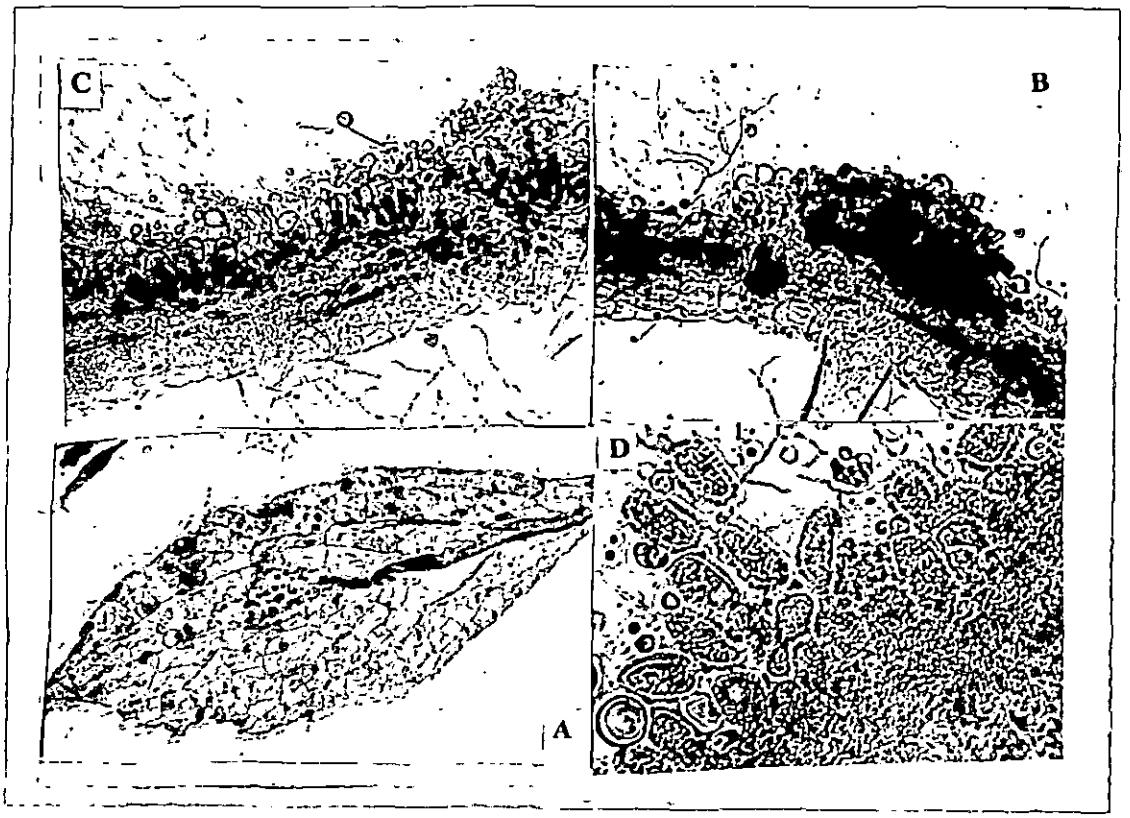

Fig. 24. Coleosporium campanulae - A. Infected leaf, x½; B. Section through a telium, x400; C. Section through a telium, x400; C. Section through a telium showing laterally united one-celled teliospores, x400; D. Section through a uredosorus showing uredospores, x500.

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 µ. uredia not found.

Habitat - On living leaves of Habenaria dansa Wall; Herminium angustifolium Benth; Satyrium nepalense Don Prodr; Anthogonium gracile Lindle.

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

Specimen studied - DGC1, DGC2, DGC3, DGC4, 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.

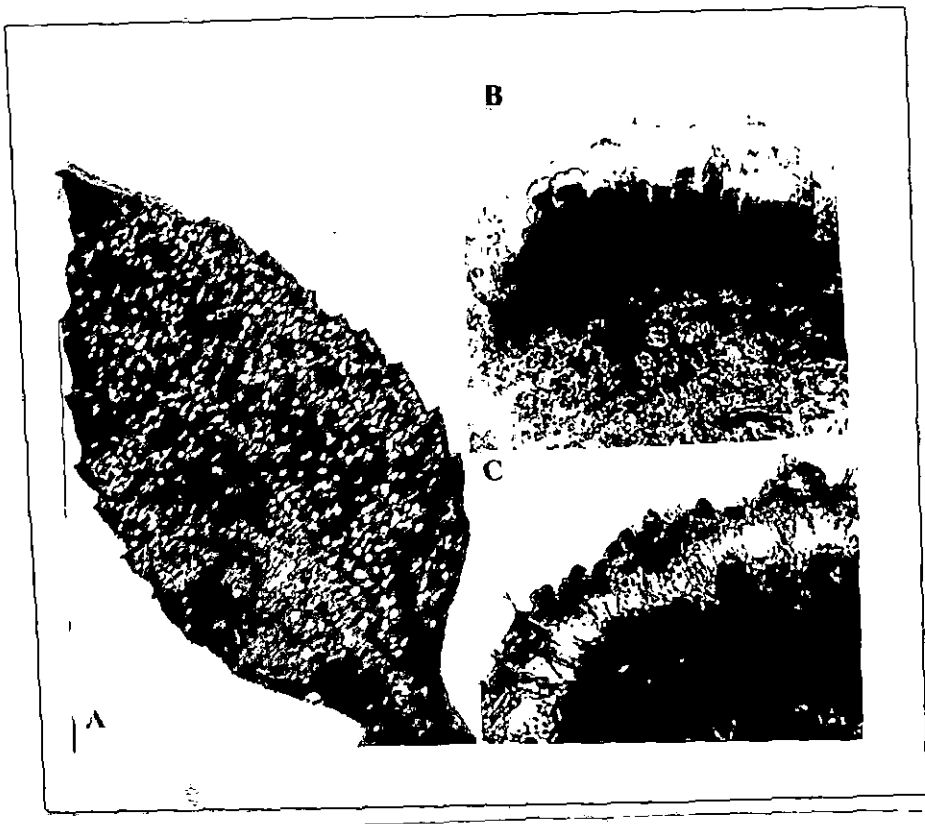

Fig. 25. Coleosporium myricacids - A. Infected leaf,x½; B. Section through a telium showing laterally united teliospores,x214; C. Mature telium showing germination of teliospores,x143.

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

Habitat - On leaves of Campanula colorata Wallich.

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

Specimen studied - DSC 123, September 15, 1976.

Coleosporium myrsinidis Syd., Ann. Mycol. 35 : 229 (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 μ.

Habitat - On living leaves of Myrsine nepalensis Less.

Fig. 26. Coleosporium plectranthi - A. Infected leaf,x½; 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 plectranthi 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 - uredospores 1-celled in chains, outer surface spiny, 15 - 26 µ diameter, hyaline; teliospores crowded laterally within the sub-epidermal layer forming a crust, promycelium internal, 1-celled, hyaline, 86 - 99 x 10 - 13 µ.

Habitat - On living leaves of Plectranthus serardianus Benth.

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

Specimen studied - DGC 85, September 25, 1974.

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

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

Physonema Lév. in Ann. Sci. nat. Bot. 3rd. Ser. VIII, p. 374, 1847.

Podocystis Fr. Summa vegot. scand. II, p. 517, 1847.

Peloscorium Lév in Ann. Sci. nat. Bot. 3rd ser. VIII p. 374, 1847.

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

Pycnia subcuticular, rarely sub-epidermal, conoid. Aecia when present with rudimentary peridium or none, without paraphyses, orange yellow; aeciospores in chains, globoid and verruculose; uredia subepidermal, pulverulent; uredospores associated with capitate paraphyses, podicellate; 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, Herculalis and others and aecia on Conifers like Larix, Tsuga, Abies and Pseudotsuga.

Pycnia 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 Melampsora. Next to telia, pycnia are very conservative to variation and offer a good basis for diagnosis. The only exceptions cited were those of Ravenelia and Melampsora. These two genera show a range of variation from subcuticular to subepidermal condition. Especially in Ravenelia the teliospores may be 1-celled (Haplora ravenelia) or 2-celled (Pleuravenelia) 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 Melampsora, 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 Melampsora farlowi (Arth.) J. J. Davis on Rosa canadensis formerly placed under a separate genus Uecium, 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, x½;
B. Section through a telium showing teliospores, x876.

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

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

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

Melampsora hyperici-orum Wint. in Rabh., Krypt. Fl. Ed. 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 µ.

Uredia not found.

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

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

Specimen studied - DGC 101, June 2, 1976.

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

Ameria Arthur, Result Sci. Congr. Bot. Vien, 1905, p. 342, 1906.

Arvema Fr. Syst. Mycol. 3 : 495. 1832.

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

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

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

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

Peloconia Sydow, Ann. Mycol.

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

Pycnia subcuticular, flat, without conspicuous ostiolar paraphyses; aecia caeoid without peridium but surrounded by incurved paraphyses; aeciospores in chains, globoid; uredia subepidermal erumpent, pulverulent and paraphysate; paraphyses cylindric and incurved; uredi/ospores 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 germpores, 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 Frommea and Phragmotelium, 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.

Frommea differs from Phragmidium in having smooth teliospores with distinct single apical germpore in each cell as against verrucose spores of Phragmidium with two to three lateral germpores in each cell.

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

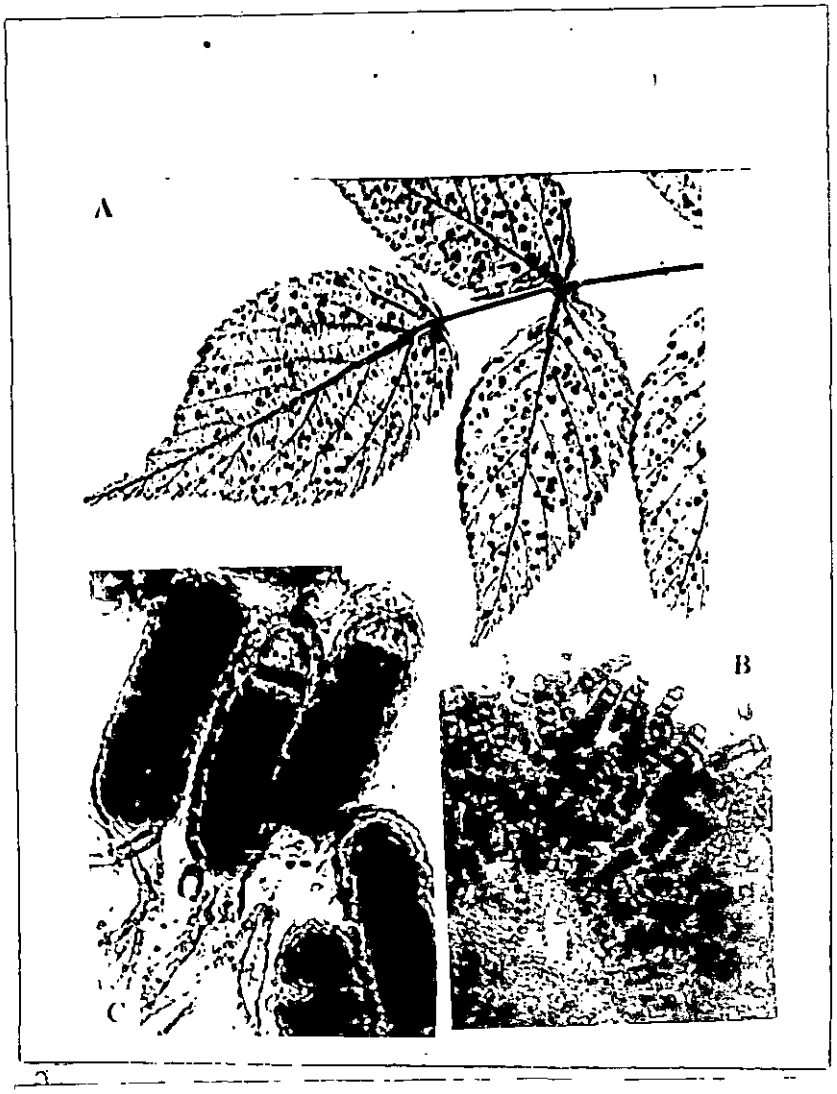

Fig. 28. Phragmidium barclayi - A. Infected leaf, x½;
B. Section through a telium showing teliospores, x134;
C. Many celled teliospores, x427.

Phragmidium barclayi Diet., Hedwigia 39 : 264(1900).

(Fig. 28)

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

Causal - organism - telia orange coloured, hypophyllous; teliosporas 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 u hygroscopic.

Uredia not found.

Habitat - On living leaves of Rubus niveus, Wall.

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

Specimen studied - DCC 172, June 12, 1978.

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

(Fig. 29)

Symptoms-Lesions distributed irregularly throughout

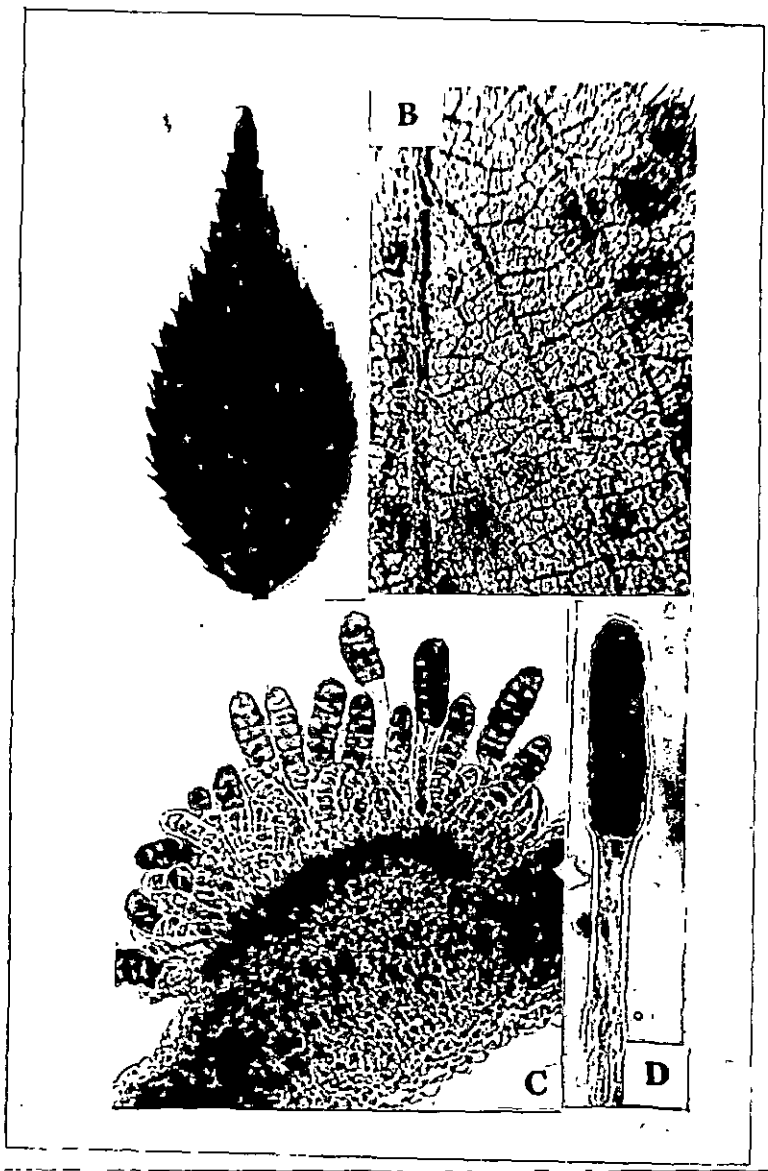

Fig. 29. Phragmidium octoloculare - A. Infected leaf, x½;
B. Portion of a leaf showing pustules, x200;
C. Section through a telium showing teliospores, x100;
D. Many-celled teliospore, x300.

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

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 μ.

Uredia not found.

Habitat - On living leaves of Rubus roseofolius Smith.

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

Specimen studied - DGC 60, June 7, 1874.

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, erumpent; teliospores pedicellate, 2-6-celled or more (phragmospores), smooth, reddish-brown, with 2 to 3 lateral germpores in each cell; pedicel hyaline, not swelling in water; spores germinating

Fig. 30. Phragmotelium mvsorense - A. Infected leaves, x½;
B. Teliospores, x300.

immediately at maturity without any resting period.

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

Phragmotelium mysorensis Thirum. & Mundk., Proc. Indian Acad. Sci. Sect. B., 15 : 101 (1942).

(Fig. 30)

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

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

Habitat - On living leaves of Rubus lasiocarpus, Sm.

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

Specimen studied - DGC 173, July 2, 1978.

PUCCINIA Persoon in (Depa Meth. Fung. p.33, 1797). Syn. Meth. Fung. p. 225, 1801).

Allodus Arth. in Result. Sci. Congr. Internal Bot. Wein, 1905. p. 345, 1906.

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

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

Entomyces Thuem. in Journ. Sci, Math. Phys. Nat. Lisbon, 6 : 239, 1876.

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

Eriosporangium Bentero ex Leville in Ann. Sci. Nat. Bot. III Ser 5 : 249, 1846.

Jackya Bubak in ost Bot. Z. 1 : 42, 1902.

Lentinia Juel 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.

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

Micropuccinia Rostrup in Plantopatologi, p. 226, 1902.

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

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

Pleomeris Syd. in Ann. Mycol. 19 : 171, 1921.

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

Pseudopuccinia Hohnel apud weese in Mitt. Bot. Lab. Tech. Hochsch. Wien, II, p. 41, 1923.

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

Rostrupia Lagerh. in J. Bot. Paris, 3 : 188, 1889.

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

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

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

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

Type species : Puccinia graminis Pers.

Pycnia subepidermal, cupulate, ostiolate, with ostiolar paraphyses. Aecia subepidermal or evanescent; aeciospores produced in chains, angularly globoid or sphorical. Uredia subepidermal, with or without paraphyses; uredospores produced singly on pedicels. Telia subepidermal, mostly replacing the urodia 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 normal2celled teliospores typical of Puccinia. Some of these teratological phenomena have been cited by Arthur et al. The genus Hostrupia 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 Diorchidium, so that the separation of the genera showing oblique separation, laterally disposed germpores and other intermediate characters, is only arbitrary.

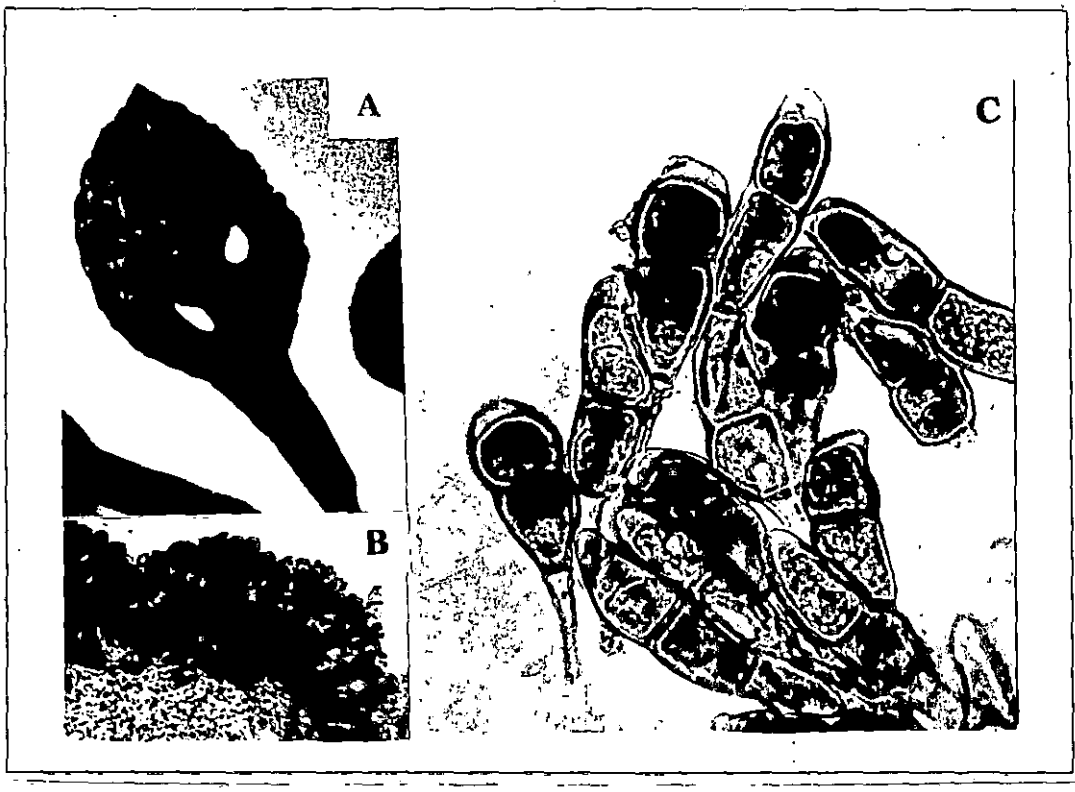

Fig. 31. Puccinia sinaliae - A. Infected leaf, x½; B. Section through a tollum, x175; C. Two-celled tellospores, x455.

The number and disposition of the gerapores separate Puccinia from Cumminsiella and Stereostratum, being two and lateral in Cumminsiella and 4 to 5 in Stereostratum. The subcuticular nature of the pycnium differentiates Sorateae 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 Hiyamia.

Puccinia ainsliaeae syd. in Sydow P. & M., Monographia Uredinearum 1 : 6 (1902).

(Fig. 31)

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

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

Uredia, pycnia and aecia not found.

Habitat - On living leaves of Ainsliaea aptera DC.

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

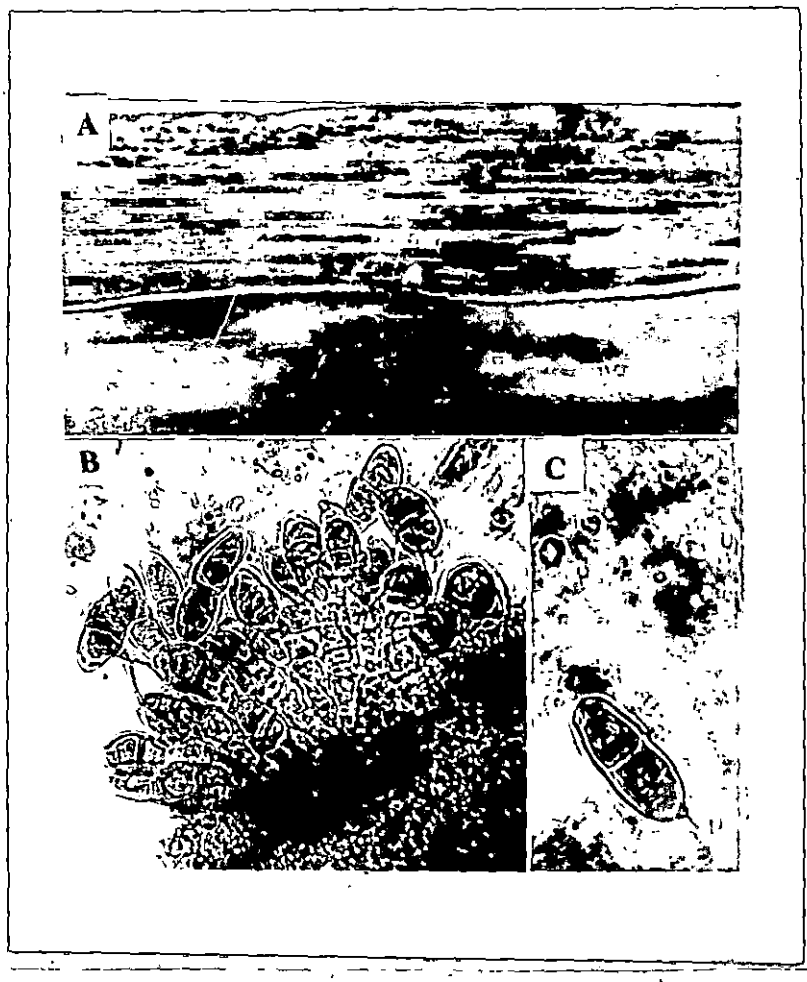

Fig. 32. Puccinia arundinariae - A. Infected leaf, x½;
B. Section through a telium showing teliospores, x457;
C. A teliospore, x571.

Specimen studied - DCC 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; pustules light brown, irregular, linear shaped, numerous, erumpent.

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

Uredia, pycnia and aecia not found.

Habitat - On living leaves of Arundinaria intermedia Muro.

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

Specimen studied - DCC 84, March 12, 1975.

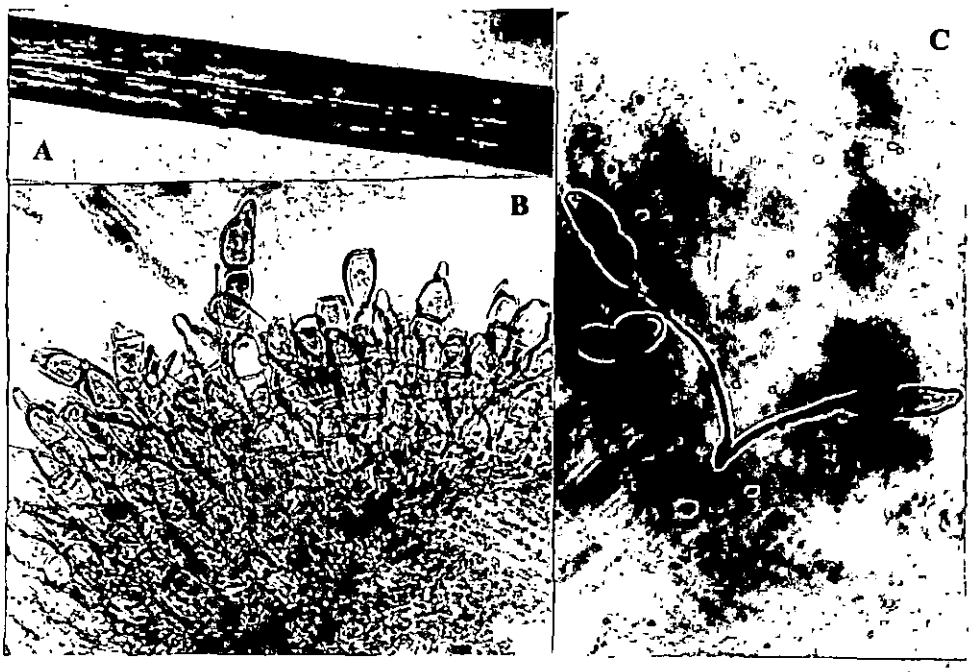

Fig. 33. Puccinia caricis - A. Infected leaf, x½;
B. Section through a telium showing teliospores, x365;
C. Teliospores, x288.

Puccinia carlois (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; pustules solitary, distinct, erumpent, 0.5 mm diameter.

Causal - organism - telia hyaline; teliospores 2-celled, thick walled, smooth, 49 - 56 x 13 - 16 μ, constricted in the middle, apical cell prolonged, pedicel short and hyaline.

Uredia, pycnia and aecia not found.

Habitat - On living leaves of Carex cruciata, Wahl.

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

Specimen studied - DGC 64, April 7, 1975.

Puccinia chlorophytae sp. nov.

(Fig. 34)

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

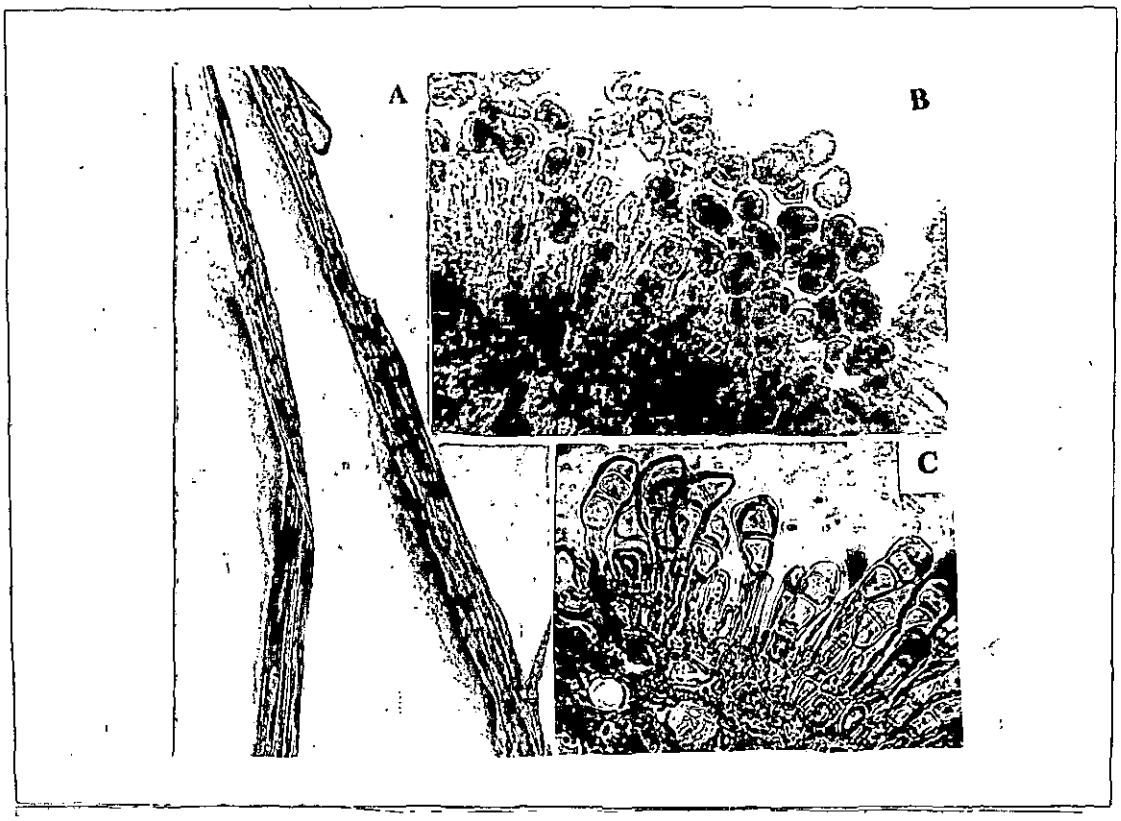

Fig. 34. Puccinia chlorophytae - A. Infected leaf, x½; B. Section through a tellum, x333; C. Section through a tellum showing teliospores, x389.

on both the surfaces of leafblade; pustules 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 - 40 x 20 - 23 µ, pedicel persistant, 33 - 49 x 7 µ.

Uredia, pycnia and aecia not found.

Etymology - From the name of the host.

Habitat - On living leaves of Chloranthus sp.

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

Type specimen studied - DGC 56 (IMI 217598), Leg. B.B. Dowan, 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. 28:(1980)

(Fig. 35)

Symptoms-Lesions distributed irregularly on

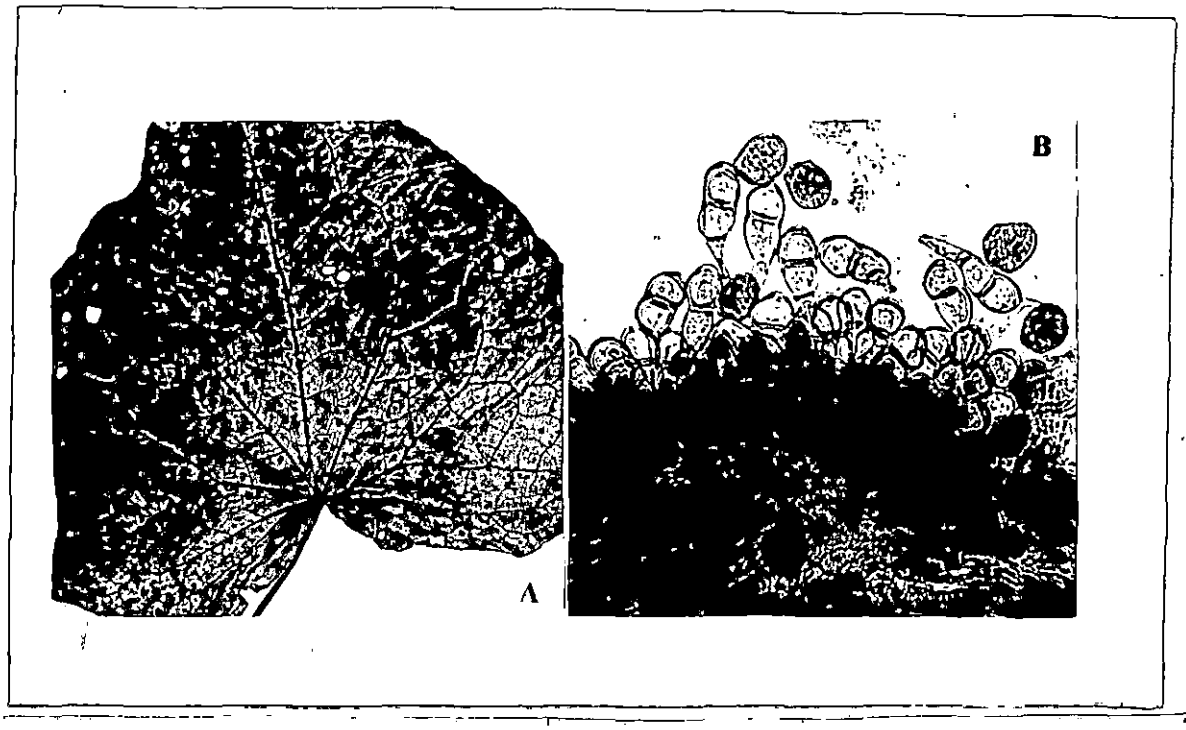

Fig. 35. Puccinia fagopyri - A. Infected leaf,x ;
B. Section through a telium showing teliospores,x268.

the under surface of the leaves; pustules minute, circular, brown, erumpent.

Causal - organism - telia dark brown, hypophyllous; teliospores dark-brown, smooth, 2-celled, top cell blunt, 26 - 36 x 13 - 16 µ.

Uredia, pycnia 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 geranii - silvatici Kraut., 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; pustules large, brown, erumpent.

Causal - organism - telia dark-brown, scattered;

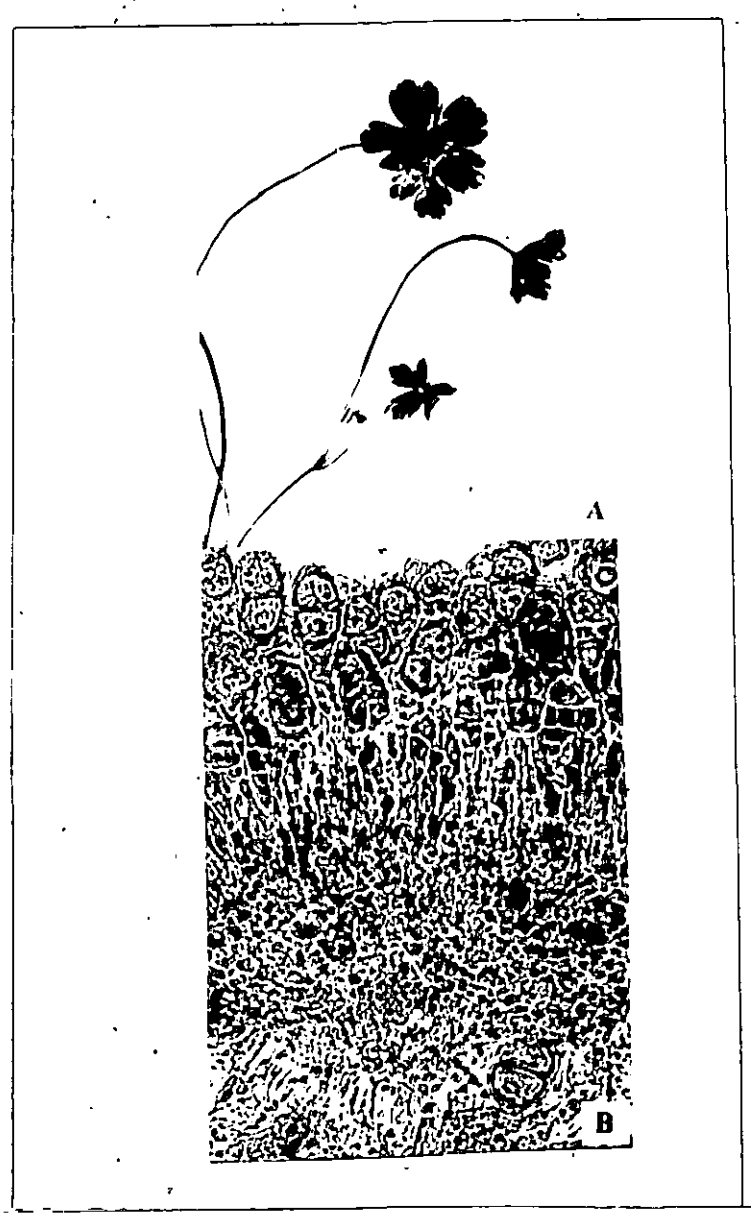

Fig. 36. Puccinia geranii-silvatici
A. Infected leaf, x½; B. Section through a telium showing teliospores, x367.

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

Uredia, pycnia and aecia not found.

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

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

Specimen studied - DGC 146, June 25, 1977.

Puccinia lauricola (Thirum.) Comb. nov. Karwalia lauricola (Thirum) Thirum., Mycologia, 41 : 97, 1049.

(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, 61 - 75 x

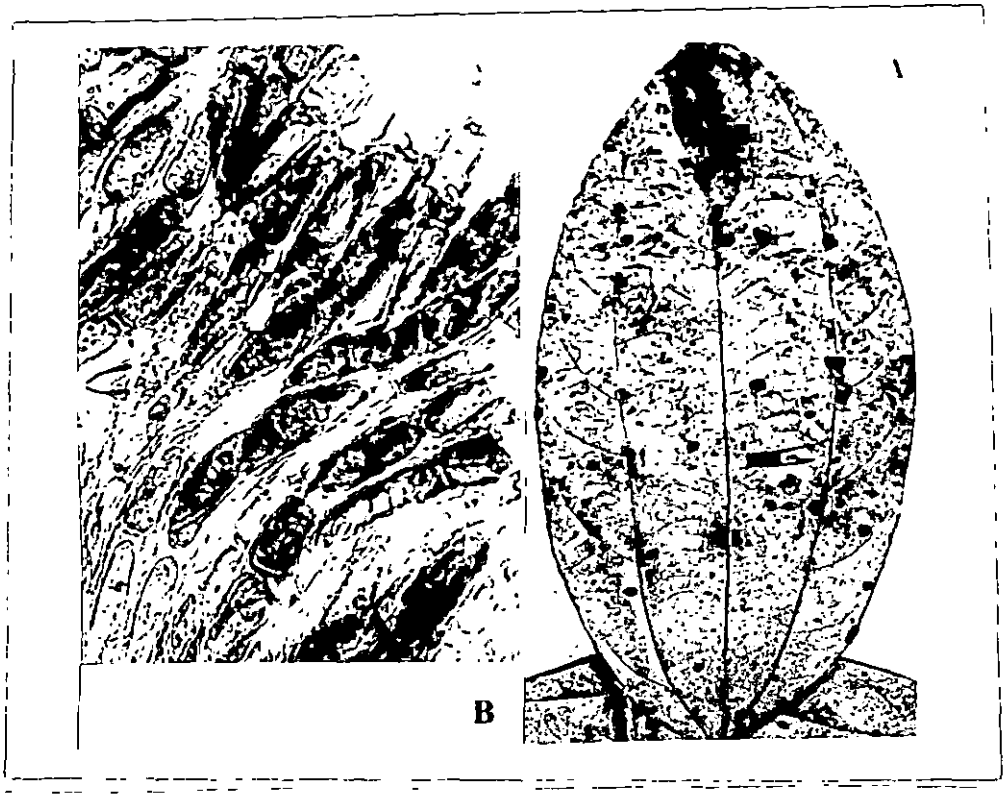

Fig. 37. Puccinia lauricola - A. Infected leaf, x½;
B. Section through a telium showing teliospores, x500.

14 - 22 μ, stalk long, slender, thin-walled, wall smooth, 2 - 3 μ thick, apex thick, pedicels hyaline upto 300 μ long.

Uredia, aecia and aecia not found.

Habitat - On living leaves of Cinnamomum caudatum, Nees.

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

Specimen studied - DGC 173, May 12, 1970.

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

(Fig. 38)

Symptoms-Lesions distributed irregularly on the under surface of the leaves; pustules 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 μ, pedicels persistent, apex conical, constricted at the septum.

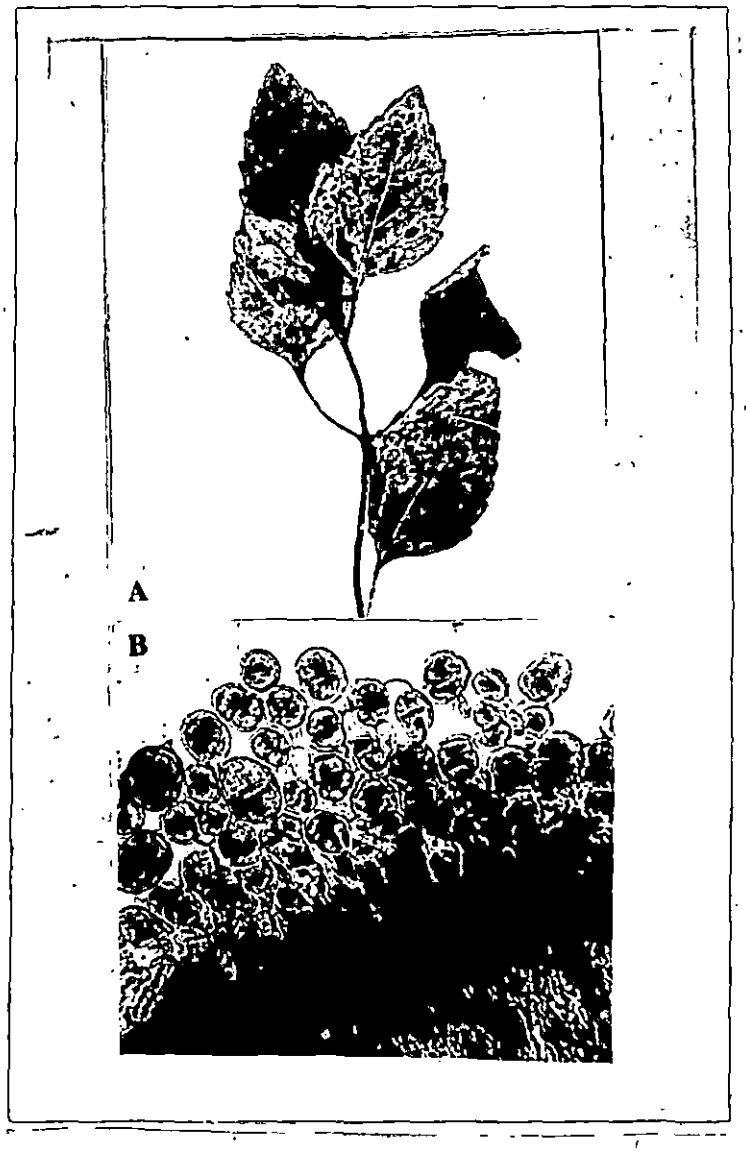

Fig. 38. Puccinia menthae - A. Infected leaves,x1;
B. Section through a telium showing teliospores,x280.

Uredia, pycnia and aecia not found.

Habitat - On living leaves of Calamintha umbrosa Benth.

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

Specimen studied - DGC 86, June 15, 1975.

Puccinia notochaetae sp. nov.

(Fig. 39)

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

Causal - organism - telia hyaline, scattered; teliospores 2-celled, smooth walled, 34 - 41 x 10 - 17 µ, 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.

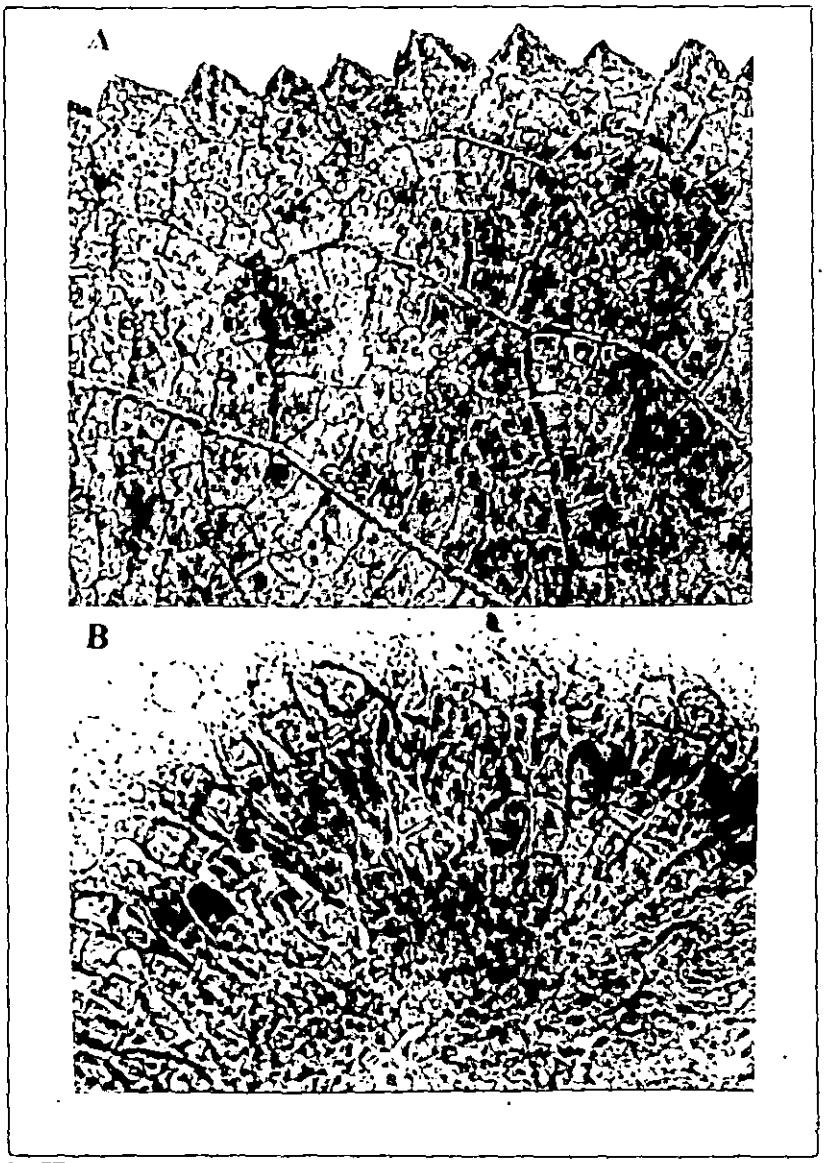

Fig. 39. Puccinia notochaete - A. A portion of the leaf showing distribution of lesions, x½; B. Section through a telium showing teliospores, x406.

Type specimen studied - DGC 181, (IMI 242415), 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 oenanthes (Diet.) Hiyabe, Journ. Sapporo Agric. Coll. 2(3) : 106 (1906).

(Fig. 40)

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

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

Uredia, pycnia and aecia not found.

Habitat - On living leaves of Oenanthe sp.

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

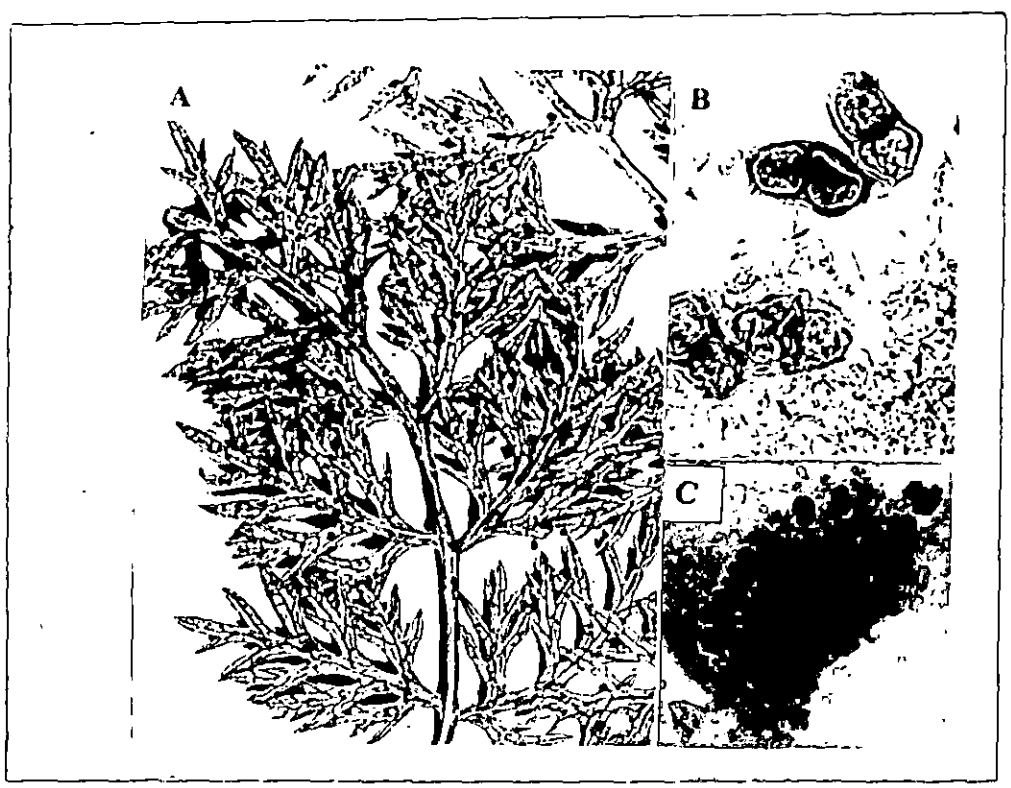

Fig. 40. Puccinia oenanthes - A. Infected leaves, x½;
B. Teliospores, x333; C. Section through a telium, x66.

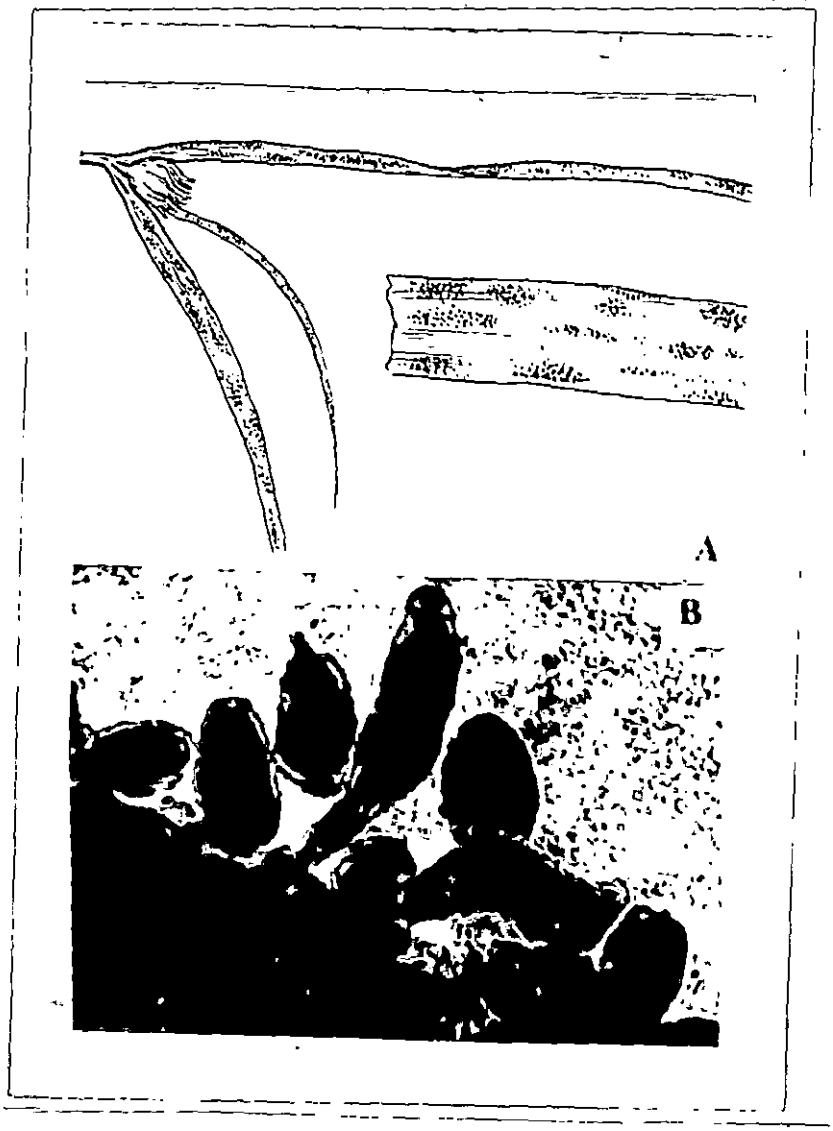

Fig. 41. Puccinia zoysiaeoliana - A. Infected leaves and a portion of a leaf showing the distribution of pustules,x1; B. Section through a mixed sorus showing uredospores and teliospores,x1177.

Specimen studied - DGC 182, August 19, 1979.

Puccinia romagnoliana Maire & Sacc., Annls. Mycol., 1 : 220, 1903.

(Fig. 41)

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

Causal - organism - uredia hypophyllous, brown; uredospores single-celled, stalked, round, echinulate, 16 - 19 µ diameter; telia like uredia; teliospores 2-celled, oblong, apex conical, smooth-walled, 26 - 36 x 16 - 20 µ; pedicel deciduous.

Pycnia and aecia 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.

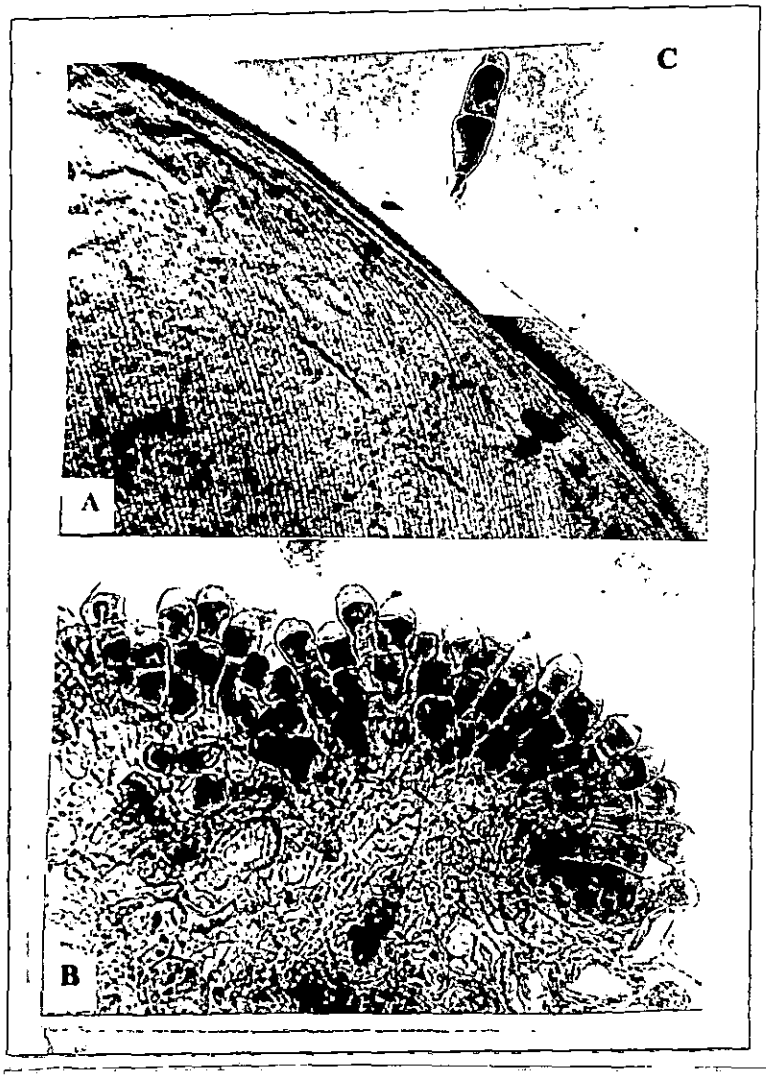

Fig. 42. Puccinia roscoeae - A. Portion of the infected leaf,x½; B. Section through a telium showing teliospores,x400; C. Teliospore,x667.

Puccinia roscoeae Barclay. Descript. List. Urod. Simla II : 237 (1889).

(Fig. 42)

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

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

Uredia, aecia and aecia not found.

Habitat - On living leaves of Ceutlova lutea Royle; Globba Hookari Clarke; Hedychium acuminatum Roscoe.

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

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

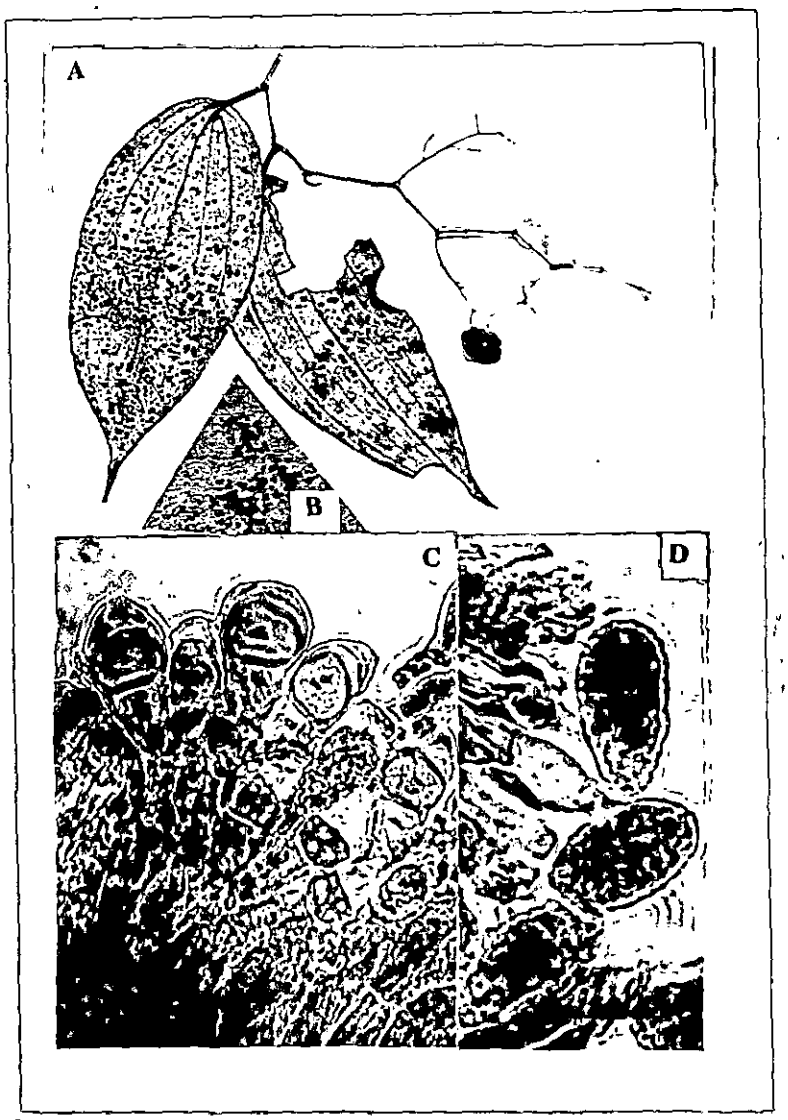

Fig. 43. Puccinia smilacinae - A. Infected leaves, x½;
B. Portion of a leaf showing pustules, x½;
C. Section through a sorus showing teliospores, x472;
D. Uredospores, x536.

Puccinia smilacina H. & P. Sydow, Annls mycol. 12 : 106 (1914).

(Fig. 43)

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

Causal - organism - uredia brown, scattered; urediospores brown, oval, echinulate, 20 - 23 μ diameter; telia hypophyllous; teliospores ellipsoidal, 2-celled, smooth, 33 - 40 x 13 - 16 μ, slightly constricted at the septum, apex pointed, pedicel hyaline.

Pycnia and aecia not found.

Habitat - On living leaves of Smilacina fusca, Wall.

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

Specimen studied - DGC 58, June 6, 1974.

UROMYCES Link in Mag. Gess. Naturf. Freunde, Berlin,
8 : p. 28, 1816.

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

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

Capitularia Raborh, Bot. St. *9* : 499, 1851.

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

Groveola Syd. Ann. Mycol. *19* : 173, 1921.

Haplotelium Syd. Ann. Mycol. *20* : 124, 1922.

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

Nielsenia Syd. Ann. Mycol. *19* : 171, 1921.

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

Ontotelium Syd. Ann. Mycol. *19* : 174, 1921.

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

Schroeteriaster Magnus, Ber. Dtsch. Bot. Ges., *13* : 334,
1893.

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

Teleutospora Arth. Bull. Torry Bot. cl. 48 : 38; 1921.

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

Uromycodes clements in Genera of Fungi. p. 98, 1909.

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

Type species : *Uromyces appendiculatus* (Pers.) Link
(Leguminoseae).

Pycnia 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 germpores; *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 germpore, 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 *Poliotelium* becomes arbitrary, species of the genera *Scopella*, *Maravalia*, *Trochodium* and other were origenally placed under *Uromyces* before their differentiating characters were understood. *Scopella Maravalia* and some other genera do not posses apical germpores, but their promycelium is the prolongation of the teliospores apex. The genus *Haplopyxis* though having one-celled *Uromyces*-like teliospores, has three layered walls and two lateral germpores like those of *Uropyxis*.

The genus Diehlamyz 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 allii-cepulae, Uromyxis amorphae and other posses exospores which swell in water upto 15 u, so that this character is of specific significance only. Thirumalachar therefore merged Diehlamyz with Uromyces.

The genus Schroeteriaster 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 Phakopsora. 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 Schroeteriaster, 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 Schroeteriaster 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

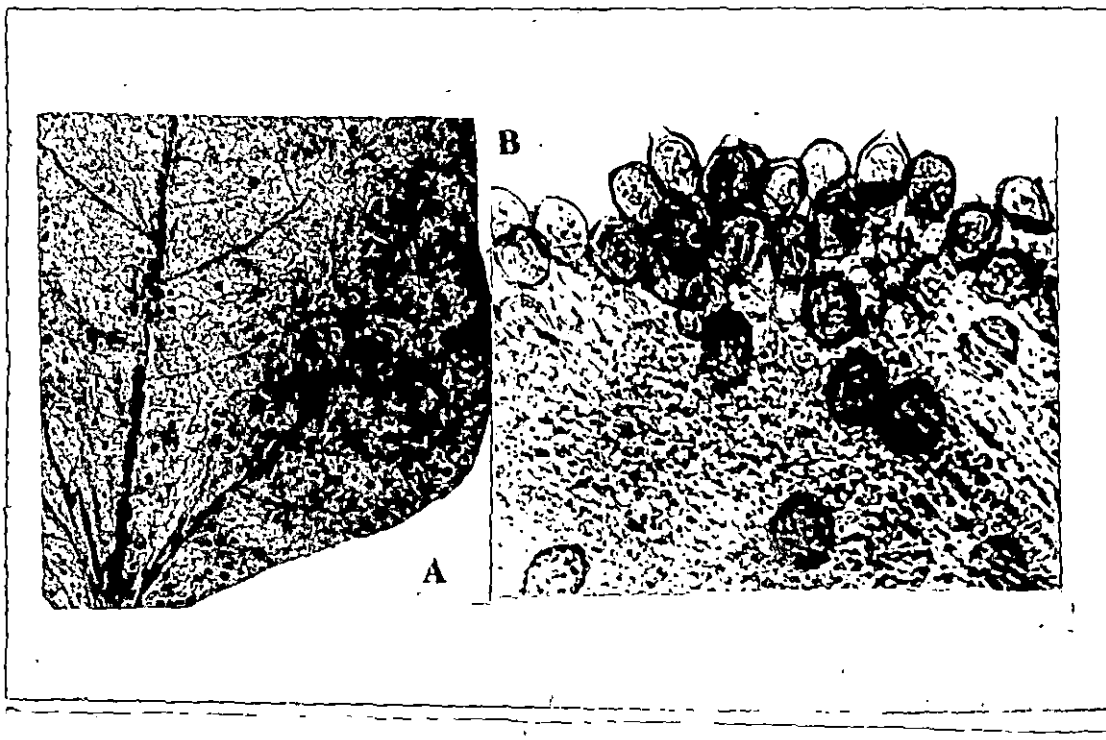

Fig. 44. Uromyces appendiculatus - A. Portion of a leaf showing infectist areas,x½; B. Section through a teliosorus showing teliospores,x285.

Melampsoraceae, the aecial stage would have occurred on Larex 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.

Casual - organism - telia amphigenous, brown, scattered; teliospores 1-celled, sub-globose, hyaline papilla at the apex, smooth-walled, chestnut brown, 26 - 30 x 20 - 23 μ, 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.

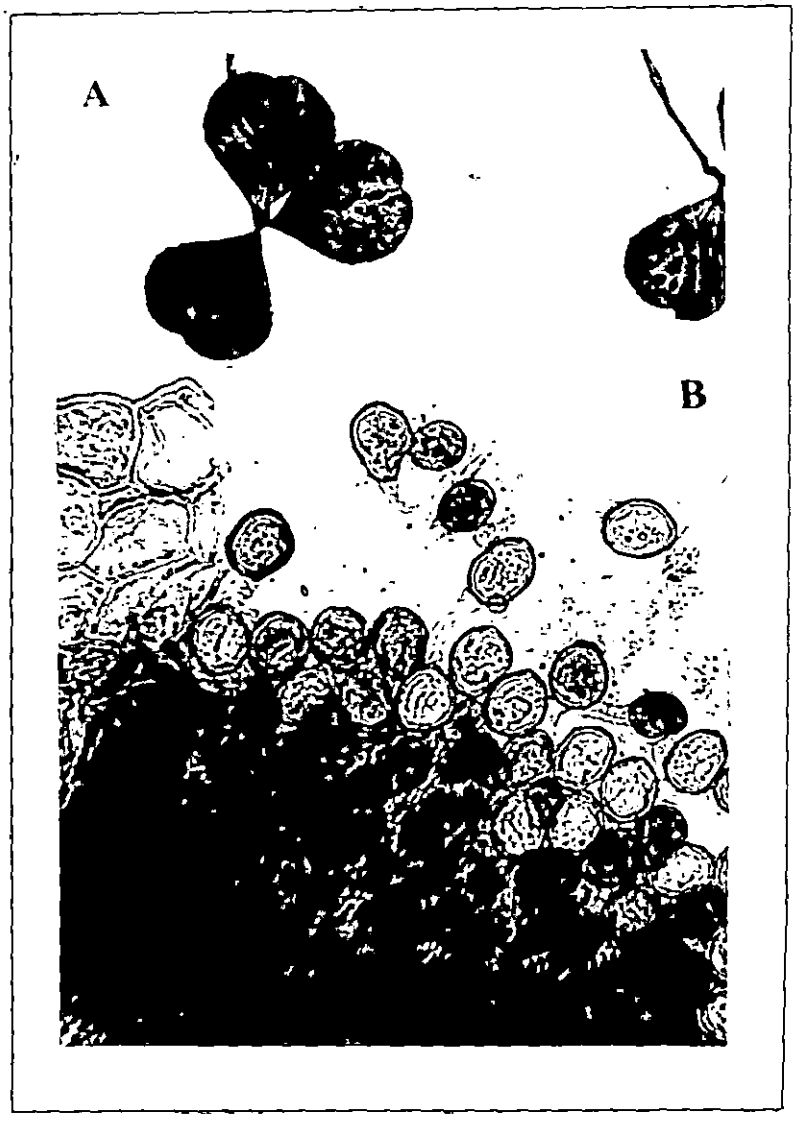

Fig. 45. Uromyces trifolii - A. Infected leaves, x½;
B. Section through a telium showing teliospores, x400.

Uromyces trifolii (R.A. Redw. ex DC.) Fuckel, Symb. Myc. : 63 (1870).

(Fig. 45)

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

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

Uredia not found.

Habitat - On living leaves of Trifolium repens L.

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

Specimen studied - DGC 75, June 14, 1975.

AECIDIUM 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. berberidis 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 Andrachne, 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 (1928) has reduced it to synonyms. There is no indication of a promycelium-like structure in the germinating spores. Aeciospores of Uromyces hobsoni 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 synonym of Aecidium.

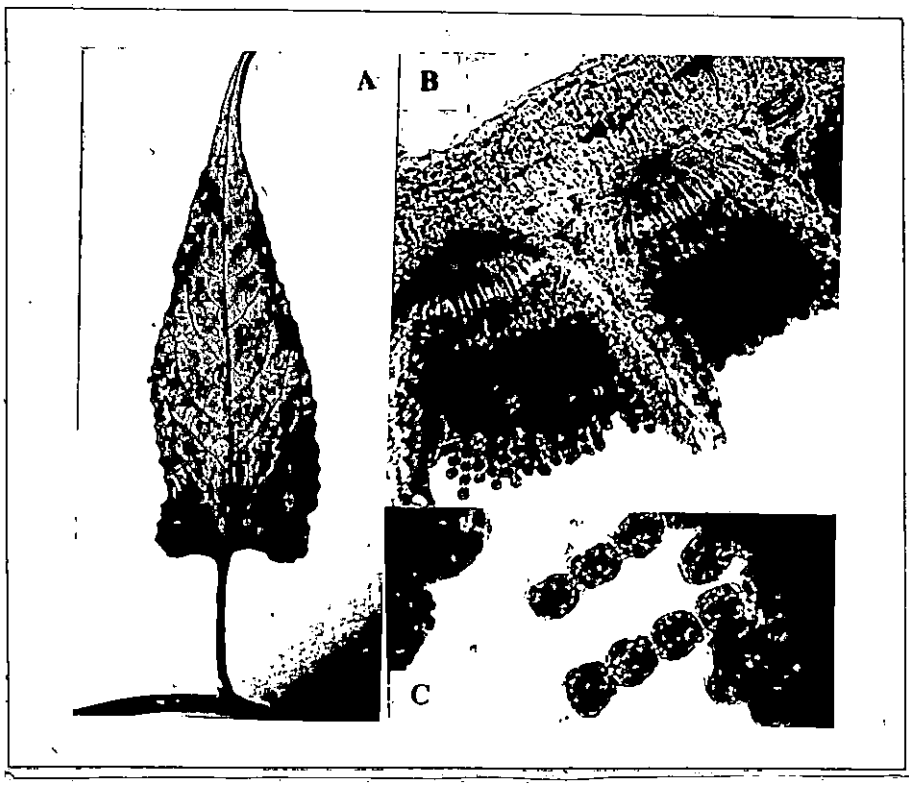

Fig. 46. Aecidium flavescens - A. Infected leaf, x½;
B. Section through aecia showing aeciospores, x133;
C. Aeciospores in chain, x400.

Aecidium flavescens Barclay, Jl. Asiatic Soc. Bengal 60(2) : 228 (1891).

(Fig. 46)

Symptoms-Lesions distributed on the under surface of the leaves. Pustules yellowish.

Causal - organism - aecium colourless, aecial cup partly within leaf tissue and partly projects above it, peridium light coloured, 231 - 297 µ diameter; aeciospores in chains, smooth, 13 - 16 µ diameter.

Habitat - On living leaves of Senecio scandens, Wall.

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

Specimen studied - DSC 144, June 12, 1977.

Aecidium violae Schum., Enum. Pl. Saell. 2 : 224(1803).

(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; pustules yellowish, irregular, 6 - 9 mm diameter.

Causal - organism - aecia embedded in the spongy

Fig. 47. Aecidium violae - A. Infected leaves, x½;
B. Section through an aecium showing aeciospores, x133;
C. Aeciospores in chain, x533.

mesophyll, break through the lower epidermis, peridium long, white cylindrical, aeciospores smooth, spherical, 13 - 16 μ diameter.

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

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

Darluca filum (Biv.) Cast., Cat. el. Marseille. Suppl. p. 58, 1851.

(Fig. 48)

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

Causal - organism - pycnidia black, spherical,

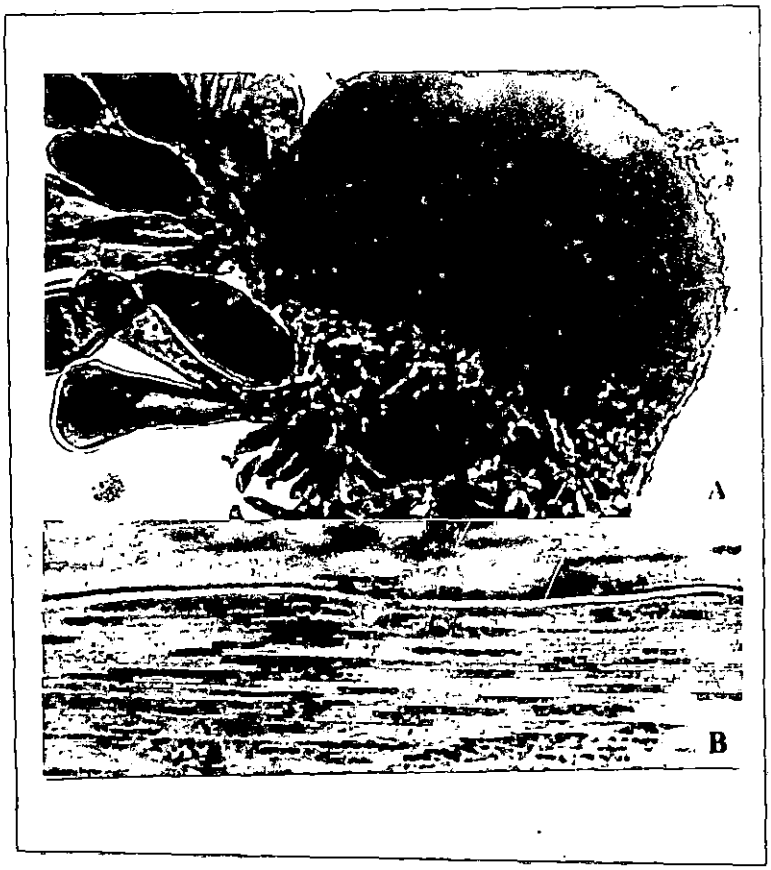

Fig. 48. Puccinia pittieriana - A. Pycnidium with uredospores, and 2-celled conidia, x742; B. Portion of an infected leaf, x½.

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

Habitat - On uredia of Puccinia arundinariae Schw. on living leaves of Arundinaria intermedia Muro.

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).

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

Colletotrichum lindemuthianum (Sacc. & Magn.) Bri. & Cav., Funghi Parmen. 50 (1889).

(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

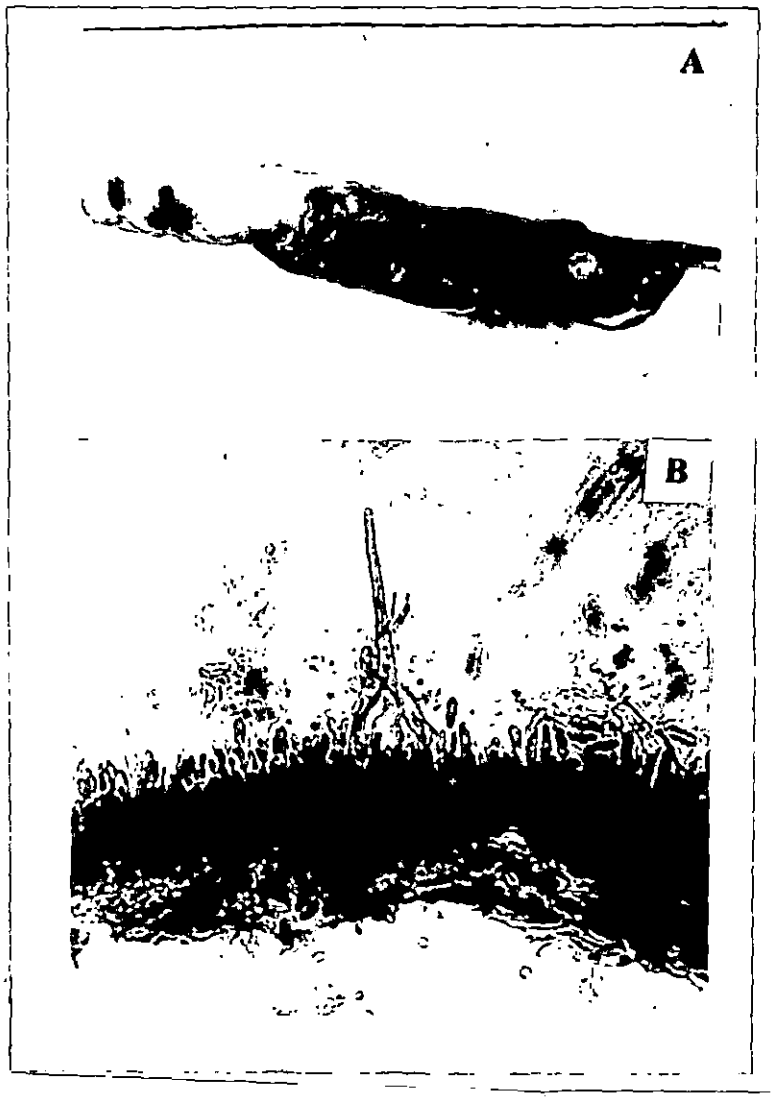

Fig. 40. Colletotrichum lindemuthianum - A. Infected pod, x1; B. Section through an acervulus showing conidia, conidiophores and seta, x300.

dries up leading to the depression of the spots.

Causal - organism - acervuli 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 u length and 3 u breadth.

Habitat - On pods of Phaseolus vulgaris Linn.

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

Specimen studied - DOC 77, June 12, 1977.

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

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

Monochaetia dennisoides (Otth.) Sacc., Syll. Fung. 18 : 485 (1906).

(Fig. 8D)

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

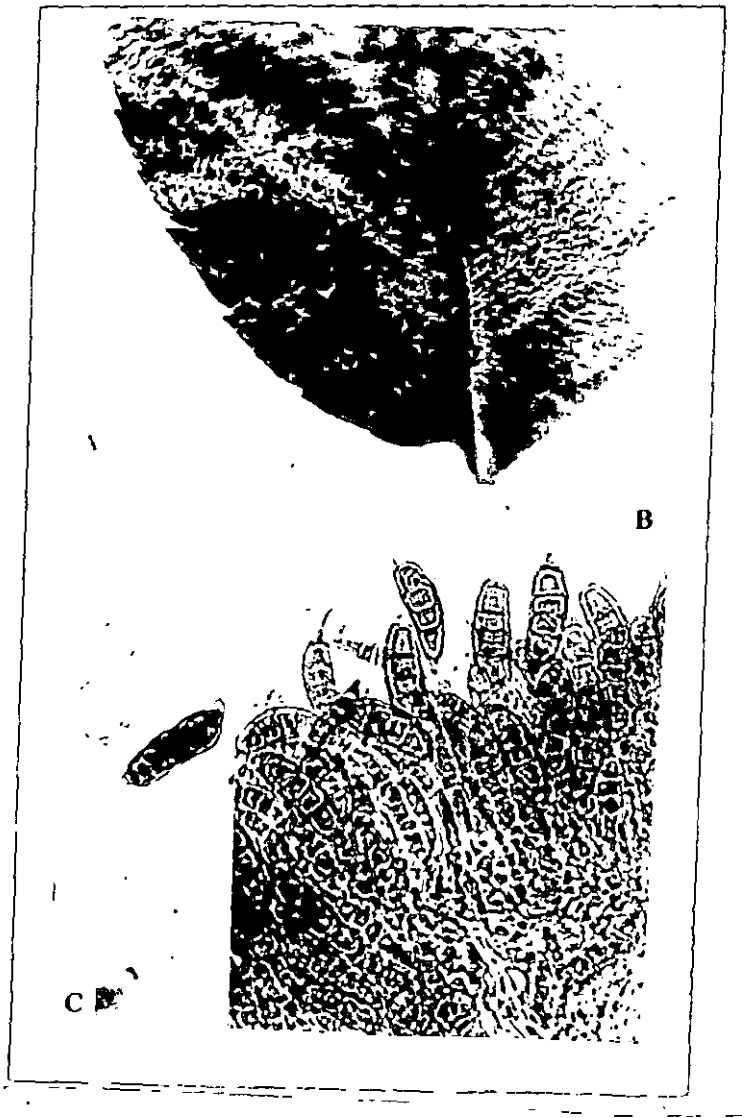

Fig. 50. Monochaetia desmazoides - A. Portion of a infected leef,x½; B. Section through a acervulus showing conidia with apical appendages,x600; C. A conidium with single apical appendage,x600.

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

Causal - organism - acervuli dark, discoid to cushion shaped, sub-cutineous, 264 - 297 μ diameter; conidiophore slender, slender, simple; conidia dark, several celled with hyaline pointed ends with a single apical appendage, 23 - 26 x 7 - 10 μ.

Habitat - On living leaves of Rosa moschata Mill.

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 : Isariopsis alba-rosella (Desm.) Saccardo.

Isariopsis indica Gopinathan Nair, Curr. Sci. 33(1): 25 (1964) in Herb as Cercospora jujubae Choudhury.

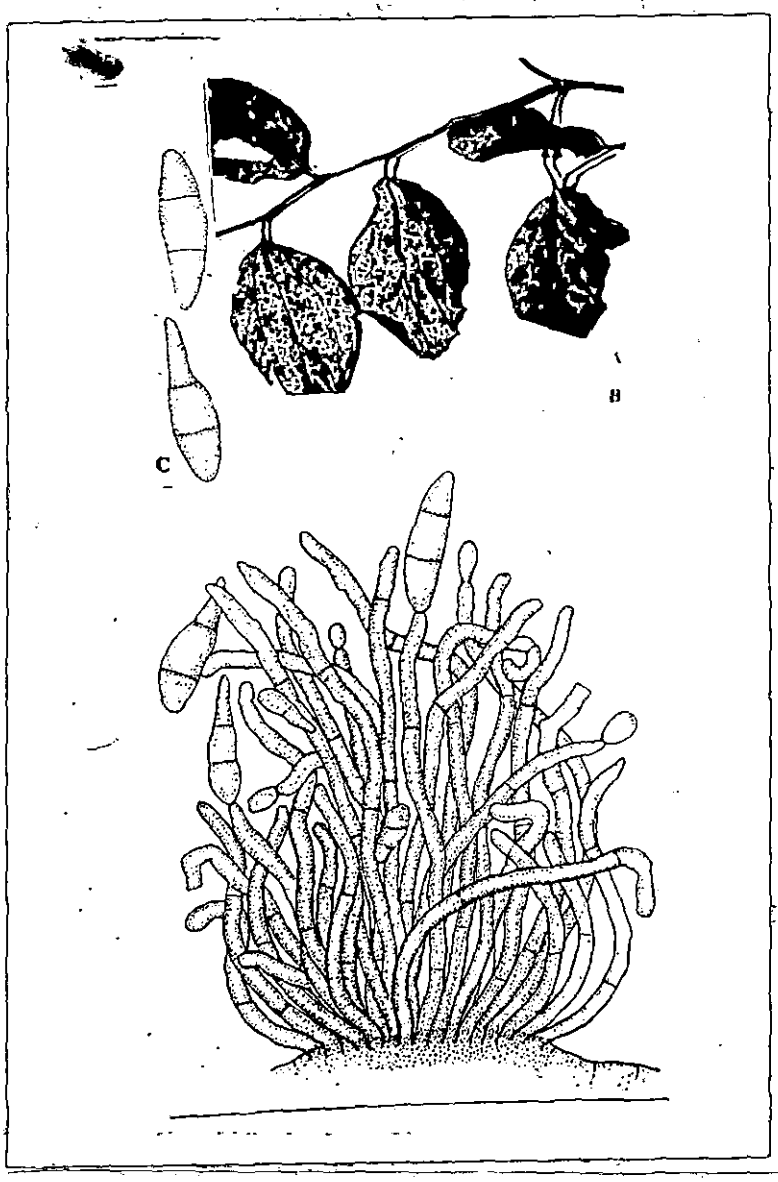

Fig. 51. Isariopsis indica - A. Infected leaf, x½;
B. Synnema with conidia, x500; C. Conidia, x580

(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 called, cylindrical to obclavate, often curved, tapering towards the tip, 26 - 36 x 7 μ.

Habitat - On living leaves of Zizyphus jujuba Lamk.

Locality - Jalpaiguri, West Bengal.

Specimen studied - DGC 90, February 12, 1976.