

EXPLORATION OF BRYOPHYTE FLORA OF SYLHET ZONE

A THESIS

**SUBMITTED TO THE DEPARTMENT OF BOTANY,
UNIVERSITY OF DHAKA, IN FULFILMENT FOR
THE DEGREE OF MASTER OF PHILOSOPHY**

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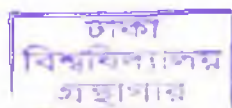
SUBMITTED BY

SHIRIN AKHTAR

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JANUARY, 2010

**HIGHER CRYPTOGAMS AND TISSUE
CULTURE LABORATORY
DEPARTMENT OF BOTANY,
UNIVERSITY OF DHAKA,
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GIFT

*Dedicated
To
My Parents*

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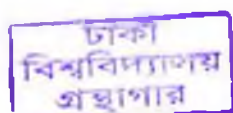
DECLARATION

I hereby declare that this thesis entitled "Exploration of Bryophyte Flora of Sylhet Zone" has been done by me and all the works presented herein my own. I further declare that this work has not been submitted anywhere for any other academic degree.

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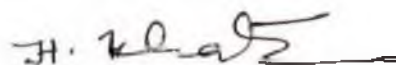
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CERTIFICATE

This is to certify that this thesis contains the result of research on "Exploration of Bryophyte Flora of Sylhet Zone" in Higher Cryptogams and Tissue Culture Laboratory and has carried out by Shirin Akhtar under my supervision. It is further certified that the work presented here is original and suitable for submission as an M. Phil. thesis.

January, 2010



(Dr. Hamida Khatun)
Associate Professor,
Department of Botany,
University of Dhaka,
Dhaka-1000,
Bangladesh.

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CONTENTS

Abstract	1
Introduction	2
Aims and objectives	5
A brief introduction to Sylhet zone	6
Literature Review	11
Materials and Methods	17
Classification	22
Synopsis of the present study	25

TAXONOMIC ENUMERATION OF BRYOPHYTIC FLORA

Key to the Classes	28
Class 1. Hepaticopsida	28
Order 1. Marchantiales	28
Key to the families of Marchantiales	29
Family 1. Ricciaceae	29
Genus 1. <i>Riccia</i>	30
Key to the species of <i>Riccia</i>	30
1. <i>Riccia bengalensis</i>	30
2. <i>R. discolor</i>	34
3. <i>R. sullivantii</i>	37
4. <i>R. gangetica</i>	40
5. <i>R. billardieri</i>	43
6. <i>R. bogransis</i>	47
7. <i>R. lithophilii</i>	50

Family 1. Targioniaceae	53
Genus 1. Cyathodium	53
1. <i>Cyathodium tuberosum</i>	53
Family 1. Marchantiaceae	57
Genus 1. <i>Marchantia</i>	57
Key to the species of <i>Marchantia</i>	57
1. <i>Marchantia palmata</i>	57
2. <i>M. nepalensis</i>	63
Class 2. Anthoceropsida	68
Order 1. Anthocerotales	68
Family 1. Anthocerotaceae	68
Key to the genera of Anthocerotaceae	68
Genus 1. Anthoceros	69
1. <i>Anthoceros laevis</i>	69
Genus 2. Notothylas	72
1. <i>Notothylas indica</i>	72
Class 3. Bryopsida	75
Key to Orders of Bryopsida	75
Order 1. Dicranales	76
Family 1. Lecobryaceae	76
Genus 1. <i>Octoblepharum</i>	76
1. <i>Octoblepharum albidum</i>	76
Order 2. Fissidentales	82
Family 1. Fissidentaceae	82
Genus 1. <i>Fissidens</i>	82

Key to the species of <i>Fissidens</i>	83
1. <i>Fissidens splachnobryoides</i>	84
2. <i>F. xiphioides</i>	88
3. <i>F. zollingeri</i>	92
4. <i>F. virens</i>	95
5. <i>F. semperfalcatus</i>	98
6. <i>F. nobilis</i>	101
7. <i>F. orishae</i>	104
8. <i>F. ganguleei</i>	107
9. <i>F. javanicus</i>	110
10. <i>F. diversifolius</i> var. <i>rubricaulis</i>	113
11. <i>F. laxitextus</i>	116
12. <i>F. latus</i>	119
Order 3. Syrrhopodontales	122
Family 1. Calymperaceae	122
Genus 1. <i>Calymperes</i>	122
Key to the species of <i>Calymperes</i>	123
1. <i>Calymperes tenerum</i>	123
2. <i>C. noakhalensis</i>	127
Order 4. Pottiales	132
Family 1. Pottiaceae	132
Key to the genera of Pottiaceae	132
Genus 1. <i>Hyophila</i>	133
Key to the species <i>Hyophila</i>	133
1. <i>Hyophila comosa</i>	133
2. <i>H. involuta</i>	137

Genus 2. <i>Semibarbula</i>	141
Key to the species of <i>Semibarbula</i>	141
1. <i>Semibarbula ranuui</i>	142
2. <i>Semibarbula orientalis</i>	145
Order 5. Funariales	149
Family 1. Funariaceae	149
Genus 1. <i>Physcomitrium</i>	149
1. <i>Physcomitrium pulchellum</i>	150
Order 6. Eubryales	155
Key to the families of Eubryales	155
Family 1. Bryaceae	155
Key to the genera of Bryaceae	156
Genus 1. <i>Pohlia</i>	156
1. <i>Pohlia ampullacea</i>	156
Genus 2. <i>Bryum</i>	160
Key to the species of <i>Bryum</i>	160
1. <i>Bryum coronatum</i>	161
2. <i>B. cellulare</i>	164
3. <i>B. apiculatum</i>	167
Family 2. Bartramiaceae	170
Genus 1. <i>Philonotis</i>	170
1. <i>Philonotis hastata</i>	170
ORDER 7. ISOBRYALES	174
Key to the families of Isobryales	174
Family 1. Erpodiaceae	174

Genus 1. <i>Erpodium</i>	174
1. <i>Erpodium mangiferae</i>	175
Family 2. Neckeraceae	179
Genus 1. <i>Homaliodendron</i>	179
Key to the species of <i>Homaliodendron</i>	179
1. <i>Homaliodendron exiguum</i>	180
2. <i>H. flabellatum</i>	183
Order 8. Hypnobryales	188
Key to the families of Hypnobryales	188
Family 1. Brachytheciaceae	189
Genus 1. <i>Brachythecium</i>	189
1. <i>Brachythecium acuminatum</i>	189
Family 2. Hylocomiaceae	193
Genus 1. <i>Macrothamniella</i>	193
1. <i>Macrothamniella pilosula</i>	193
Family 3. Entodontaceae	197
Genus 1. <i>Erythrodontium</i>	197
1. <i>Erythrodontium julaceum</i>	197
Family 4. Plaglotheciaceae	201
Genus 1. <i>Stereophyllum</i>	201
1. <i>Stereophyllum anceps</i>	201
Family 5. Amblystegiaceae	206
Genus 1. <i>Campylium</i>	206
Key to the species of <i>Campylium</i>	206
1. <i>Campylium gollanii</i>	206
2. <i>C. stellatum</i>	212

Family 6. Sematophyllaceae	215
Key to the genera of Sematophyllaceae	215
Genus 1. Glossadelphus	215
1. <i>Glossadelphus zollingeri</i>	215
Genus 2. Aptychella	219
1. <i>Aptychella borii</i>	219
Family 7. Hypnaceae	223
Key to the genera of Hypnaceae	223
Genus 1. Vesicularia	224
1. <i>Vesicularia dubyana</i>	224
Genus 2. Ectropothecium	230
Key to the species of Ectropothecium	230
1. <i>Ectropothecium buitenzorgii</i>	230
2. <i>E. rostellatum</i>	234
Genus 3. Isopterigium	237
1. <i>Isopterigium pallidulum</i>	237
Results and discussion	241
References	241

LIST OF PLATES AND MAP

A. PLATES

PLATE NO.	TAXON	Page
1.	<i>Riccia bengalensis</i>	33
2.	<i>R. discolor</i>	36
3.	<i>R. sullivantii</i>	39
4.	<i>R. gangetica</i>	42
5.	<i>R. billardieri</i>	46
6.	<i>R. bogransis</i>	49
7.	<i>R. lithophilii</i>	52
8.	<i>Cyathodium tuberosum</i>	56
9.	<i>Marchantia palmata</i>	60,62
10.	<i>M. nepalensis</i>	65,67
11.	<i>Anthoceros laevis</i>	71
12.	<i>Notothylas indica</i>	74
13.	<i>Octoblepharum albidum</i>	79,81
14.	<i>Fissidens splachnobryoides</i>	87
15.	<i>F. xiphioides</i>	91
16.	<i>F. zollingeri</i>	94
17.	<i>F. virens</i>	97
18.	<i>F. semperfalcatus</i>	100
19.	<i>F. nobilis</i>	103

20.	<i>F. orishae</i>	106
21.	<i>F. ganguleei</i>	109
22.	<i>F. javanicus</i>	112
23.	<i>F. diversifolius</i> var. <i>rubricaulis</i>	115
24.	<i>F. laxitextus</i>	118
25.	<i>F. laxis</i>	121
26.	<i>Calymperes tenerum</i>	126
27.	<i>C. noakhalensis</i>	129,131
28.	<i>Hyophila comosa</i>	136
29.	<i>H. involuta</i>	140
30.	<i>Semibarbula ranuii</i>	144
31.	<i>Semibarbula orientalis</i>	148
32.	<i>Physcomitrium pulchellum</i>	152,154
33.	<i>Pohlia ampullacea</i>	159
34.	<i>Bryum coronatum</i>	163
35.	<i>B. cellulare</i>	166
36.	<i>B. apiculatum</i>	169
37.	<i>Philonotis hastata</i>	173
38.	<i>Erpodium mangiferae</i>	178
39.	<i>Homaliodendron exiguum</i>	182
40.	<i>H. flabellatum</i>	185,187
41.	<i>Brachythecium acuminatum</i>	192
42.	<i>Macrothamniella pilosula</i>	196

43.	<i>Erythrodontium julaceum</i>	200
44.	<i>Stereophyllum anceps</i>	205
45.	<i>Campylium gollanii</i>	209,211
46.	<i>C. stellatum</i>	214
47.	<i>Glossadelphus zollingeri</i>	218
48.	<i>Aptychella borii</i>	221
49.	<i>Vesicularia dubyana</i>	227,229
50.	<i>Ectropothecium buitenzorgii</i>	233
51.	<i>E. rostellatum</i>	236
52.	<i>Isopterigium pallidulum</i>	240

B. MAP

1. Map of Sylhet zone	10
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ABSTRACT

For the present study a total of 700 specimens have been collected from different habitats of 4 administrative districts of Sylhet zone. Out of these collected specimens 52 species have been identified, described and classified under 3 classes, namely Hepaticopsida, Anthoceropsida and Bryopsida. In Hepaticopsida 9 species have been described under 3 families: Ricciaceae, Targioniaceae and Marchantiaceae of the order Marchantiales. *Antheceros leavis* of the genus *Anthoceros* and *Nothothylas indica* of *Nothothylas* have been described under the family Anthocerotaceae of the order Anthocerotales of the class Anthoceropsida. A total of 42 species have been described under 21 genera covering 16 families: Leucobryaceae, Fissidentaceae, Calymperaceae, Pottiaceae, Funariaceae, Bryaceae, Bartramiaceae, Erpodiaceae, Neckeraceae, Amblystegiaceae, Brachytheciaceae, Entodontaceae, Plagiotheciaceae, Sematophyllaceae, Hylocomiaceae and Hypnaceae including 8 orders: Dicranales, Fissidentales, Syrrhopodontales, Pottiales, Funariales, Eubryales, Isobryales, and Hypnobryales of the class Bryopsida. It is observed that genera *Riccia* of the class Hepaticopsida, *Fissidens*, *Semibarbula* and *Hyophila* of the class Bryopsida are common and widely spread in Sylhet zone. Camera lucida drawing of all these species has been done. All necessary information and identification key of families and species have been documented.

INTRODUCTION

The largest delta in the world, Bangladesh is rich in Bryophyte flora because the country is suitable for growth and proliferation of this group of plants round the year except for two or three months during the dry winter seasons.

The bryophytes grow best in moist and shady places. These conditions are readily available in my study area. Although extensive study has not been done of occurrence of bryophytes, it can be fairly assumed that my study area, Sylhet zone is quite rich in bryophyte flora. Sylhet zone consisting of 12595 sq. km is bounded on the north by the Khasia and Jainta hills for a short distance and by a Surma river on the east by the Indian district of Cachar, on the south by Hill Tripura state of both India and the districts of Comilla and Mymensingh of Bangladesh. The climate of Sylhet zone is specially rich in Bryophyte because of its extreme humidity. Maulvi Bazar and Habiganj district are inundated by high rise of water level during rainy season in the Manu and the Khowai rivers engulfing the areas of Barlekha, Kulaura, Rajnagar, Chunarughat, Shaistaganj. This inundation may have influenced the growth and development of Bryophyte flora in Sylhet zone.

Extensive survey work has not been on extent of occurrence of bryophytes of Bangladesh. Bruhl and Sarkar (1929) for the first time described the Moss flora of the then Bengal and also reported a new species, *Calymperes noakhaliensis* Bruhl et Sarkar.. They collected this new species from the stem of the palm trees from Noakhali district. Work on Hepaticae was done by Khan (1955). He reported 8 species of *Riccia*, among them *Riccia perssonii* Khan was new to science. Work on Mosses of eastern India and its adjacent regions was done by Gungulee during 1957 to 1980, he published a series of reports from the eastern region of the subcontinent, but these contained little information about the Moss flora of Bangladesh. Tixier (1967) made a checklist of 47 taxa and most of them were Acrocarpous mosses. He also described a new species

Syrrhopodon chittagongense Tixier which was collected from Chittagong. Monographs published by Gungulee (1969, 1971) on the base of mosses collection of Sylhet and Noakhali districts. Hadiuzzaman and Chakravarty (1891) published a paper on Marchantiales of Bangladesh and they described 6 species. They (1984) also published Anthocerotae of Bangladesh and documented 4 species. Hadiuzzaman (1984a) reported a taxonomic study of *Fissidens* Hedw. of Bangladesh and he described 10 species among them 9 were new record for Bangladesh. Hadiuzzaman (1984b) published 4 species of the genus *Calymperes* Sw. of which three were new records for Bangladesh.

Another important work on Acrocarpous mosses of Bangladesh was carried out by Banu (1991). She identified 96 taxa of which 77 were newly reported from Bangladesh. She added 5 new taxa to science which included 3 new species *Fissidens hadii* Banu, *Calymperes hazarikhilense* Banu and *Splachnobryum schofieldii* Banu. and two new varieties namely *Fissidens sylvaticus* Griff. var. *ramosus* Banu and *Splachnobryum flaccidum* Braithw. var. *navicularis* Banu.

The vigorous work on genus *Riccia* of Bangladesh was done by Kamruzzaman (1995). He described 45 taxa of which 3 were reported for the first time from Bangladesh. He also added 36 new taxa to science. The taxa described under 3 subgenera including subgenera I-*Euriccia*, II-*Ricciella* and III-*Ricciomamillosa*, of which *Ricciomamillosa* was put recorded as a new subgenus for the genus *Riccia*.

Another outstanding work on Pleurocarpous mosses of Bangladesh was done by Khatun (2002). Khatun (l.c.) identified 72 taxa, of which 62 were reported for the first time from Bangladesh. She also added a new species *Vesicularia retiformis* Khatun to science.

Asiatic Society of Bangladesh (2007) compiled a total of 248 species of bryophytes under 34 families have been included, based on studies carried out over the past half a century in the region that comprises Bangladesh.

Recently, Rahman (2008) worked on Bryophyte flora of Boldah garden, Dhaka and he described 38 taxa under 2 classes.

AIMS AND OBJECTIVES

Bryophytes known as indicator plants and are very important ecologically. Different species of mosses may absorb harmful metals which are exhausted from industries and automobiles and as such show the indication of the extent of pollution in the environment. Now a days people are becoming more conscious about the environmental change of the earth. The present condition of the environment can be easily measured with the help of this group of plants. But most of the bryophytic plants are under threat on account of draining of wet lands, human encroachment, river erosion and agricultural expansion etc. Despite bryophytes flora plays an important role in the environment, no detailed studies on bryophytes of Sylhet zone were conducted so far. Consequently there is a dire need for exploring and documenting the bryophytes of Sylhet zone. The present study has been undertaken with the following objectives;

- (i) To explore the bryophytic plant in Sylhet zone.
- (ii) To identify the indicator plants in Sylhet zone
- (iii) To know the distribution pattern of bryophytes in the study area.
- (iv) To conserve the rare and endangered plants through both *in-situ* and *ex-situ* approach.

A BRIEF INTRODUCTION OF SYLHET ZONE

GEOGRAPHICAL LOCATION

The greater Sylhet district is situated in the north-east part of Bangladesh, lies between latitude 24°-01' and 25°-15' north and longitude 91°-0' and 92°-0' east (Rizvi 1971). The north, south and east part of Sylhet zone are covered by Indian lands and west part consists of Netrokona and Kishorganj District. The south-West part consists of Brahmanbaria district (Map 1).

ADMINISTRATIVE DISTRICTS

The greater Sylhet zone consist of 4 administrative districts, Sylhet , Sunamganj, Habiganj and Maulvi Bazar (Map 1). Sylhet district consists of 10, Moulvi Bazar 6, Habiganj 8 and Sunamganj 8 thanas.

TOPOGRAPHY

The Sylhet district is bordered in the north abrupt rise of the Shillong (within Assam) with elevations up to 121920cm, locally 182880cm. From the south, the northern tips of the Tripura hill ranges intrude into the area, with elevation of 6096cm to locally more than 30480cm. In the north-east of the district, a few low ranges run close and parallel to the border isolated hills or low ranges rise out of the plain near Chatak, north-east of Sylhet and south of Fenchuganj. Most of the hills are very steep and occur in uniformly low ranges, closely and strongly dissected, with outliers scattered in the plain (Rizvi 1971).

GEOLOGY

The Sylhet district can be subdivided into four main landscape: the hills, the outwash plain, the Surma-Kushiyara flood plain and the Sylhet basin. The Surma-Kushiyara flood plain covers about two-thirds of the eastern

subdivisions and extends a few miles into Sunamganj and Habiganj. Most of these two subdivisions is occupied by the Sylhet basin. In contrast of the hard quartzes which occur in the Shillong plateau, most of the rocks in the Sylhet are little consolidated sandstones and shales and unconsolidated sandy sediments.

SOILS

The soils of Sylhet district have different characteristics depending on ages, drainage and parent material. Almost all soils are acid, but top soils become near neutral when flooded for more than two weeks. In the Surma-Kushiara flood plain, there are a few small areas with recent soils, for example, in the northern part of Hakaluki haor. These are grey, generally stratified, silty and loamy soils occurring on gently undulating ridges and basins. Annually in the rainy seasons fresh sediments are added. The main soils on the relatively high flood plain ridge have grey silty to loamy topsoils, and grey silty to clayey subsoil with rocky structure. The basin soils are very similar, but more clayey. Almost all the soils are seasonally flooded, and dry out strongly by the middle of the dry seasons. The soils of the outwash plains are intermittently flooded for a few hours to few days after heavy rain. Along the northern border and around the hill ranges, northern of Sylhet town these soils are generally sandy or loamy, with a rather dense ploughpan below the cultivated layer. Elsewhere the soils of outwash plains are silty to clayey. They are grey, with some mottling in the subsoil, and have generally weaker structure than the flood plain soils. The high terraces occurring in small areas along some of the hill ranges in the south are covered by generally yellowish brown, deep, permeable, well drained clay with good structure.

CLIMATE

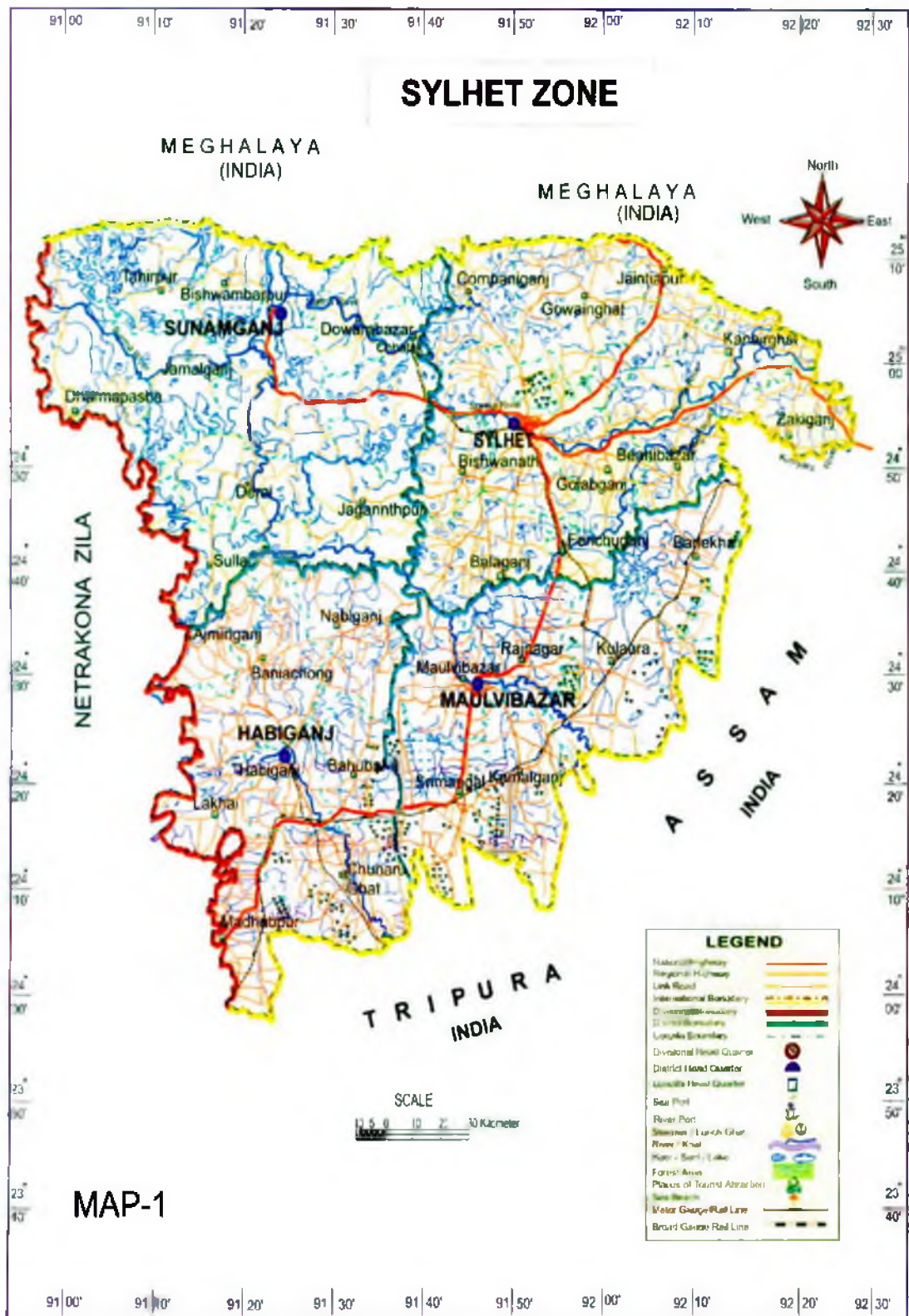
Sylhet is the wettest district in Bangladesh. Mean annual rainfall ranges from about 243.8cm in the south to more than 508cm at the foot of the Shillong plateau in the north. Despite the higher rainfall, the climatic regime is similar to that of the remainder of the province. The cool and dry winter, December-February is followed by the relatively cooler but very wet monsoon season, June-September. From mid-November to late February, the weather is dry and relatively cool. The average rainfall is only 5.08cm during the whole of the period, but heavy showers occur in some years, especially in February, the average temperature is between 65°-70°F., with extreme minima and maxima ranging between a little below 50° and about 90°F. Lower minimum temperature may be experienced on some hill tops during this period.

The period March-May is one of heat and increasingly violent thunder-shower. The average temperature is about 80°F., with extreme minima and maxima ranging between about 60 and 105°F. Total rainfall during these three months averages about 101.6cm at Sylhet. Amounts vary greatly from one year to another, however, March and April sometimes being almost completely dry, whereas in other years they may each have more than 50.8cm of rain. May is always a wet month, especially in the north-east where southerly winds rising to cross the Assam hills frequently causes heavy rainfall and early floods.

June to September is the period of the true monsoon but humid conditions continue up to early November. The average temperature is 80-85°F., with extreme minima about 70-75°F. and extreme maxima about 95° during the main monsoon period. Average rainfall totals during this period vary from about 190.5cm in the south to more than 406.4cm in the extreme north. Individual months during the monsoon seasons sometimes have more than 50 inches rainfall which coinciding with still heavier rainfall in the adjoining Shillong hills, may cause catastrophic flooding in the district.

VEGETATION

The high rainfall and humidity undulating nature of land formation, innumerable low-lying areas, haors, ditches, small hillocks, tilas etc., do support luxurious and varied types of vegetation in Sylhet zone. There are natural forests of bamboos, canes, grasses, reeds and both natural and cultivated timber-yielding plants of great economic important. Besides these, there are many herbs, shrubs, climbers, lianas and epiphytes. Parasites abound in the jungle and fallow lands whose quantitative and qualitative accounts have not yet fully enumerated. Among the latter group there are many plants of medicinal values as well as plants of academic interest. Sylhet forest and jungle are in general very rich in orchids, ferns and bryophytes but unfortunately no detailed work has been done on these plants. Flora of Sylhet division can be divided into three board group, namely (i) cultivated plants, (ii) tree epiphytes and others plants forest and jungle and (iii) others natural vegetation of land and water



LITERATURE REVIEW

A lot of papers and literature have been published on bryophytes all over the world as well as Indian sub-continent. At first Ray (1696) worked on *Riccia*. Hooker (1808) worked about mosses of Nepal and listed them in "Musci Nepalensis". Braun (1821) separated *Riccia fluitans* from other species of the genus. On the basis of sporangial position Dumortier (1822) divided *Riccia* into two genera viz. *Riccia* and *Tessellina*. Lindenburg (1836) divided the family Ricciaceae into four genera viz. *Riccia* (Mich) L. *Corsinia* Raddi, *Oximitria* Bisch. and *Sphaerocarpus* Mich. Montagne (1842-1843) collected a lot of mosses from Nilgiri Hills and published a paper on it.

Muller (1853, 1854, 1871, and 1878) published a number of papers on Indian mosses. Stephani (1898-1900, 1917-1924) reported a total of 138 *Riccia* species from Geneva. Schiffner (1909) supported the genus *Thallocarpus* and kept it along with *Sphaerocarpus*. Sedgwick (1910, 1911, and 1913) reported 72 species of Indian mosses.

McAllister (1916) studied on *Sphaerocarpus* and treated it as a *Riccia*. Kashyap (1919) reported a new liverwort between *Riccia* and *Corsinia*. Hampe (1872, 1873), Mitten (1873), Jaeger (1864, 1875), Brotherus (1898), Prain (1905), Paris (1904, 1904a, 1905a, 1906), Fleischer (1904-1922, 1929) and Herzog (1926) worked on mosses of India and Ceylon and reported a lot of papers. Kashyap (1929) prepared a key to identify all new species of *Riccia*. Again Kashyap (1929) published a monograph entitled "Liverworts of Western Himalayas and Panjab plain" and reported some new species of *Riccia*.

Pande (1933) studied on the monograph of *Riccia robusta* Kash.. Chopra (1938a,b) worked on the distribution of *Riccia* species of India. Evans (1939) described the classification system of the Hepaticae. Ahmad (1942) published

three new species of *Riccia* from India viz. *Riccia gangetica* Ahmad, *Riccia manglorica* Ahmad and *Riccia orientalis* Ahmad.

Chopra (1943) reported 14 species of *Riccia* viz. from India. Jacobs (1949) published two new species of the genus *Riccia*; *Riccia tenella* and *Riccia eldeeniae*. Schuster (1953) worked on the Hepaticae of Minnesota, Newzealand. Khan (1955) published a new and interesting species *Riccia perssonii* from east while Pakistan. Further he (1957) reported seven species of *Riccia* from East Pakistan.

Arnell (1957) studied on Hepaticae in south-west Africa. Pande and Udar (1958) reported 11 species of *Riccia* of south India and they also added a species *R. tuberculata* Pande etc. to science. Bapna (1958) published 8 species of *Riccia* from Jodpur, India. Bapna and Viyas (1962) reported two species of *Riccia* which was collected from Jodpur.

Pande (1959) published 11 species of *Riccia* from Indian territory, he also added a new species to science. Ciliated *Riccia* plant *R. ozarkiana* was first collected by Mc Gregor (1960) from Ozarks. Extensive work had been done on moss flora of Indian subcontinent and adjacent regions by Dixon (1911-1922) and he also published a number of papers. Foreau (1929, 1930) reported 323 species of and varieties mosses which were collected from south India. He (1961) also reported a list of 383 species of moss flora of the Palni Hills.

Herzog (1926) described valuable information about India mosses in his "Geographie de Moose". He (1938, 1939) also reported 70 taxa of mosses which were collected from Sikim and Hindukush regions of Himalayas. Seppelt (1974) worked on *Riccia crystallina* of different localities in South Australia.

Many bryologist like Wadhwa and Vohra (1963, 1965, 1966), Raghavan and Wadhwa (1968), Chopra and Kanta (1966), Srivastava (1966), Crundwell and Nyholm (1962), Handoo and Srivastava (1964) described many mosses from India, Nepal and different parts of the world and reported a number of papers, they also added a number of new species to science. Wijk and Chopra (1966) reported "A Preliminary key to the genera of Indian Mosses. "

Chopra *et al.* (1966), Crum (1957), Iwatsuki (1962, 1963), Robinson (1965, 1968), Vohra (1964, 1966, 1968, 1969, 1970) published a series of publication "Musci of the Himalayas". Ando (1968) studied on five known species of *Hypnum* of Asia and published in a paper. Watson (1968) described a key of British *Riccia* species.

Udar *et al* (1970, 1971) collected a lot of mosses from Western Himalayas and reported the genus *Buxbaumia* and he also added a new species, *Buxbaumia himalayensis* Udar *et al* to science. Iwatsuki and Noguchi (1971) published a new genus of the family Sematophyllaceae.

Udar (1976) collected all types of bryophytes from India and he published a book "Bryology in India" where he documented all types of information about bryophytes.

Very significant, skillful and monumental work had been done by Gangulee (1957, 1959, 1960, 1963, 1964, 1966, 1969, 1969a, 1970, 1971, 1972, 1974, 1976, 1977, 1978, 1980,) on mosses of Eastern India and its adjacent regions and he published a series of publications which enriched our knowledge on the moss flora of Indian sub-continent.

Biological significance of morphological characters of the order Marchantiales was reported by Bischler and Jobet-Ast (1981). Stark *et.al.* (1982) reported a

preliminary list of bryophytes including Hepaticae and Musci from Organ mountain, New Mexico.

Noguchi (1985) reported 31 species under 8 families of Isobrylian mosses which were collected by Iwatsuki in New Caledonia. Haji Mohamed (1985) worked on South Indian and Sri Lankan mosses and reported a paper "Notes on two mosses from South India and Sri Lanka". Shaw (1985) reported a paper on the tradition of make-do taxonomy at a symposium on species concept in bryophytes.

Gangulee (1986) described 100 representative form of 100 genera in his book "Handbook of Indian Mosses". Ando (1987) worked on the genus *Hypnum* and he also reported a number of species of this genus. Crum and Anderson (1987) reported *Hylocomium splendens* B.S.G. var. *tenue*. Noguchi and Streimann (1988) studied on Papua New Guinea mosses and published a paper on the *Pterobryaceans* mosses. Ando (1989) worked on genus *Hypnum* and gave them detailed description.

Gergdol *et al.* (1991) worked on Dolomite mosses and described their vegetation and adaptation. Smith (1992) studied on *Grimmia trichophylla* and gave its taxonomic status in mosses classification. Stone and Catcheside (1993) worked on the mosses species of Queensland and reported two new species, *Fissidens oblatius* and *F. badijinborus*..

Crundwell *et al.* (1994) worked on the bryophyte flora of the Azores. Hedenas (1995) studied on diplolepidous pleurocarpous mosses and gave a taxonomic relationship of two type's mosses.

Albison (1997) studied on different groups of Swedish Hepatics made relationship and association of them.

Ros and Guerra (1998) collected a lot of moss species from Spain gave a check list. Shabbra (1999) worked on the family Funariaceae and reported three new records. Vigorous worked on wetland bryophytes in Muddus National Park, north Sweden were done by Sjors and Een (2000). Ros *et al.* (2000) studied on economic importance and vegetational adaptation of different types of bryophyte of Morocco.

Heinrichs *et al.* (2001) reported detailed description of the sporophytes of *Steereochila*. So and Grolle (2001) worked on some known species of *Plagiochila* (Hepaticae) and published a paper. Stern (2001) studied on South Wiltshire bryophytes and reported a list of them.

Zander (2002) reported the mosses of Antarctica. Tan and Choy (2002) studied in detail of the genus *Fissidens* of Singapore they also added a new species *Fissidens pseudoceylonensis* to science. Prisce (2002) published a monograph of moss genus *Macrodictum*. Again he (2002) published a revision of the genera *Eucamptodontopsis* and *Schliephackea*.

Hedderson *et al.* (2003) studied on bryophytes diversity of the Holnicote estate, Somerset, U.K. Holyoak (2003) studied on a taxonomic review of some British costal species of the *Bryum bicolor* complex with a description of *Bryum dyffrynense*. Bednarek-Ochyra and Ochyra (2003) reported a new moss species, *Racomitrium patagonicum* from southern America. Vana (2004) studied on bryophyte flora of Uganda. Uyar and Cetin (2004) reported a new check list of mosses of Turkey.

Townsend (2005) worked on mosses of Caucasian region and eastern Turkey and reported a paper on the work. Hednas and Walting (2005) published a paper on bryophyte flora of Uganda. Draper *et al.* (2005) studied on epiphytic bryophyte flora of the Rif and Tazzeka Mountains and gave a details description.

Draper *et al.* (2006) studied on epiphytic bryophyte flora of Atlas and also included a synthesis of the distribution of epiphytic bryophytes in Morocco. They described 65 taxa including 2 liverworts. Josephine and Milne (2006) worked on detailed description of the genus *Diphyscium* in Australia. Bruggeman (2006) published a paper on bryophyte flora of Uganda. In this paper he described about the genus *Fissidens*.

Ellis (2007) worked on families Calymperaceae and Octoblepharaceae of Uganda and published a paper on them. Townsend (2007) worked on mosses of Tanzania and published a paper and reported *Pollia baronii* Wijk Margad. as new to Tanzania. Meager *et al.* (2007) studied on mosses of the family Lepidozoniaceae of Newzealand and reported a new species of the genus *Bazzania*. Ellis (2007) worked on the family Calymperaceae in Borneo and he also added 2 new species to this family.

Callaghan *et al.* (2008) published a paper on knowledge gaps in bryophyte distribution and prediction of species richness. Wilbraham and Joanna (2008) studied on the family Orthotrichaceae and published a paper on it. Tangney (2008) described a detailed description of the genus *Libophyllum* Lindb.

MATERIALS AND METHODS

Collection and preservation

In greater Sylhet zone, including Sylhet, Sunamganj, Habiganj and Maulvi Bazar having mostly deciduous and evergreen vegetation. There are also many tea gardens, hills slopes and some places lacking human interference where bryophytes grow silently. About 700 specimens were collected from different areas, vegetations and different climatic conditions by author and other collectors. Thalloid materials were collected from lakes, ponds, *haors*, soil and different substratum. Extensive care was taken for collection of thalloid materials. Initially thalloid materials were collected with the help of blade and knife. When thalloid materials were collected from soil or any terrestrial substratum, soil or unwanted particles were clamped with it. So thalloid materials were placed in water and washed those thalloids materials with the help of slow running water. Special care was taken for washing of thalloids materials so that scales rhizoids and other important particles do not remove. After washing and ensuring that the materials will be suitable for examination then it placed in suitable size of plastic pot and 70% alcohol used as fixative for long time preservation.

Round the year mosses samples were collected from different vegetations and substratums i.e. soil, bark of tree, brick, old building wall, rock, decaying wood etc. with the help of knife and scrapple. Special care was taken for collection of sporophytes because they are very important for identification of plants. Some times unwanted particle clamped with specimens so, they were separated with the help of suitable instruments. They were then placed on newspapers and allowed for air dry thoroughly. Gemma, capsule, and its calyptra, operculum etc. are very delicate and soft so, special care was taken for them. After thoroughly dried, specimens were placed in folding packets made up of thick brown paper, each measuring 7.5 cm. × 12 cm.

Different information e.g. their habitat; on which they grow may it be on the bark of tree, tree trunk, tree base, fallen twigs, on soil, on rock, decaying wood etc., date of collection. Name of collectors were noted on each brown paper packet and they were placed in a suitable place for future use. Collection numbers were given in bold numerical in the following text.

Practical examination

Thalloid plants with sporophytes were selected from the preserve materials. With the help of forceps the materials were placed on dry and clean slide and in the watch glass and their morphological features were observed keenly. Special characters found were documented. Suitable number of thallus were selected for camera-lucida drawing at suitable magnification.

Spores are very important for identification of thalloids so, with the help of needle and forceps sporangium were taken out from the thallus and separated it from unwanted particles. Then mature capsule was taken on previously prepared clean slide and one drop of 10% aqueous glycerin solution was taken on the slide so that sporangium not dried.

The shape, size and if any special structure of the sporangium were observed keenly. With the help of needle spores were slotted out from the sporangium and some spores were taken on the another slide and after adding one drop of 10% aqueous glycerin solution the spores were covered with clean cover slip and observed under a compound microscope. Spores characters (a) rounder, (b) oval, (c) elliptical, (d) semi-elliptical, (e) smooth, (f) rough, (g) papillate, (h) reticulate etc. were documented. For observing their position of reproductive structure, arrangement of internal tissues, general shape of the specimens and any special feature of the thallus, freehand thin section T.S. and L.S. of the thallus were taken with the help of a razor blade. Camera lucida drawing was made of different types of spores, thallus, scales and others important structures which were helpful for identification of thalloids. Scales may be semilunar, irregular etc. were documented. Characters of elaters were

documented as of various in shape. Margin of thallus were considered as undulating, slightly undulating or twisted. The measurement of all the important parts was taken with the help of previously calibrated oculometer.

After removing unwanted particle from the preserver leafy samples a small amount was taken on a clean and dry slide and observed the nature of curling of leaves or the whole plants, seta, capsule, peristome teeth etc in dry condition which were helpful for identification of plants. Camera lucida drawing was made of dried plants at suitable magnification. Then dried materials were soaked in water for detailed study of various parts of plants. With the help of needle and forceps a single plant was separated carefully from the wetted samples and put on a clean slide and observed in details under binocular microscope. Then camera lucida drawing was made of the whole plants at suitable magnification. Stems characters were observed in details as are they are erect or creeping, branches are simple or one-branched short or pinnate, regularly pinnate, irregularly pinnate, bipinnate or tripinnate, straight, soft or hard, wiry, julaceous or complanate, with or without central strand, presence or absence of any glandular cells, gemmae etc which were helpful for identification of plants. The following characteristic features of leaf were considered (a) at first their position and arrangement on main stem and branch stem in both dry and wet conditions, (b) crowded or thin arrangement, (c) spreading, julaceous, spiral or irregular, distichous, erect, appressed to stem or patent, erectopatent, secund, squarrose, complanate, falcate or falcatosecund etc. (d) weather unchanged or crisped or contorted on drying and (e) whether bearing gemmae or not which were most important for identification of plants. The measurement of the whole plants and all the important parts was taken with the help of previously calibrated oculometer

Leaves are very important character for identification of plants. With the help of forceps and needle some leaves were separated with great care from

middle position of stem. The upper leaves are immature and lower leaves are often small or scanty. So, middle leaves were considered for examined. Middle leaves of stem are normal and suitable for examination because lower leaves are very small and the upper most ones are not fully developed. On basis of importance the shape, length, breadth, margin, apex, costa and areolation of leaves were documented. Leaves margin considered as they may be crenulate, serrate or dentate, bordered or unbordered, uni-, bi- or multistratose, coloured or undifferentiated, plane, incurved, recurved or involute, revolute etc. The characteristics feathers of leaves apex considered as whether they acuminate or acute, obtuse or rounded or apiculate, mucronate, aristate, cuspidate etc. The shapes of the leaves were documented as they may be lanceolate, lanceolate from an ovate base, ovate, ovate-lanceolate, narrowly ovate-lanceolate, oblong, oblong-lanceolate, ovate-oblong, cordate, cordate-lanceolate, linear, elongate, ovate-apiculate etc. which were most important for identification of plants. Midrib or costa may be single or double, presence or absence. The following feachers of costa were taken into consideration: (a) short costa reaching much below the apex, (b) sub percurent, percurent to various degree, (c) whether with or without spines papillae etc.

Characteristic features of cells were considered whether as they were papillose, mamilose, smooth etc. and their shape and size were also documented which very important taxonomic and identifying characters of plants were. Before removing leaves from stems position of reproductive organs, archegonia, antheridia, characteristics of perigonial, and perichaetial leaves were documented. Vegetative reproductive structures such as gemmae were found in some species, their size, shape and position on the plant were recorded. Different parts of sporophyte such as seta, capsule, peristome teeth, annulus, operculum, spores etc. were considered to examine.

Characteristics feathers of capsule were considered as: (a) the capsule was erect or inclined, cernuous or pendulous etc., (b) the shape of capsules, (c) the

size of capsule, (d) the nature of capsule in fresh and dry condition, (e) presence or absence of stomata, (f) presence or absence of annulus and (g) capsule cleistocarpic or stegocarpic. The shape, size and nature of operculum, calyptra and spores were also documented.

The whole plant, stem, leaves, capsule, seta, operculum, calyptra etc. were measured in cm/mm. Spores and other important microscopic parts were measured in micron (μm). Camera lucida drawing was made of all figures with utmost care. For detailed study Meoptra compound microscope, PZO Warsfawa binocular and Reichert simple microscopes were used. The bold numerical number indicated number of voucher specimen The voucher specimens will be deposited in Dhaka University Salar Khan herbarium.

CLASSIFICATION

The name bryophyte was first used by Haeckel (1866). Schimper (1879) raised bryophytes, as it to the rank of a division. Eichler (1883) divided the bryophytes into two groups; Hepaticae and Musci. Howe (1899), Casstle (1946), Smith (1955), Takhtajan (1953), Schuster (1963), Hodgson (1964), Hattori (1966) and others classified the bryophytes into three classes; (a) Hepaticae, (b) Anthocerotae and (c) Musci. Maintain of the rule of International Code of Botanical Nomenclature, Rothmaler (1951) changed the name of classes Hepaticae, Anthocerotae and Musci into Hepaticopsida, Anthoceropsida and Bryopsida. In the present study Pariher's classification system (1956) has been followed for the class Hepaticopsida and Anthoceropsida. Majority of the species of the class Musci have been identified with the help of Gangulee's monograph (1969-1986) and has also been followed for class Bryopsida.

Pariher's (1956) system of classification for classes Hepaticopsida and Anthoceropsida are given below:

Class: Hepaticopsida

Order 1. Marchantiales *

Family: 1. Ricciaceae 2. Corsioniaceae
3. Targioniaceae 4. Marchantiaceae

Order 2. Jungermanniales

1. **Sub-order: Metzgerineae**
Family: 1. Pelliaceae 2. Riccardiaceae
2. **Sub-order: Jungermannineae**
Family: 1. Porellaceae 2. Frullaniaceae

Order: 1. **Anthocerotales ***

Family: 1. Anthocerotaceae

Only important families are noted from the classification.

Classification used by Gangulee (1969-1986) is being followed for Bryopsida.

Class **Bryopsida**

Subclass **I. Sphagnidae**

Order 1. **Sphagnales**

Subclass **II. Andreaidae**

Order 2. **Andreaeales**

Subclass **III. Bryidae**

Section A. NEMATODONTEAE

Cohort I. **Tetraphidae**

Order 1. **Tetraphidales**

Cohort II. **Buxbaumiidae**

Order 1. **Buxbaumiales**

Cohort III. **Polytrichiidae**

Order 1. **Polytrichales**

Order 2. **Dawsoniales**

Cohort IV **Calomnidae**

Order 1. **Calomniales**

Cohort V. **Schistostegidae**

Order 1. **Schistostegales**

Section B. ARTHRODONTAEAE

Cohort VI. **Eubryiidae**

Series I. HAPLOLEPIDAEAE

Order 1. Archidiales

2. Dicranales *

3. Fissidentales *

4. Syrrhopodontales*

5. Pottiales *

6. Grimmiales

Series II. HETEROLEPIDAEAE

Order 1. Encalyptales

Series III. DIPLOLEPIDAEAE

Order 1. Funariales *

2. Eubryales *

3. Isobryales *

4. Hookeriales

5. Hypnobryales *

*These are the orders which I found in Sylhet zone

SYNOPSIS OF THE PRESENT STUDY

Class: Hepaticopsida

ORDER VARIETY	FAMILY	GENUS	SPECIES /
1. Marchantiales	1. Ricciaceae	1. <i>Riccia</i>	1. <i>R. bengalensis</i>
			2. <i>R. discolor</i>
			3. <i>R. sullivantii</i>
			4. <i>R. gangetica</i>
			5. <i>R. billardieri</i>
			6. <i>R. bogransis</i>
			7. <i>R. lithophilii</i>
	2. Targioniaceae	1. <i>Cyathodium</i>	1. <i>C. tuberosum</i>
	3. Marchantiaceae	1. <i>Marchantia</i>	1. <i>M. palmata</i>
			2. <i>M. nepalensis</i>

Class: Anthoceropsida

ORDER VARIETY	FAMILY	GENUS	SPECIES /
1. Antocerotales	1. Anthocerotaceae	1. <i>Anthoceros</i>	1. <i>Anthoceros laevis</i>
		2. <i>Notothyllus</i>	1. <i>Notothyllus indica</i>

CLASS: Bryopsida

ORDER	FAMILY	GENUS	SPECIES / VARIETY
1. Dicranales	1. Leucobryaceae	1. <i>Octoblepharum</i>	1. <i>O. albidum</i>
2. Fissidentales	1. Fissidentaceae	1. <i>Fissidens</i>	1. <i>F. splachnobryoides</i> 2. <i>F. xiphioides</i> 3. <i>F. zollingeri</i> 4. <i>F. virens</i> 5. <i>F. semperfalcatus</i> 6. <i>F. nobilis</i> 7. <i>F. orishae</i> 8. <i>F. ganguleei</i> 9. <i>F. javanicus</i> 10. <i>F. diversifolius</i> var. <i>rubricaulis</i> 11. <i>F. laxitextus</i> 12. <i>F. laxus</i>
3. Syrrhopodontales	1. Calymperaceae	1. <i>Calymperes</i>	1. <i>C. tenerum</i> 2. <i>C. noakhalsensis</i>
4. Pottiales	1. Pottiaceae	1. <i>Hyophila</i> 2. <i>Semibarbula</i>	1. <i>H. comosa</i> 2. <i>H. involuta</i> 1. <i>S. ranuii</i> 2. <i>S. orientalis</i>
5. Funariales	1. Funariaceae	1. <i>Physcomitrium</i>	1. <i>P. pulchellum</i>
6. Eubryales	1. Bryaceae	1. <i>Pohila</i>	1. <i>P. ampullacea</i>

		2. <i>Bryum</i>	1. <i>B. coronatum</i> 2. <i>B. cellulare</i> 3. <i>B. apiculatum</i>
	2. Bartramiaceae	1. <i>Philonotis</i>	1. <i>P. hastata</i>
7. Isobryales	1. Erpodiaceae	1. <i>Erpodium</i>	1. <i>E. mangiferae</i>
	2. Neckeraceae	1. <i>Homaliodendron</i>	1. <i>H. exiguum</i> 2. <i>H. flabellatum</i>
8. Hypnobryales	1. Brachytheciaceae	1. <i>Brachythecium</i>	1. <i>B. acuminatum</i>
	2. Hylocomiaceae	1. <i>Macrothamniella</i>	1. <i>M. pilosula</i>
	3. Entodontaceae	1. <i>Erythrodontium</i>	1. <i>E. julaceum</i>
	4. Plagiotheciaceae	1. <i>Stereophyllum</i>	1. <i>S. anceps</i>
	5. Amblystegiaceae	1. <i>Campylium</i>	1. <i>C. gollanii</i> 2. <i>C. stellatum</i>
	6. Sematophyllaceae	1. <i>Glossadelphus</i>	1. <i>G. zollingeri</i>
		2. <i>Aptychella</i>	1. <i>A. borii</i>
	7. Hypnaceae	1. <i>Vesicularia</i>	1. <i>V. dubyana</i>
		2. <i>Ectropothecium</i>	1. <i>E. buitenzorgii</i> 2. <i>E. rostellatum</i>
		3. <i>Isopterigium</i>	1. <i>I. pallidulum</i>

1. Sporangia simple, Capsule not contain photosynthetic tissue	Hepaticopsida
- Sporangia othewise	2
2. Sporangia consist meristematic tissus, and sporangia not bear seta and Capsule	Anthoceropsida
- Sporangia not consist meristematic tissue and sporangia consist seta and capsule	Bryopsida

28

sex organs occur singly or in groups. Wall of sporangium one celled thick. Capsule dehiscence by irregular valves or opens by partial or complete disintegration of capsule wall. Elaters often present except few.

KEY TO THE FAMILIES OF MARCHANTIALES

1. Photosynthetic filaments and

air chambers simple, air pore

not surrounded by concentric ring of cells

Ricciaceae

- Photosynthetic filaments and

air chambers well developed, air pore

surrounded by concentric ring of cells

2

2. Archegonium and antheridium

grow within vegetative thallus

Targioniaceae

- Archegonium and antheridium

grow on special structure

Marchantiaceae

FAMILY **RICCIACEAE** Reichenb.

Plants thalloid, dorsal region bearing photosynthetic filaments. The photosynthetic region of the thallus has got no air chamber. Distinct pores are absent or rudimentary. Sex organs scattered, occur singly, embedded along the dorsal median longitudinal strip of thallus. Sporangium embedded, without foot and seta; dehiscence by decay of capsule wall. Elater or oil bodies are absent.

GENUS *RICCIA* (Mich.) L.
 Miche, Nov. Plant. Gen. 106, 1729.
 Linnaeus, Spec. Plant. 1138, 1953.

Sporophyte without an involucre, embedded in thallus tissue, air chambers simple, not stellate. Epidermis with air pores and air pore not surrounded by involucre. Antheridia and archegonia scattered in thallus.

KEY TO THE SPECIES OF *RICCIA*

- | | | |
|----|--|-----------------------|
| 1 | Sporangia dorsal | 2 |
| | - Sporangia ventral | 3 |
| 2. | Spore areole papillate | <i>R. bengalensis</i> |
| | - Spore areole non papillate | <i>R. discolor</i> |
| 3. | Spore winged | 5 |
| | - Spore not winged | 4 |
| 4. | Spore spiny | <i>R. sullivantii</i> |
| | - Spore not spiny | <i>R. gangetica</i> |
| 5. | Spore winged cartwheel like | <i>R. billardieri</i> |
| | - Spore wing not so | 6 |
| 6. | Diameter of areole smaller
and thick walled | <i>R. bogransis</i> |
| | - Diameter of areole larger
and thin walled | <i>R. lithophilii</i> |

1. *Riccia bengalensis* Khan, The Bryologist 60: 29-31, 1957.

STATE 1

Plant green in colour, dichotomously branched for twice or thrice, normally overlapping in dense, sometimes forming rosette, each rosette ± 2.12 cm in diameter. Individual thallus ± 32 mm long and ± 4.15 mm broad, apex obtuse,

margin slightly undulating, air pores distinctly seen. Both smooth and rough rhizoids are arisen from the lower epidermis. Scales, multicellular, contain more or less hexagonal cells which are grown ventrally. Cross section $\pm 3.93 \times 0.78$ mm. Epidermal cells dome shaped, hyaline, sometimes destroyed. Each photosynthetic filament consists of 4-5 cells, air chamber slit like. Storage region compact, contains thin walled more or less hexagonal and pentagonal cells. Sporangia in mid line, two or three rows, numerous, grow in dorsally or slightly projecting ventrally. Spores dark brown, not winged, most of them are rounded, $\pm 142\mu\text{m}$ in diameter. Spores reticulation forming areoles. Spore areole papillate. Number of areoles 7-9 and each of which $\pm 11.13 \mu\text{m}$ in diameter, papillae arise from the angle of areoles.

Specimens examined

Sylhet: Jalalabad, Sylhet Sador, on damp soil, Shirin Akhtar, 13.08. 2007, **44**;
Daudpur, Sylhet sador, on moist soil, Shirin Akhtar, 11.08. 2007, **33**;
Fulbari, gopalganj, on moist soil, Shirin Akhtar, 04.08. 2007, **28**.

Habiganj: Raghunondon Reserve Forest, Madhabpur, on moist soil, Shirin Akhtar, 20.08.2008, **285**.

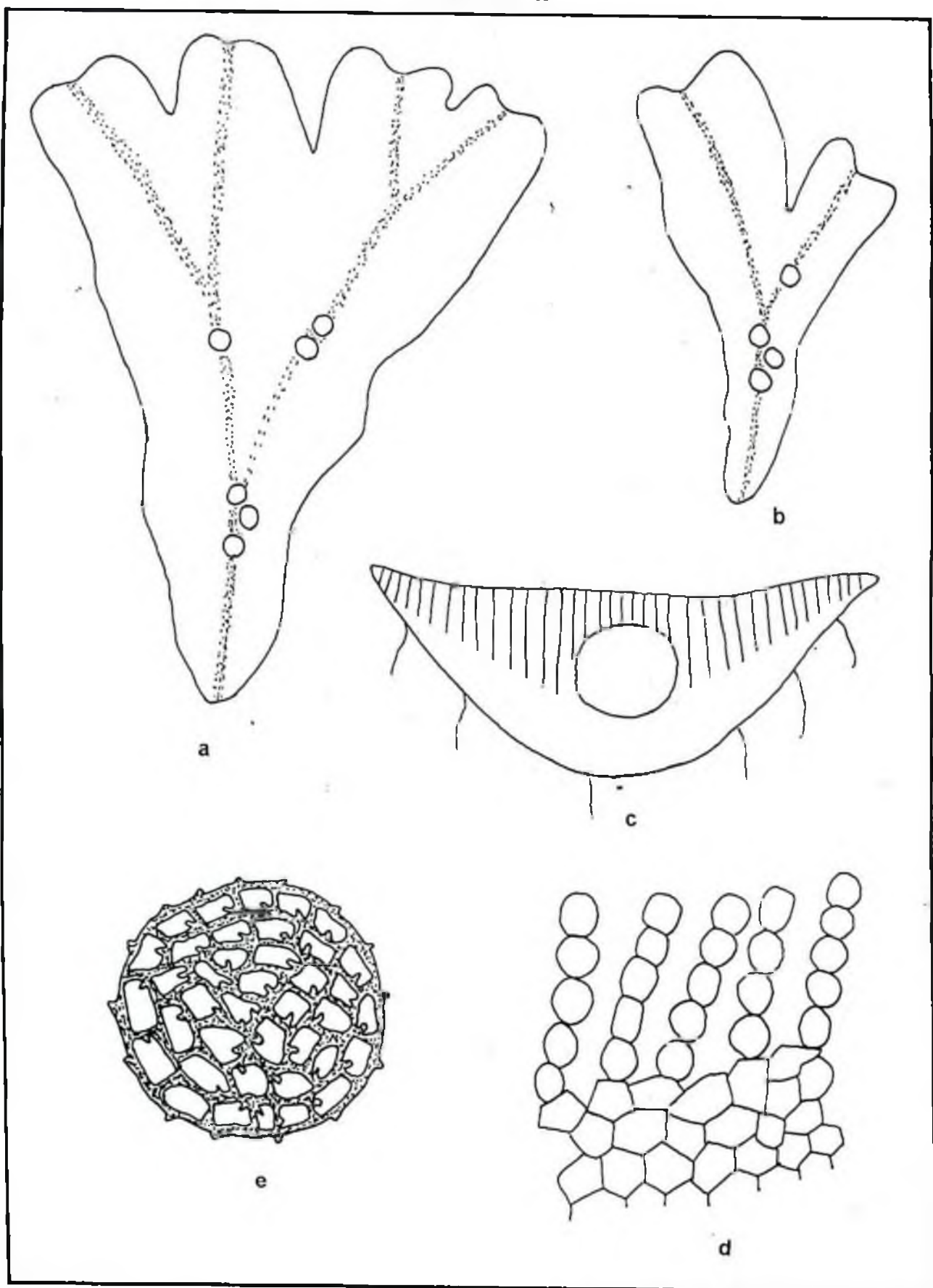
Maulvi Bazar: Bhanugash Reserve Forest, Komolganj, on moist soil, Shirin Akhtar, 10.08. 2007, **08**.

PLATE 1

Riccia bengalensis Khan

a &b.	Vegetative thallus	×10
c.	T. S. of thallus showing sporangial position	× 20
d.	T. S. of thallus (a part)	×100
e.	Spore	× 200

PLATE 1



Riccia bengalensis Khan

2. *Riccia discolor* L. et. L.

Riccia discolor L. et. L. Pugill. 4 : 1 1832

Riccia golani Levier, Sp. Hepat. 6 : 2, 1917-1924

PLATE 2

Plant dioecious, dichotomously branched for twice or thrice rarely unbranched, ± 19.12 mm long and ± 4.32 mm broad, forming rosette, each rosette ± 2.12 cm in diameter, sometimes overlapping. Thallus margin slightly undulating. The groove prominent at apex, dark in color indicates growing point. Both smooth and rough rhizoids are arisen from the lower epidermis. Scales violet, purple or hyaline, semilunar and bend arise from middle portion of the thallus as ventrally Cross section $\pm 4.21 \times 0.95$ mm. Epidermal cells more or less rounded, hyaline. Air space narrow or slit like. Each photosynthetic filament consists of 4-5 cells; most of them are rounded ± 53 μ m in diameter. Sporangia grow dorsally. Spore dark brown, more or less round, ± 142 μ m in diameter. Spores reticulation forming areoles. Number of areoles 5-7 and each of which ± 13.5 μ m in diameter, Triradiating mark not distinct.

Specimens examined

Sylhet: Kanaighat, Jointapur, on moist soil, Shirin Akhtar, 12.08. 2007, 29;
Osmanpur, Balagonj, Shirin Akhtar, 12.08. 2007, 30.

Sunamganj: Patharia, Sunamgonj, on damp brick, Shirin Akhtar, 12.08. 2007, 35.

Maulvi Bazar: Kamalpur, Maulvi Bazar, on moist soil, Shirin Akhtar, 14.08. 2007, 38; Sujanagar, Borolekha, on moist soil, Shirin Akhtar, 23.08. 2008, 286.

PLATE 2

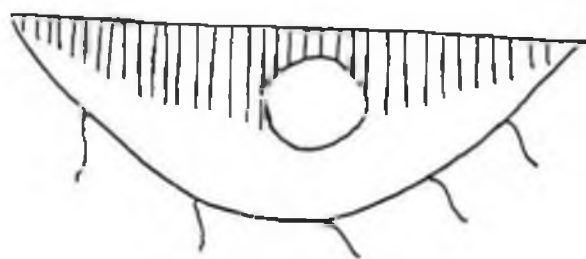
Riccia discolor L. et L.

- | | | |
|----|---|------|
| a. | Vegetative thallus | ×10 |
| b. | T. S. of thallus showing
sporangial position | ×20 |
| c. | T. S. of thallus (a part) | ×100 |
| d. | Spore | ×200 |

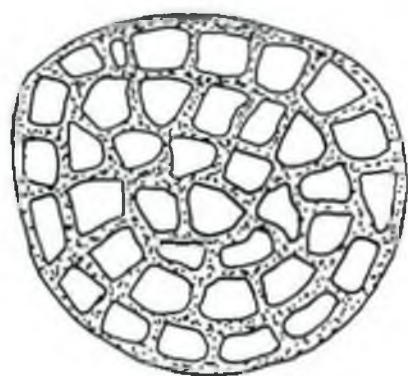
PLATE 2



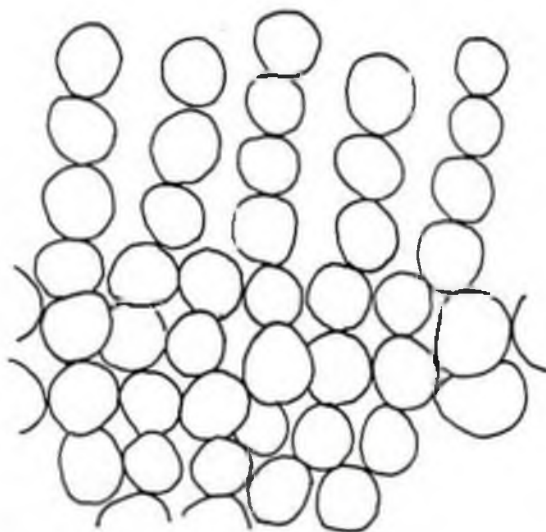
a



b



d



c

Riccia discolor L.

3. *Riccia sullivantii* Aust., The Bryologist 73 : 478 (1970)

PLATE 3

Plant dark green in color dichotomously branched rarely unbranched. The branches ± 23 mm long and ± 2.98 mm wide, sometimes forming rosettes each rosette ± 32 mm in diameter. Margin slightly undulating. Both smooth and rough rhizoids are arisen from the lower epidermis. Ventral scales absent. Cross section $\pm 3.12 \times 0.82$ mm. Epidermal cells hyaline, more or less rounded, ± 43 μ m in diameter. Each photosynthetic filament consists of 4-5 cells most of them are rounded, ± 38 μ m in diameter. Storage region compact consists of hexagonal and pentagonal cells. Sporangia pendulous. Spores spiny, dark brown more or less round, ± 95 μ m in diameter. Spores reticulation forming areoles. Number of areoles 5-7 and each of which ± 12.12 μ m in diameter. Triradiating mark indistinct.

Specimens examined

Sylhet: Tetali, Sylhet Sadar, on moist soil near a pond, Shirin Akhtar, 09.07.2007, 12; Lal Bazar, Sylhet Sadar, on moist soil, Akhtar, 11.08.2007, 11.

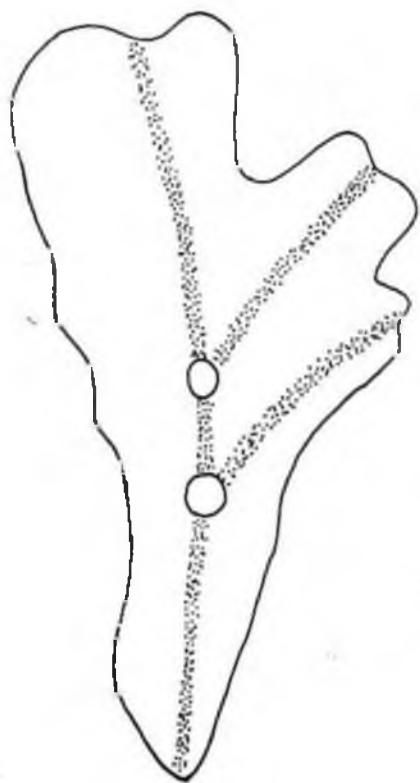
Habiganj: Chaumohoni, Madhabpur, in the pond water, Shirin Akhtar, 22.08.2007, 14.

PLATE 3

***Riccia sullivantii* Aust.**

a&b	Vegetative thallus	×10
c.	T. S. of thallus showing sporangial position	×20
d.	T. S. of thallus (a part)	×100
e.	Spore	×200

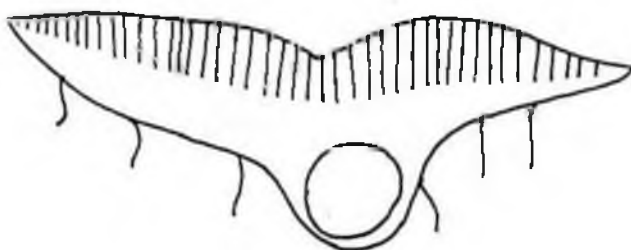
PLATE 3



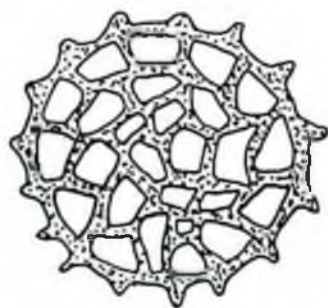
a



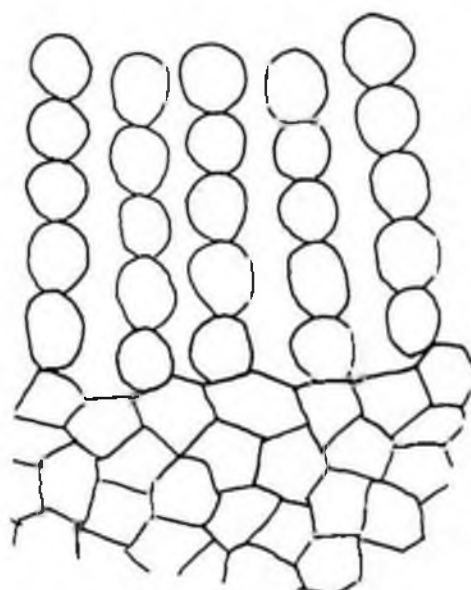
b



c



e



d

Riccia sullivantii Aust.

4. *Riccia gangetica* Ahmad. Curr. Sci. **11**: 433, 1942.

PLATE 4

Plant monoecious, dark green, dichotomously branched for 1-2 times or unbranched. Normally in dense, overlapping and rarely forming rosette and each rosette ± 1.23 cm in diameter. Individual thallus ± 1.01 cm long and 2.12 mm broad, fleshy, broader anteriorly, narrower posteriorly, dorsal furrow conspicuous, margin brown and slightly wavy. Both smooth and rough rhizoids are arisen from the lower epidermis. Scale hyaline, violet or reddish brown. Cross section $\pm 2.02 \times 0.99$ mm. Epidermal cells hyaline, more or less rounded or oval ± 34 μ m in diameter. Each photosynthetic filament consist of 4-5 cells, each cell more or less oval shaped ± 32 μ m in diameter. Storage region in column, air space narrow. Antheridia 1-3 seriate, ostiole conspicuously projecting along the furrow in anterior region. Archegonia also 1-3 seriate, but in most thallus in single row the mid dorsal line with distinctly projecting neck. Sporangia grow ventrally. Spores dark brown more or less round ± 132 μ m in diameter. Spores reticulation forming areoles and reticulation both thick and thin walled. Number of areole 6-10 and each of which ± 12.32 μ m in diameter. Spores wing absent.

Specimens examined

Maulvi Bazar: Chadnighat, Maulvi Bazar Sadar, on moist soil, Shirin Akhtar and Jahirul Haque, 26.07.2007, **17**; Najirabad, Maulvi Bazar Sadar, on moist soil, Shirin Akhtar and Jahirul Haque, 26.07.2007, **20**.

Habiganj: Nurpur, Habiganj, on moist soil, Shirin Akhtar and Jahirul Haque, 21.08.2008, **45**; Debpara, Nabigonj, on moist soil, Shirin Akhtar and Jahirul Haque, 21.08.2008, **388**; Changhat, Rahulbal, on moist soil, Shirin Akhtar and Monirul Haque, 21.09.2009, **339**.

PLATE 4

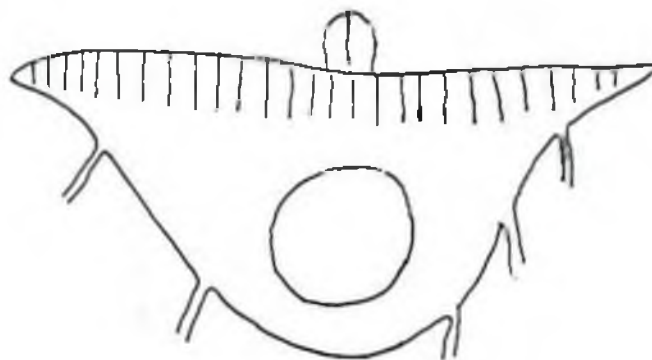
***Ricccia gangetica* Ahmad**

- | | | |
|----|---|------|
| a. | Vegetative thallus | ×10 |
| b. | T. S. of thallus showing
sporangial position | ×30 |
| c. | T. S. of Thallus (a part) | ×100 |
| d. | Spore | ×300 |

PLATE 4



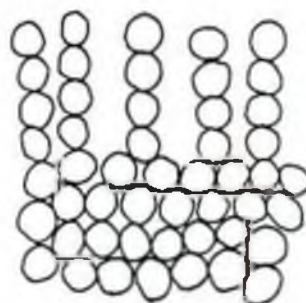
a



b



d



c

Riccia gangetica Ahmad.

5. *Riccia billardieri* Mont. et N.

Riccia billardieri Mont. et N. Sp. Hep. 602, 1844-1847

Riccia bulbifera St. Sp. Hep. 1 : 24 1898

PLATE 5

Plants pale green to green in color generally dichotomously branched for twice or thrice, or sometimes unbranched, not thicker, compact, crowded together forming overlapping. Thalloids plants sometimes forming incomplete rosette, ± 1.23 cm long and ± 0.31 cm broad. Thallus margin wavy, dorsal groove narrow anteriorly and inconspicuous posteriorly. Both smooth and rough rhizoids arise from lower epidermis of the thallus. From the ventral portion of the thallus semilunar, reddish, violet and distinct scales are arisen. Cross section $\pm 2.95 \times 0.64$ mm (3-5 times as broad as high). Epidermal cells ovoid, hyaline. Each photosynthetic filament contains 4-5 cells; most of them are ovoid ± 36.0 μ m in diameter. Photosynthetic region in column, with narrow air space. Sporangia round, spherical, grow ventrally or slight dorsally in single row, numerous. Spores with undulating wing, purple reddish, brown or opaque brown, ± 132.19 μ m in diameter, wall ornamentation reticulate cart wheel like, thick wall not uniform but projected distinctly, projection truncate or emarginated. Each spore consists of 7-11 areoles and each of which ± 12.2 μ m in diameter. Triradiate marking not distinct.

Specimens examined

Sylhet: Jalalpur, Sylhet Sadar, on moist soil, Shirin Akhtar and Jahirul Haque, 22. 07. 2007, 18; Bagha, Jaintapur, on moist soil, Shirin Akhtar and Jahirul Haque, 22. 07. 2007, 47; Manikpur, Jakirgang, on moist soil, Shirin Akhtar and Mozammel Haque, 26. 08. 2008, 370.

Maulvi Bazar: Chadnighat, Maulvi Bazar Sadar, on moist soil, Shirin Akhtar and Jahirul Haque, 14.08.2007, **48**; Najirabad, Maulvi Bazar Sadar, on moist soil, Shirin Akhtar and Jahirul Haque, 16.08.2007, **16**.

Habiganj: Chaumohoni, Madhabpur, on moist soil, Shirin Akhtar, 22.08.2007, **26**; Debpara, Nabigonj, on moist soil, Shirin Akhtar, 24.08.2007, **52**.

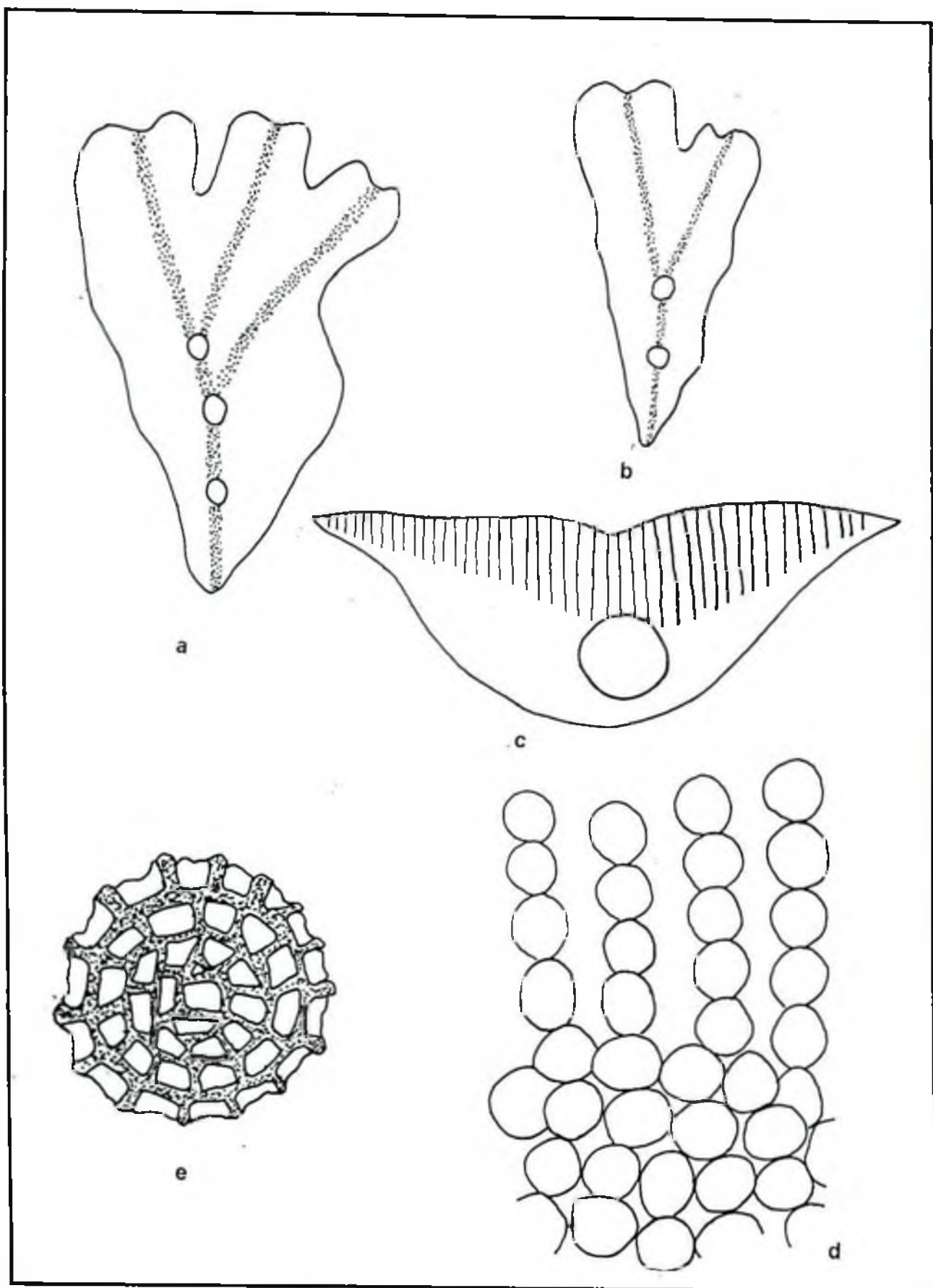
Sunamgang: Mollapara, Sunamganj, on moist soil, Shirin Akhtar, 25.08.2007, **71**; Dinarpur, Azmarigang, on moist soil, Shirin Akhtar, Jahirul Haque and Monirul Haque, 27.08.2007, **68**.

PLATE 5

Riccia billardieri Mont. et. N.

a&b.	Vegetative thallus	×10
c.	T. S. of thallus showing sporangial position	×20
d.	T. S. of thallus (a part)	×100
e.	Spore	×300

PLATE 5



Riccia billardieri Mont. et N.

6. ***Riccia bogransis*** (Kamruzzaman, Phd. Thesis, on the genus *Riccia* of Bangladesh, p. 77)

PLATE 6

Plant monoecious, usually dichotomously branched for once sometimes unbranched, green in color, overlapping and rarely forming rosette, ± 9.23 mm. long and ± 2.13 mm broad. Both smooth and rough rhizoids are arisen from the lower epidermis. Thallus fleshy, dorsal furrow distinct, margin slightly undulating. Scales not present. Cross section $\pm 1.98 \times 0.87$ mm (nearly double as broad as high). Epidermal cells hyaline, more or less rounded ± 45.32 μ m in diameter. Each photosynthetic filament contain 4-6 cells, each cell $\pm 51.23 \times 33.12$ μ m. Storage region thin, intercellular space distinct. Archegonia normally uniseriate, rarely biseriate. Antheridia biseriate. Sporangia grow ventrally, crowded. Spores more or less rounded, dark brown, ± 75 μ m in diameter, reticulation thick walled. Number of areoles 6 to 9 and each of which ± 6.12 μ m in diameter. Spores wing wavy, ± 7.12 μ m in wide. Triradiate marking not distinct.

Specimens examined

Sylhet: Tajpur, Balagonj, on moist soil, Shirin akhtar and Jahirul Haque, 12. 10. 2007, **39**; Fatepur, Goyainghat, on moist soil, Shirin Akhtar and Jahirul Haque, 12. 10. 2007, **41**; Alinagor, Biani Bazar, on moist soil, Shirin Akhtar and Jahirul Haque, 12. 10. 2007, **79**.

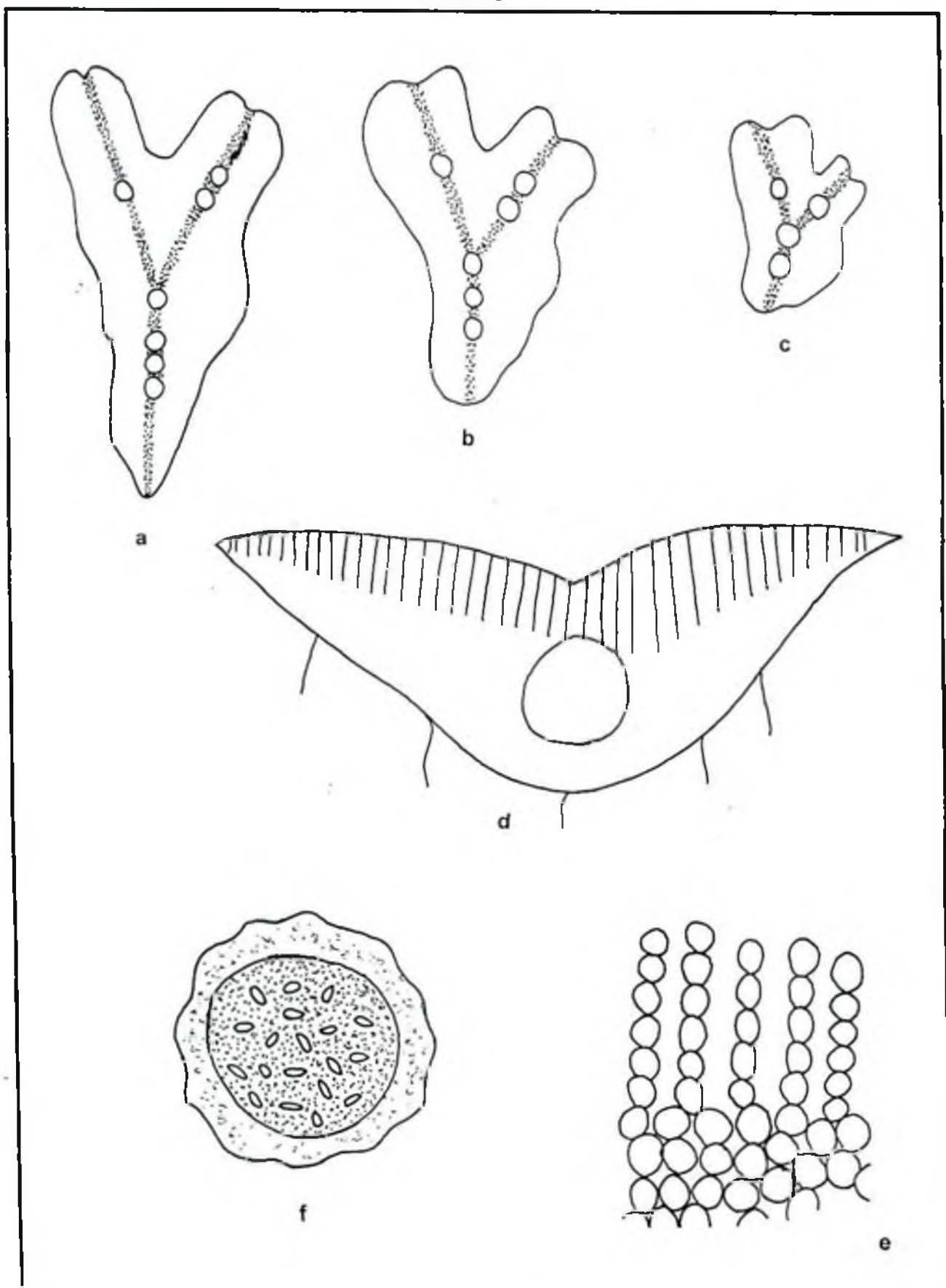
Habiganj: Nurpur, Habiganj, on moist soil, Shirin Akhtar and Jahirul Haque, 21.08.2008, **94**; Debpara, Nabigonj, on moist soil, Shirin Akhtar and Jahirul Haque, 21.08.2008, **313**.

PLATE 6

Riccia bogransis (Kamruzzaman)

- | | | |
|-----------|---|------|
| a, b & c. | Vegetative thallus | ×10 |
| d. | T. S. of thallus showing
sporangial position | ×30 |
| e. | T. S. of thallus (a part) | ×100 |
| f. | Spore | ×300 |

PLATE 6



Riccia bogransis (Kamruzzaman)

7. *Riccia lithophilii* (Kamruzzaman, Ph.D. thesis on the genus *Riccia* of Bangladesh, p. 136)

PLATE 7

Plant monoecious, green in colour, forming mat like, unbranched or dichotomously branched for once, usually grow on stones, ± 12 mm long and ± 2.23 mm broad, irregular overlapping, sometimes forming rosette and each rosette ± 1.23 cm in diameter. Thallus thick, linear, emarginated. Both smooth and rough rhizoids are arisen from the lower epidermis. Cross section $\pm 2.21 \times 1.98$ mm. Epidermal cell more or less round ± 35 μ m in diameter. Each photosynthetic filament contains 4-5 cells and each cell more or less rounded ± 28 μ m in diameter. Antheridia 2-3 seriate. Archegonia uniseriate. Sporangia grow ventrally. Normally one type of tetrad which is tetradhedral. Spores dark brown, ± 134 μ m in diameter, wall reticulate, dorsal reticulation complete, ventral reticulation incomplete. Number of areoles 6-9 and each of which ± 14.12 μ m in diameter. Spores wing crenate, ± 9.12 μ m in thickening. Triradiating mark distinct.

Specimens examined:

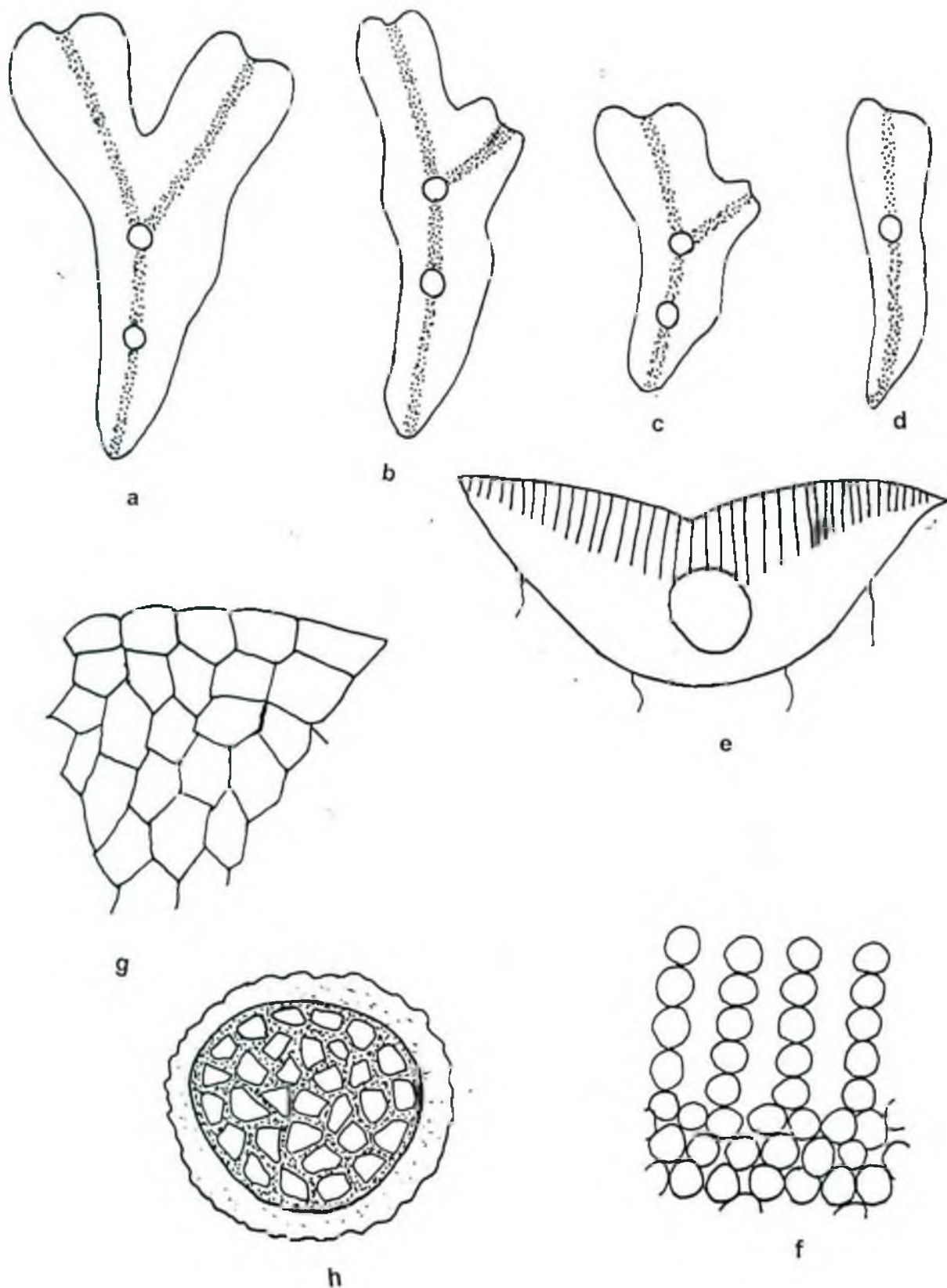
Maulvi Bazar: Balatia Hill, Srimongol, on moist stone, Shirin Akhtar and Jahirul Haque, 21.05.2007, 97.

PLATE 7

Riccia lithophilii (Kamruzzaman)

a, b, c & d.	Vegetative thallus	×10
e.	T. S. of Thallus showing sporangial position	× 30
f.	T. S. of Thallus (a part)	×100
g.	Scale	× 100
h.	Spore	×300

PLATE 7



Riccia lithophilii (Kamruzzaman)

FAMILY TARGIONIACEAE Dum.

Plants thalloid, yellow to green in colour. Air chamber of the thallus in a single layer. Antheridia grow on dorsal surface of the thallus. Archegonia grow just behind the growing point of thallus causing cessation of apical growth of thallus. Archegonia surrounded by involucre. Sporangium solitary, situated at anterior edge and postically displaced. Capsule wall one layered with annular thickenings. Elaters with 2-5 spiral bands.

GENUS *CYATHODIUM* Mehra & Sokhi (1872)

Thallus usually flat. Epidermal cells with chloroplast. Air pores surrounded by concentric ring of cells. Capsule spherical or oval, each enclosed by involucre. Capsule wall one layered with similar to annular bands. Elaters 2-3 spirals.

1. *Cyathodium tuberosum* Kashyap

Cyathodium tuberosum Kashyap, New Phyt. Vol. XII, p. 210 (1914)

Cyathodium penicillatum St., Sp. Hep. Vol. VI p. 4 (1916)

PLATE 8

Plant dioecious, thalloid, dichotomously branched for once to thrice, thin, small, tufted on old walls or ground, densely overlapping. Cells of the thallus are separated from each other by air space. Air pores surrounded by concentric rings of cells. Male plants less branched than female plants. Female plants rapid dichotomously branched, fan shaped with ascending margins. The narrow plants ± 1.32 cm long and ± 2.24 mm broad, sometimes larger

plants up to 2.5 cm long and 2.12 mm broad. Dorsal surface usually flat. Epidermal cells consist of chloroplasts. Dorsal pores found only in well developed female plants. Each pore surrounded by 2 or 3 series of 4-6 cells each. Ventral pores surrounded by ordinary cells of the thallus, elongated antero-posteriorly, simple, large. Two types of rhizoid both thin walled and thick walled arise from ventral surface of the thallus which has no peg. Scales arise from ventral portion of thallus which in rows, small plate, cells with chloroplast. Sporangium surrounded by involucre. Involucres ovoid, opened by elliptic mouth. Capsules ± 0.67 mm in diameter. Spores spiny, ± 62 μ m in diameter. Elaters very closely broadly trispiral, ± 543 μ m long.

Specimens examined

Sylhet: Tajpur, Balagonj, on moist soil, Shirin akhtar and Jahirul Haque, 15.

10. 2007, 99; Fatepur, Goyainghat, on moist soil, Shirin Akhtar and Jahirul Haque, 14. 10. 2007, 59; Alinagor, Biani Bazar, on moist soil, Shirin Akhtar and Jahirul Haque, 17. 09. 2007, 40.

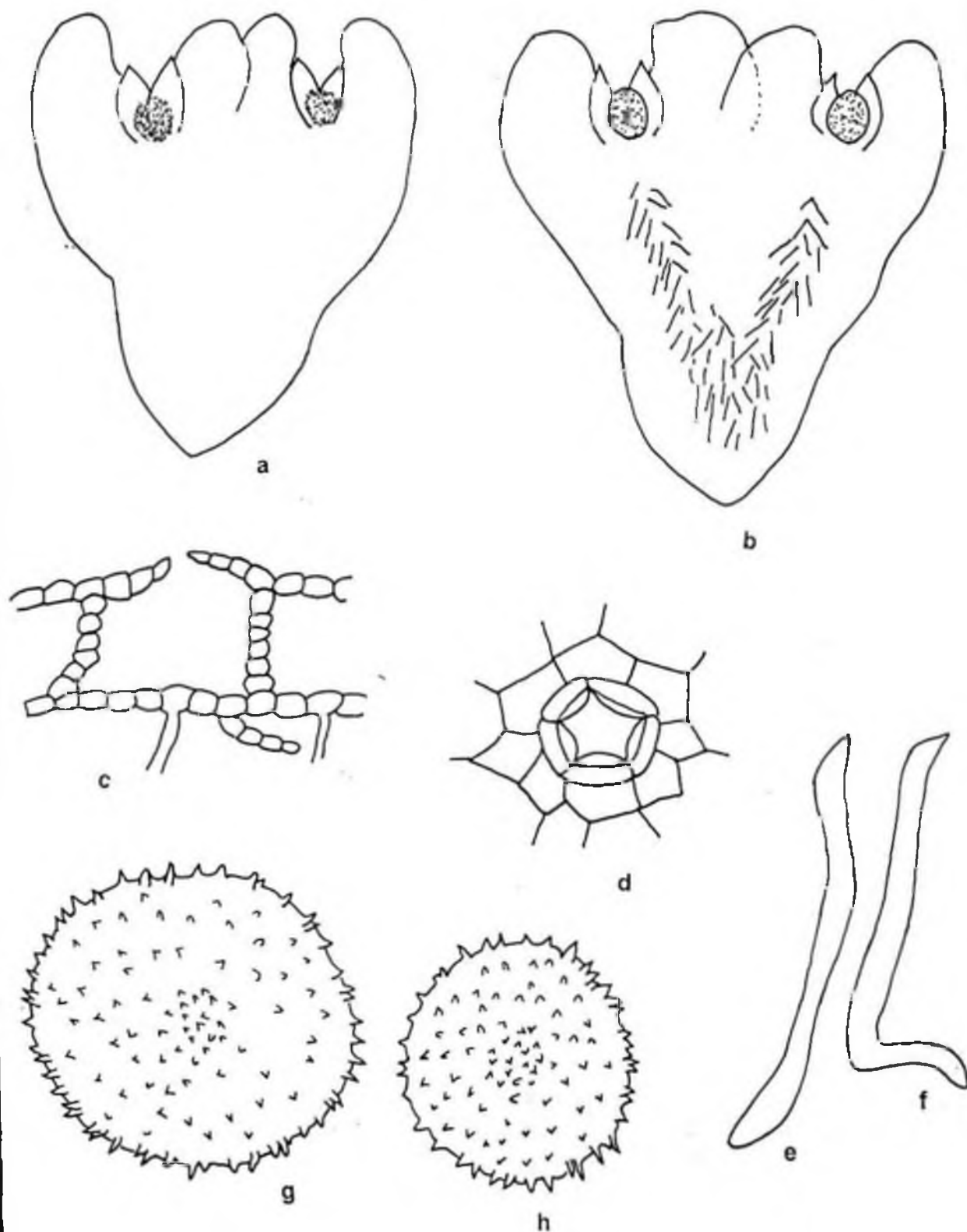
Habiganj: Monipur Tea Estate, Fenchsuganj, on moist soil, Shirin Akhtar and Jahirul Haque, 23. 10. 2007, 57; Habib Nagor Tea Estate, on moist soil, Shirin Akhtar and Jahirul Haque, 21. 10. 2007, 121.

PLATE 8

***Cyathodium tuberosum* Kashyap.**

a.	Vegetative thallus (dorsal view)	×10
b.	Vegetative thallus (ventral view)	×10
c.	T. S. of thallus (a part)	×200
d.	An air pore	×200
e & f.	Elaters	×150
g & h.	Spores	×450

PLATE 8



Cyathodium tuberosum Kashyap

FAMILY MARCHANTIACEAE

Plant thalloid with distinct midrib. Photosynthetic filaments with chloroplast. Air chamber well developed. Air pore surrounded by concentric rings of cells, Gemma cup contain with neumerous gemmae. Special stalked vertical branches which bear the archegonia and are known as archegoniophores and antheridia bearing stalk known as antheridiophore. Spore and elatar are found within sporangium.

GENUS *MARCHANTIA* (March) L.

Thalloid plants with well developed air chambered. Archegoniophore and antheridiophore bear archegonia and antheridia. Gemma and elater present.

KEY TO THE SPECIES OF *MARCHANTIA*

- | | |
|---|----------------------|
| 1. Thalloid elongated and margin of gemma cup entire and smooth | <i>M. palmata</i> |
| - Thalloid shorter and margin of gemma cup dentate | <i>M. nepalensis</i> |

1. *Marchantia palmata* Ness. Nova Acta XII, p. 193 (1824)

PLATE 9

Thallus dioecious, green in color, growing in patches, dichotomously branched, 5-10 cm long and 3-9 mm broad, with narrow lobes, margin entire, apex emerginate. Epidermal cells thin walled, pentagonal-hexagonal. Airpores consists of 6-7 superimposed concentric rings of cells, each of 5 or 6 celled, 2 rings above the epidermis. Two rows of scales arise from ventral side of each thallus. Scales are conspicuous on each side of the midrib of thallus.

Median scales fixed by an oblique semilunar longly decurrent base, appendaged, appendage sub-round to ovate, fixed by asemilunar decurrent base, tapering to an acute apex. Laminar scales, small, more or less quadrate, very close to the median scales. Marginal scales not present. Midrib slightly prominent below, gradually passing into the lamina ending in an acute margin. Gemma cup smooth or lobed or slightly warty at the margin. Female receptacle asymmetrical, deeply rayed and number of rays 8-12, green in color, with air chambers of the posterior side, slightly convex or flat, truncate or slightly emerginate. Stalk of the female receptacle ± 40 mm long. Male receptacle with many short lobes, or palmatifid with long narrow diverging lobes in the latter case 4-10 lobed. Stalk of the female receptacle ± 23 mm long. Air chamber present on the dorsal side near the base. Involucre hyaline, margin crispate, perianth purple. Capsule spherical, dark brown, several in each involucre. Spores reticulate, brown in color, ± 32 μm in diameter. Elaters prominent and each of which ± 540 μm long.

Specimens examined

Sylhet: Mominchora Tea Estate, Fenchuganj, on moist soil, Shirin Akhtar and Muzammel Haque, 15. 04. 2007, 87; Jaflong Tea Estate, Jaintapur, on moist soil, Shirin Akhtar and Muzammel Haque, 17. 05. 2008, 455.

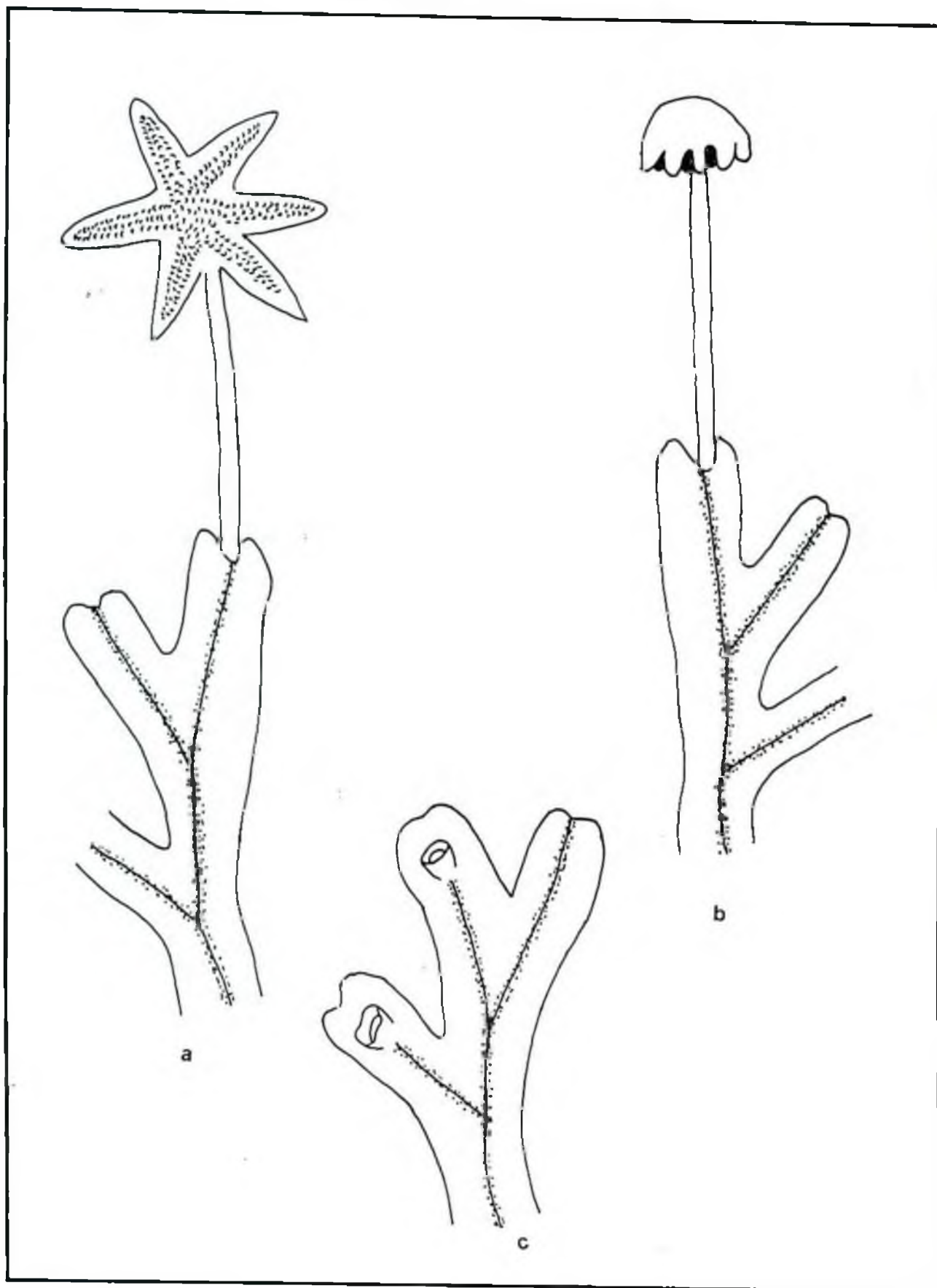
Maulvi Bazar: Noapara Tea Estate, Madhabpur, on damp wall, Shirin Akhtar and Muzammel Haque, 11. 04. 2007, 109.

PLATE 9

***Marchantia palmata* Ness**

- | | | |
|----|-------------------------------------|------|
| a. | Vegetative thallus (male thallus) | × 10 |
| b. | Vegetative thallus (female thallus) | × 10 |
| c. | Vegetative thallus (with gemma cup) | × 10 |

PLATE 9

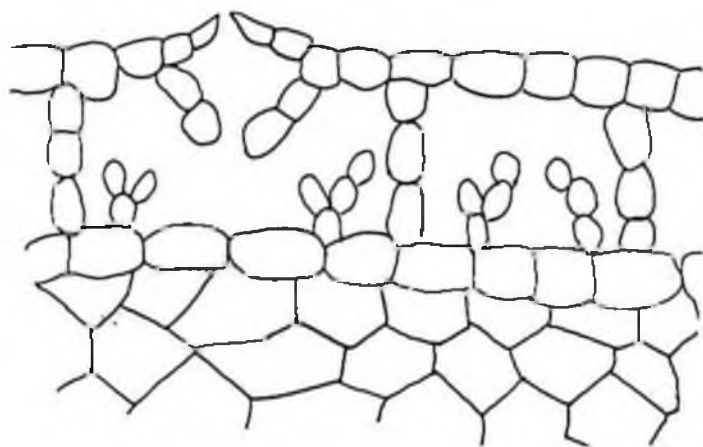


Marchantia palmata Ness

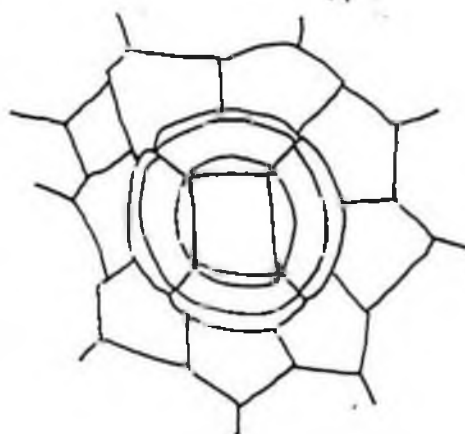
PLATE 9
(CONT.)

***Marchantia palmata* Ness.**

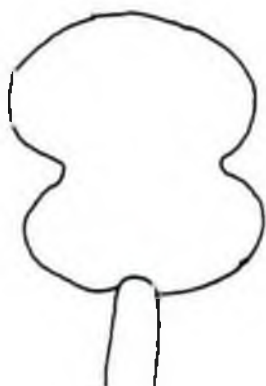
d.	T. S of thallus (a portion)	×20
e.	An air pore	× 200
f.	A single gemma	×80
g.	A complete scale	× 80
h & i	Tip of elatars	×450
j & k.	Spores	×450



d



e



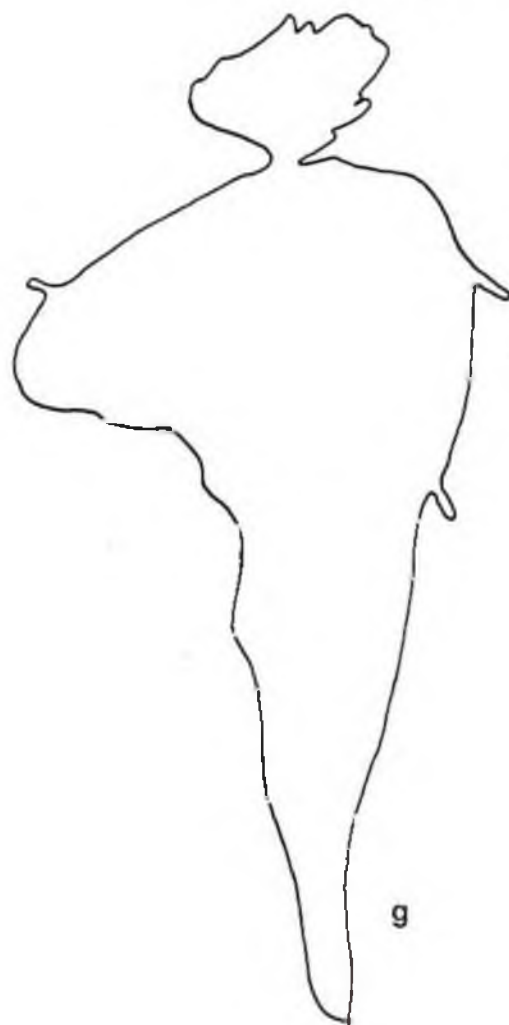
f



h



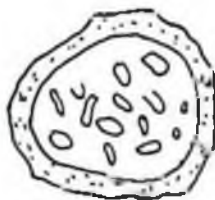
i



g



j



k

Marchantia palmata Ness

2. *Marchantia nepalensis* L. et L.

Marchantia nepalensis L. et L. in Lehm. Plug. IV. P. 10 (1832)

PLATE 10

Thallus dioecious, highly dichotomously branched, green in color, large in patch and overlapping. Female thallus larger than male one. Female thallus $\pm$ 84 mm long and $\pm$ 12 mm broad. Male thallus $\pm$ 54 mm long and $\pm$ 11 mm broad, lobes short and broad. Flat margin entire to crisped, apex emerginate. Airpores consists of 6-9 superimposed concentric rings of cells, each of 5 or 6 cells, 2 rings above the epidermis. Epidermal cells thin walled, pentagonal to hexagonal, oil cells are found in thallus. Two rows of scales arise from ventral side of each thallus. Scales are conspicuous on each side of the midrib of thallus. Median scales appendaged, appendage ovate to ovate-lanceolate, fixed by a semilunar decurrent base, tapering to an acute apex. Laminar scales, small, lingulate, very close to the median scales. Marginal scales not present. Midrib not prominent. Round gemmae cups grow on midrib at tip region on thallus, margin of gemmae dentate to shortly spinose. Female receptacle green posteriorly with air chamber and brown anteriorly, $\pm$ 5.6 mm long, no scales at basal region. Male receptacle green, stalk of the female receptacle $\pm$ 6.5 mm long, slightly lobed and number of lobed 7-9. Involucres hyaline. Spores brown, granular, $\pm$ 30.23 μ m in diameter, Elaters elongated, $\pm$ 860 μ m long.

Specimens examined

Sylhet: Mominchora Tea Estate, Fenchuganj, on moist soil, Shirin Akhtar and Muzammel Haque, 15. 04. 2007, 90; Jaflong Tea Estate, Jaintapur, on moist soil, Shirin Akhtar and Muzammel Haque, 17. 05. 2008, 451.

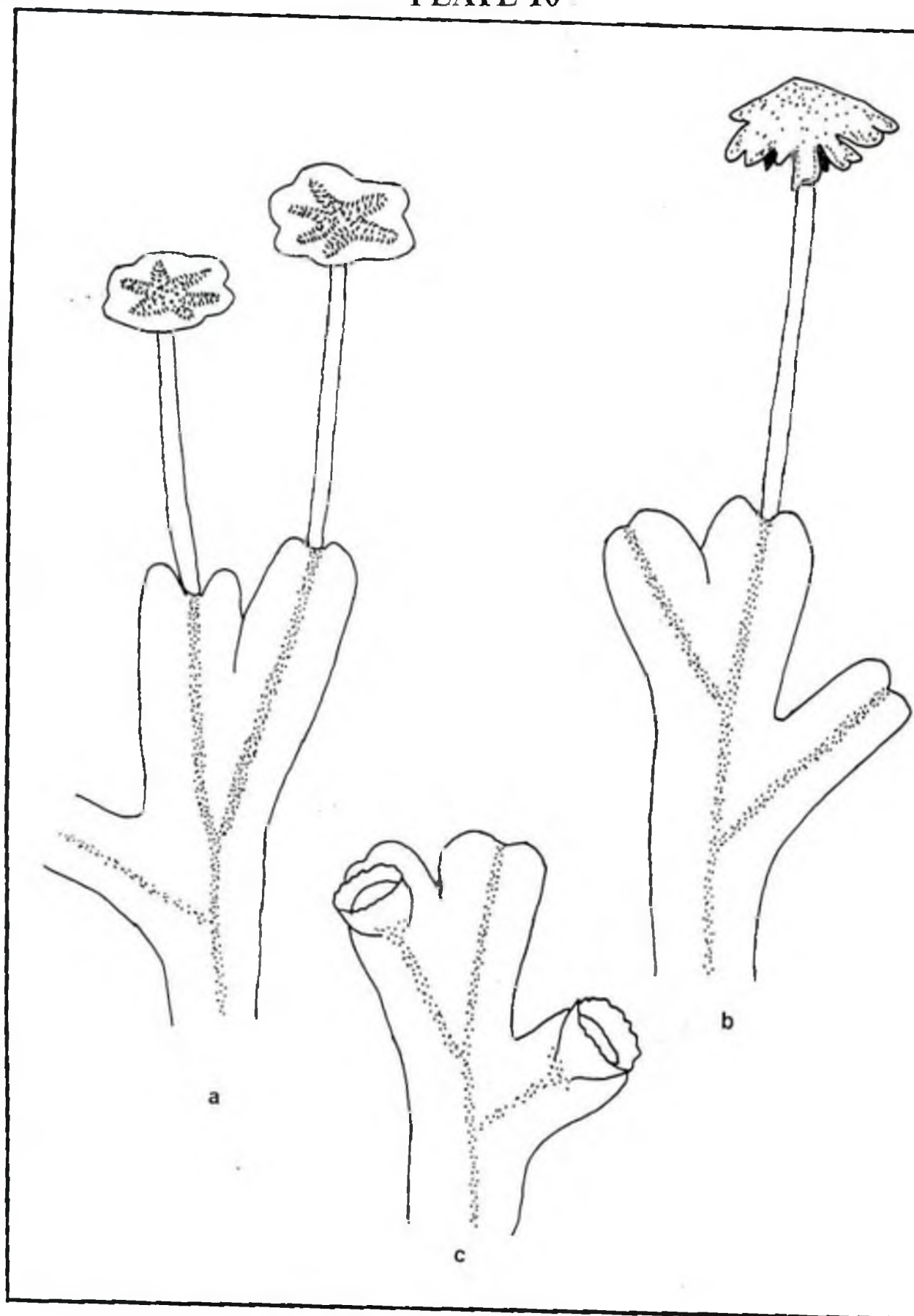
Maulvi Bazar: Hamidia Tea Estate, Maulavi Bazar sadar, on moist soil, Shirin Akhtar and Muzammel Haque, 09. 04. 2007, 73.

PLATE 10

***Marchantia nepalensis* L. et. L.**

- | | | |
|----|-------------------------------------|------|
| a. | Vegetative thallus (male thallus) | × 10 |
| b. | Vegetative thallus (female thallus) | × 10 |
| c. | Vegetative thallus (with gemma cup) | × 10 |

PLATE 10

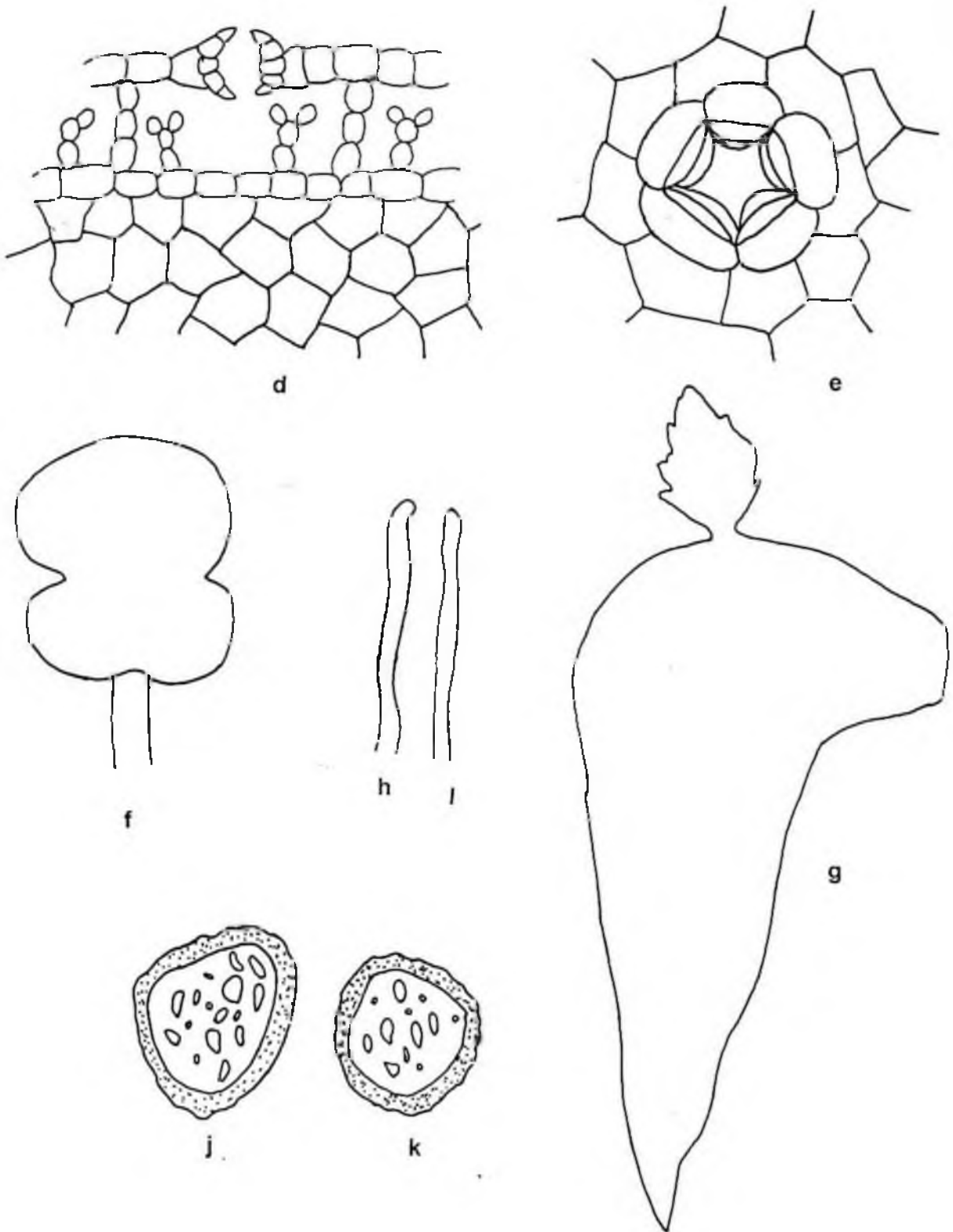


Marchantia nepalensis L. et L.

PLATE 10
(CONT.)

***Marchantia nepalensis* L. et. L.**

d.	T. S. of thallus (a portion)	×20
e.	An air pore	× 200
f.	A single gemma	×80
g.	A complete scale	× 80
h & i	Tips of elatars	×450
j & k.	Spores	×450



Marchantia nepalensis L. et L.

CLASS ANTHOCEROPSIDA

The gametophytic plant body is a dorsiventral, lobed thallus without any internal differentiation of tissues. The rhizoids are smooth-walled and ventral scales are absent. The cells lack of oil bodies. The antheridia arise on the dorsal surface of the thallus. The archegonia are almost complete embedded in the tissue of the thallus of the dorsal surface. The sporophyte consists of bulbous foot, a meristematic region and a long cylindrical capsule. The wall of the capsule is often rich in chlorophyll. The maturation of the capsule is from the tip downwards, and usually dehisces gradually into two valves which show hygroscopic twisting.

ORDER ANTHOCEROTALES

The gametophytic plant body is a dorsiventral, lobed thallus without any internal differentiation of tissues. The rhizoids are smooth-walled and ventral scales are absent. The cells lack of oil bodies.

FAMILY ANTHOCEROTACEAE

Gametophytic plant body thalloid and differentiated into dorsal and ventral region. Internal tissue of the thallus not differentiated. Sporophyte long, or short, erect or horizontal, involucre covered at base or fully covered. Scale smooth walled or scale absent.

KEY TO THE GENERA OF ANTHOCEROTACEAE

1. Thalloid shorter and sporophyte
erect and long

Anthoceros

- Thalloid elongated, sporophyte
horizontal and short

Notothylas

GENUS **ANTHOCEROS** L.

Anthoceros L. Spec. Pl. ed. 1: 1139, Prosk.,

Bull Torrey bot. Club. 78: 331-349, 1951

Plant thalloid, dorsiventrally differentiated. Thallus lacking of large mucilage cavities. Sporophyte long, erect. Envolucre is at basal portion of the sporophyte.

Spore smooth, scale absent.

***Anthoceros laevis* L.**

PLATE 11

Thallus diocious; smooth, dark green, normally forming rosette, ± 1.0 cm long and ± 1.12 cm board, solid with segments slightly overlapping along with margin, margin crispate. Thallus firmly attached to soil, 7-9 cells thick at the middle, surface variable. Male thallus narrower than the female thallus. *Nostoc* colonies present. Sporophyte ± 1.24 cm long and ± 0.45 mm in diameter. Sporophyte wall consists of stomata. Each stomata ± 78 μ m long and ± 52 μ m broad with guard cells. Involucre ± 0.26 cm long. Spores more or less round, yellow in color, thick walled, ± 72 μ m in diameter. Elaters branched or unbranched, unicellular or multicellular, brown in color, ± 87 μ m.

Specimens examined

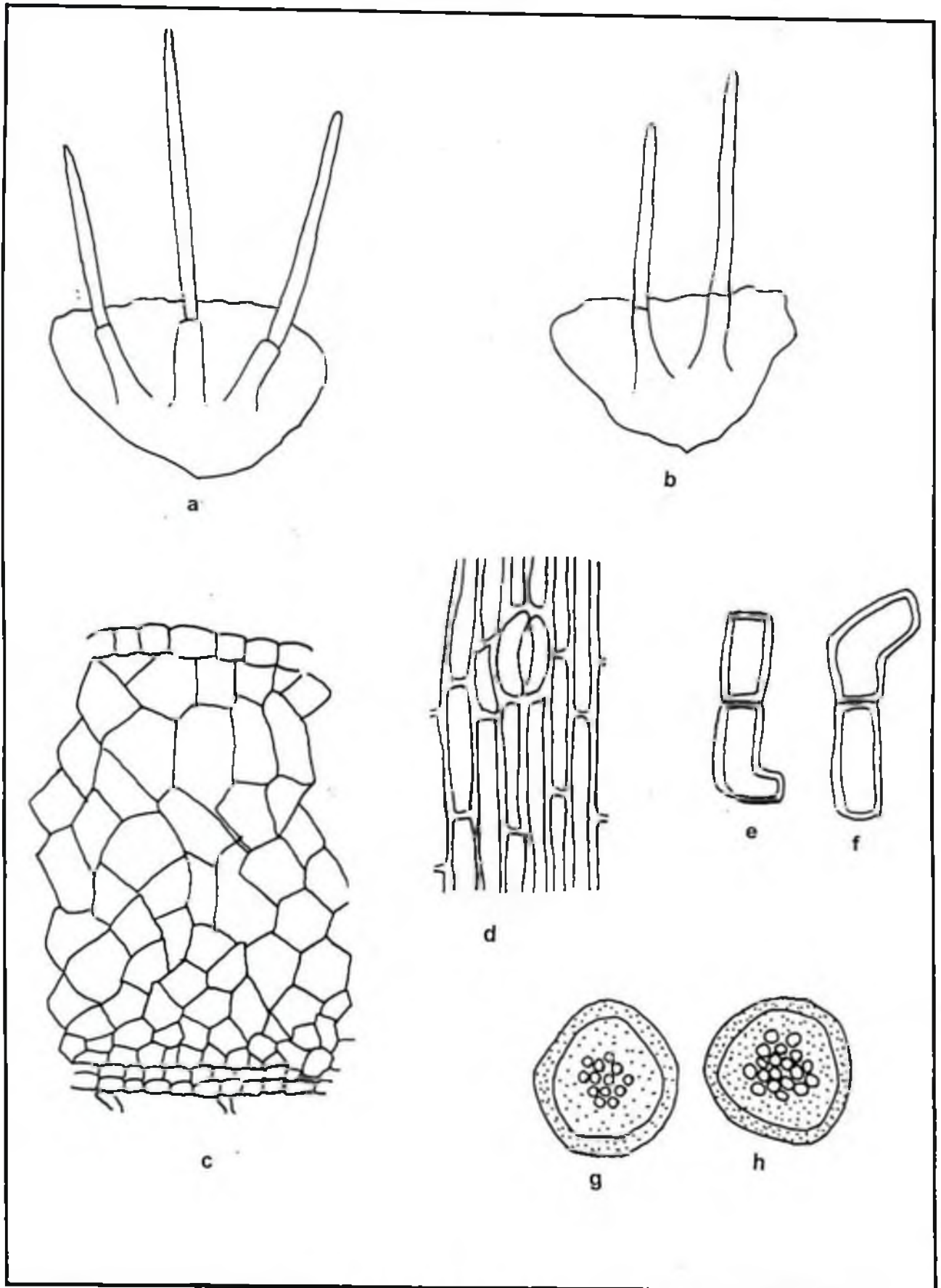
Sylhet: Mominchora Tea Estate, Fenchugonj, on moist soil, Shirin Akhtar and Muzammel Haque, 14. 08. 2007, **242**; Jaflong Tea Estate, Jaintapur, on moist soil, Shirin Akhtar and Muzammel Haque, 18. 07. 2008, **458**.

Habiganj: Monipur Tea Estate, Fenchugonj, on moist soil, Shirin Akhtar and Jahirul Haque, 23. 08. 2007, **329**; Habib Nagor Tea Estate, on moist soil, Shirin Akhtar and Jahirul Haque, 22. 07. 2007, **119**.

PLATE 11

***Anthoceros laevis* L.**

a & b.	Vegetative thalli	×10
c.	T. S. of thallus (a portion)	× 250
d.	Sporophyte wall showing stomata	× 300
e & f.	Elaters	× 550
g & h.	Spores	×550



Anthoceros laevis L.

GENUS **NOTOTHYLAS** Sulliv.

Plants thalloid, dorsiventral. On ventral surface there are found only smooth walled rhizoid and scale absent. Sporophyte short, horizontal to the surface, often fully covered with involucre.

Notothylas indica Kashyap.

PLATE 12

Thallus monoecious, green in color forming rosette, ± 1.72 cm long and ± 1.45 cm in diameter. Thallus 6-9 cells thick at middle. *Nostoc* colonies abundant within the thallus. Sporophytes born horizontally along the lobes, cylindrical, straight, sometimes curved, tapering at both ends. Young sporophyte yellow in color but at maturity condition it becomes black in color. Each sporophyte enclosed within the involucre or projected beyond it, ± 4.62 mm long. Epidermis of sporophyte thick, stomata absent. Capsule two valved, margin of each valve with a row of thick brown cells. Collumella well developed. Spores granular, ± 43 μ m in diameter. Elaters different in shapes and variable with thickening by oblique bands, as like as spore tetrads, ± 53 μ m long.

Specimens examined

Habiganj: Taliapara Tea Estate, Chunarughat, on slope of Hill, Shirin Akhtar and Muzammel Haque, 13. 08. 2007, 114 ; Noapara Tea Estate, Madhabpur, on slope of Hill, Shirin Akhtar and Muzammel Haque, 18. 08. 2008, 478.

PLATE 12

Notothylas indica Kashyap.

a.	Vegetative thallus with immature sporophyte	×10
b.	Vegetative thallus with mature sporophyte	×10
c.	T. S. of thallus (a portion)	×200
d.	A sporophyte (dehiscid)	× 20
e.	An elater	× 700
f & g.	Spores	× 550

PLATE 12



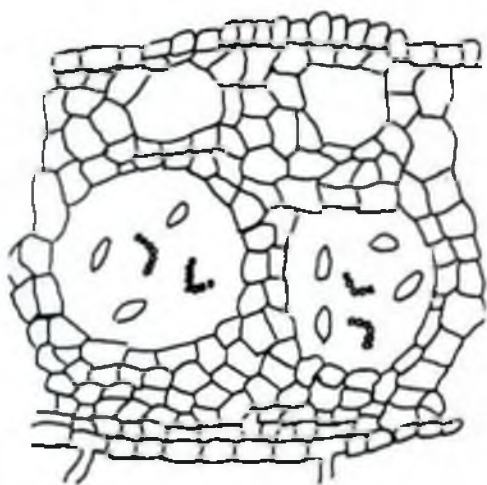
a



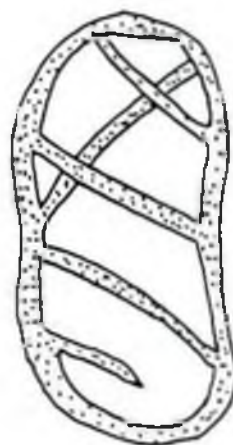
b



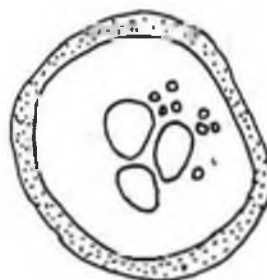
d



c



e



f



g

Notothylas indica Kashyap

CLASS BRYOPSIDA

The gametophytic plants differentiated into stem leaves and rhizoid. The rhizoids are multicellular branched and provided with oblique cross section walls. Gametophyte bear sex organ. The sex organs usually show a definite apical cell in earlier stages of their development. The sporophyte differentiated into foot, seta and capsule.

KEY TO THE ORDERS OF BRYOPSIDA

- | | |
|---|--------------|
| 1. Plants acrocarpic | 2 |
| -Plant pleurocarpic | 7 |
| 2. Leaves cells smooth and alar cells not differentiated | Diranales |
| -Leaves cells not so alar cells differentiated | 3 |
| 3. Each leaf consist of sheathing lamini and leaf cells forming limbidium | Fissidetales |
| -Leaf not so and leaf cells not forming limbidium | 4 |
| 4. Plants epiphytic, leaves curved apex | |
| Syrrhopodontales | |
| -Plants not epiphytic and leaves not so | 5 |
| 5. Capsule cylindrical, operculum conic-rostrate, calyptras hooded | Pottiales |
| -Capsule not cylindrical, operculum and calyptras not so | 6 |
| 6. Plants small in size, stem simple normally weak | Funariales |
| -Plants larger in size, stem strong | Eubryales |
| 7. Leaf margin smooth, alar cells not distinguished | Isobryale |
| -Leaf margin serrate or dentate alar cells distrinct | Hypnobryale |

ORDER DICRANALES

Plants medium in size. Leaves 3 or more ranked more or less linear. Leaf cells smooth, basal laminal cells quadrate to linear, upper laminal cells quadrate to rectangular; alar not differentiated. Sporophyte grow terminally of gametophyte. Sporophyte differentiated into foot, seta and capsule, ovoid. Cylindrical, normally curved. Collumella present.

FAMILY LEUCOBRYACEAE

Plants medium in size, green in color, growing vigorously. Stem usually unbranched rarely branched, densely foliate, without central stand. Leaf cells smooth, basal laminal cells quadrate to linear, upper laminal cells quadrate to rectangular; alar not differentiated. Sporophyte ovoid, cylindrical, normally curved, grow terminally of gametophyte, differentiated into foot, seta and capsule. Collumella present.

GENUS *OCTOBLEPHARUM* Hedw.

Sp. Musc. 50 (1801)

Lectotype : *O. albidum* Hedw.

Plants green in color, in dense cushion. Leaves thick, lingulate, crowded, rigid, loosely attached to the stem, flat. Costa broad at base by delicate, hyaline. Seta erect. Capsule erect, symmetrical. Operculum conic rostrate. Calyptra cuculate. Spores more or less round, finely papillose.

1. *Octoblepharum albidum* Hedw., Sp. Musch. 50 (1801)

O. martinicense Mitt. in Card., Mem. Soc. Sc. Nat. Cherbourg 32 : 41 (1901) *nom. nud.*

O. pallidum Besch in Card., Mem. Soc. Sc. Nat. Cherbourg 32 : 41 (1901) *nom. nud.*

PLATE 13

Plants autoicous; green in color, in dense cushions, ± 10 mm high with leaves. Stem branched or unbranched, reddish-brown, ridiculous, thickly coated with loosely attached leaves. Leaves lingulate from a wider, oblong or narrowly ovate, concave base, crowded, erect, spreading, rigid, thick, flat, upper leaves longer than lower leaves, ± 8.23 mm long and ± 1.0 mm wide at middle. Some leaves consist of numerous gemmae whose arise from leaf apex. Margin entire. Apex apiculate. Costa brown, broad and thick, occupying half of the leaf base and entire blade. Upper laminal cells more or less quadrate, $\pm 65 \times 45$ μm , middle laminal cells quadrate-rhomboidal, $\pm 85 \times 42$ μm , basal laminal cells more or less quadrate, $\pm 95 \times 35$ μm . Capsule erect, oblong to ovoid, symmetrical, ± 0.85 mm long and 0.45 mm in diameter. Seta straight, erect, smooth, brown, ± 3.5 mm long. Operculum conic-rostrate, ± 42 mm long. Calyptra cuculate or hooded. Spore more or less round, brown, ± 23.12 μm in diameter, finely papillose.

Specimens examined

Sylhet: Jaflong Tea Estate, on bark of tree, Shirin Akhtar and Muzammel Haque, 13. 11. 2007, **133**; Sadipur, Balagonj, on bark of a tree, Shirin Akhtar and Muzammel Haque, 12. 11. 2008, **481**.

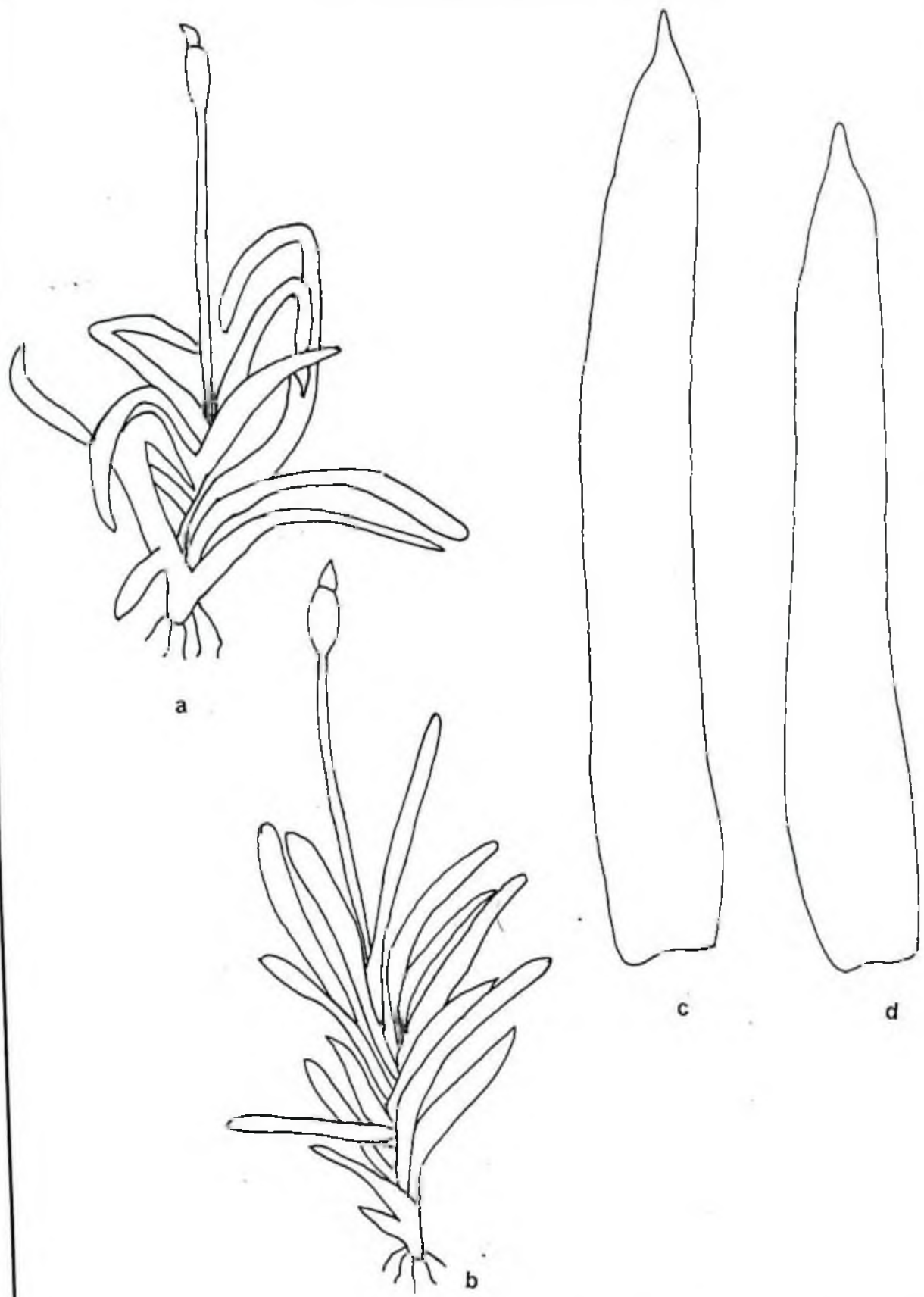
Maulvi Bazar: Rahimpur, Komolgonj, on bark of a tree, Shirin Akhtar and Muzammel Haque, 15. 11. 2007, **118**; Saphipur, Kulaura, on bark of a tree, Shirin Akhtar and Muzammel Haque, 17. 11. 2008, **439**; Tilagaon, Komolgonj, on bark of a tree, Shirin Akhtar and Muzammel Haque, 18. 11. 2008, **461**.

Habiganj: Taliapara tea Estate, Madhabpur, on bark of a tree, Shirin Akhtar and Muzammel Haque, 21. 10. 2007, **177**; Debpara, Nabiganj, Shirin Akhtar and Muzammel Haque, 18. 11. 2009, **581**.

PLATE 13

Octoblepharum albidum Hedw.

- | | | |
|--------|-----------|-----|
| a. | Dry plant | ×10 |
| b. | Wet plant | ×10 |
| c & d. | Leaves | ×10 |

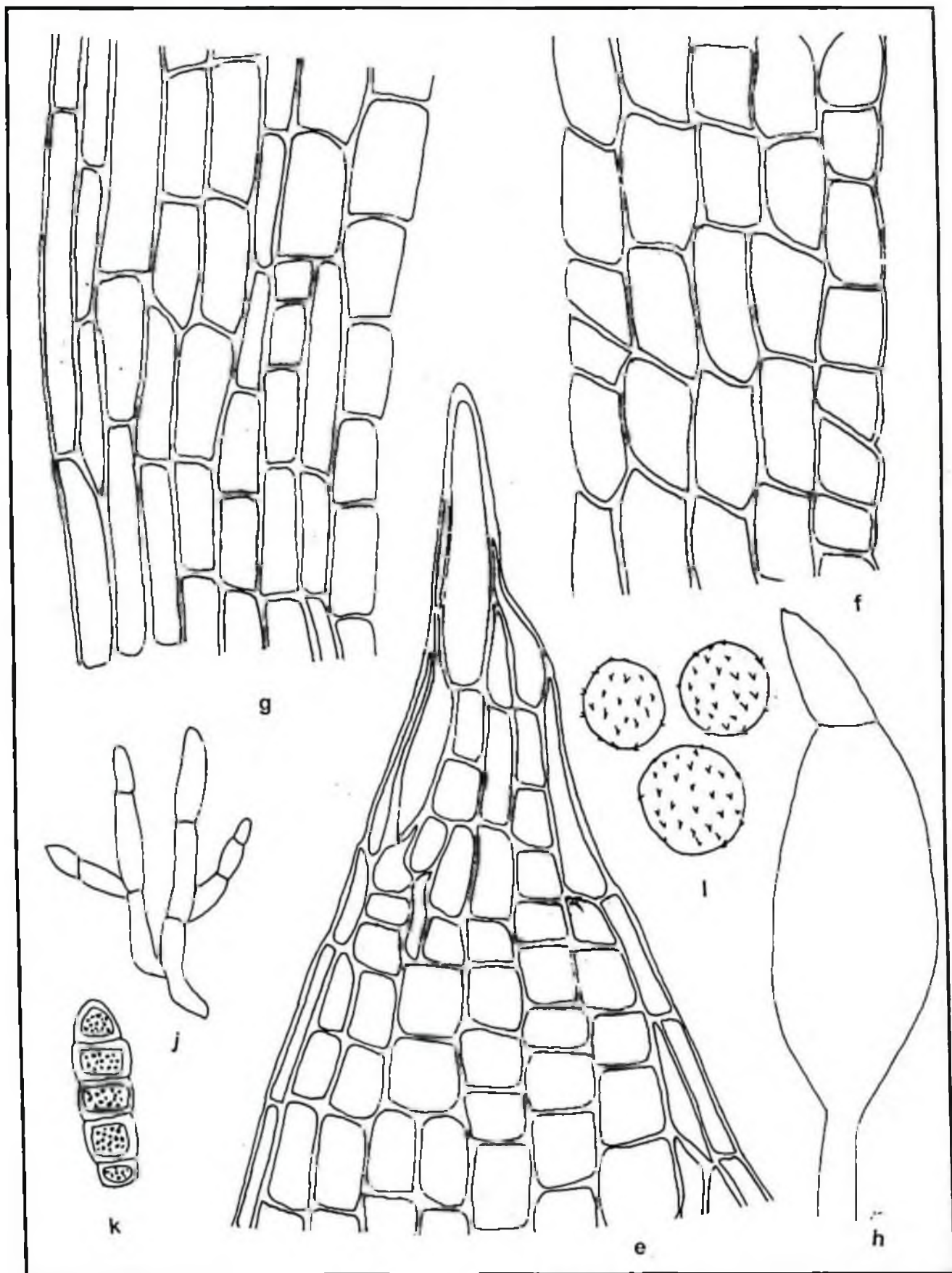


Octoblepharum albidum Hedw.

PLATE 13
(CONT.)

***Octoblepharum albidum* Hedw.**

e.	Leaf apex	×450
f.	Middle laminal cells	×450
g.	Basal laminal cells	×450
h.	Capsule with operculum	×450
i.	Spores	×450
j.	Gemma cluster	×100
k.	Single gemma	×450



Octoblepharum albidum Hedw.

ORDER FISSIDENTALES

Plant small to fairly robust. Leaves distichous, complanate. Each leaf consists of a characteristic conduplicate parts clasping the stem known as 'sheathing lamini', beyond the sheathing lamini on the same side of the costa is 'dorsal lamina'. Upper laminal cells rounded, pentagonal, hexagonal, unistratose or bistratose in patches, smooth, papillose or mamilllose, 1-3 stratose border of narrow, cartilaginous cells forming 'limbidium'. Costa percurrent to excurrent, rarely ending much below tip. Seta long or short. Sporophyte erect or inclined, grow terminal, sometimes lateral, normally symmetrical. Calyptra cucullate, entire at base. Spores small.

FAMILY FISSIDENTACEAE

Characters are same as that of order.

GENUS *FISSIDENS* Hedw.

Sp. Musc. 152 (1801)

Skitophyllum Pyl., J. de Bot. Ser. 2, 4: 133 (1814) *nom. illeg. incl. gen. prior.*

Schistophyllum Lindb., U & K nat. Crupp. Em Baldm. 16 (1878) *nom. illeg. incl. sp. prior.*

Lectotype : *F. bryoides* Hedw. *fid. Britt.*

Characters are as same as that of order.

KEY TO THE SPECIES OF *FISSIDENS*

1. Sheathing lamini equal 2
 - Sheathing lamini unequal or closed 6

2. Costa percurrent
 (ending far below tip) *F. splachnobryoides*
 - Costa excurrent 3

3. Sheathing lamini $\frac{1}{2}$ or
 less than $\frac{1}{2}$ of the leaf *F. xiphioides*
 - Sheathing lamini more than $\frac{1}{2}$ of the leaf 4

4. Leaf cells papillose 5
 - Leaf cells non papillose *F. zollingeri*

5. Leaf larger and wider *F. virens*
 - Leaf smaller and narrower *F. semperfalcatus*

6. Leaf apex distinctly dentate/crispate 7
 - Leaf apex not so 8

7. Plants and leaf larger in size *F. nobilis*
 - Plant and leaf smaller in size *F. orishae*

- | | | |
|-----|-----------------------------------|---|
| 8. | Costa percurrent | 9 |
| | - Costa excurrent | <i>F. ganguleei</i> |
| 9. | Leaf surrounded with thick border | <i>F. javanicus</i> |
| | - Leaf not so | 10 |
| 10. | Leaf with semilimbium | <i>F. diversifolius</i> var.
<i>rubicaulis</i> |
| | - Leaf without semilimbium | 11 |
| 11. | Leaf base rounded | <i>F. laxitextus</i> |
| | - Leaf base not rounded | <i>F. laxus</i> |

1. *Fissidens splachnobryoides* Broth. In Schum *et* Lauterb., Fl. Deutsch. Schutz. Suedsee. 81 (1900).

PLATE 14

Plants green in color, grow scattered or vigorously, ± 3.98 mm long and ± 1.45 mm wide with leaves. Stem unbranched, with 6-9 pairs of leaves. Leaves oblong-lanceolate, widely acuminate, curled but not much crumpled when dry, ± 1.41 mm long and ± 0.26 mm broad. Sheathing lamini equal, usually $1/2$ and sometimes $2/3$ of the whole leaf length. Dorsal lamina narrowing down to base and then short decurrent. Apical lamina symmetrical. Margin plane, entire. Simple, uniform, smooth limbium of 1-4 rows of elongated yellowish cartilaginous cells all, 1 rowed at apex and 3 rowed at sheathing lamini. Costa brown, ending far below of leaf apex. The

length of costa more or less $\frac{3}{4}$ of the whole leaf. Laminar cells chlorophyllose, smooth, transparent, oval- rhomboidal, tip cells $\pm 17.82 \times 15.21 \mu\text{m}$, middle laminar cells $\pm 20.8 \times 10.6 \mu\text{m}$, basal laminar cells $\pm 24.34 \times 8.29 \mu\text{m}$. Border cells $\pm 62.32 \times 2.45 \mu\text{m}$. Sporophytes not found.

Specimens examined

Maulvi Bazar: Chadnighat, Maulvi Bazar Sadar, on moist soil, Shirin Akhtar and Jahirul Haque, 26.09.2007, **51**; Najirabad, Maulvi Bazar sadar, on moist soil, Shirin Akhtar and Jahirul Haque, 26.10.2007, **110**.

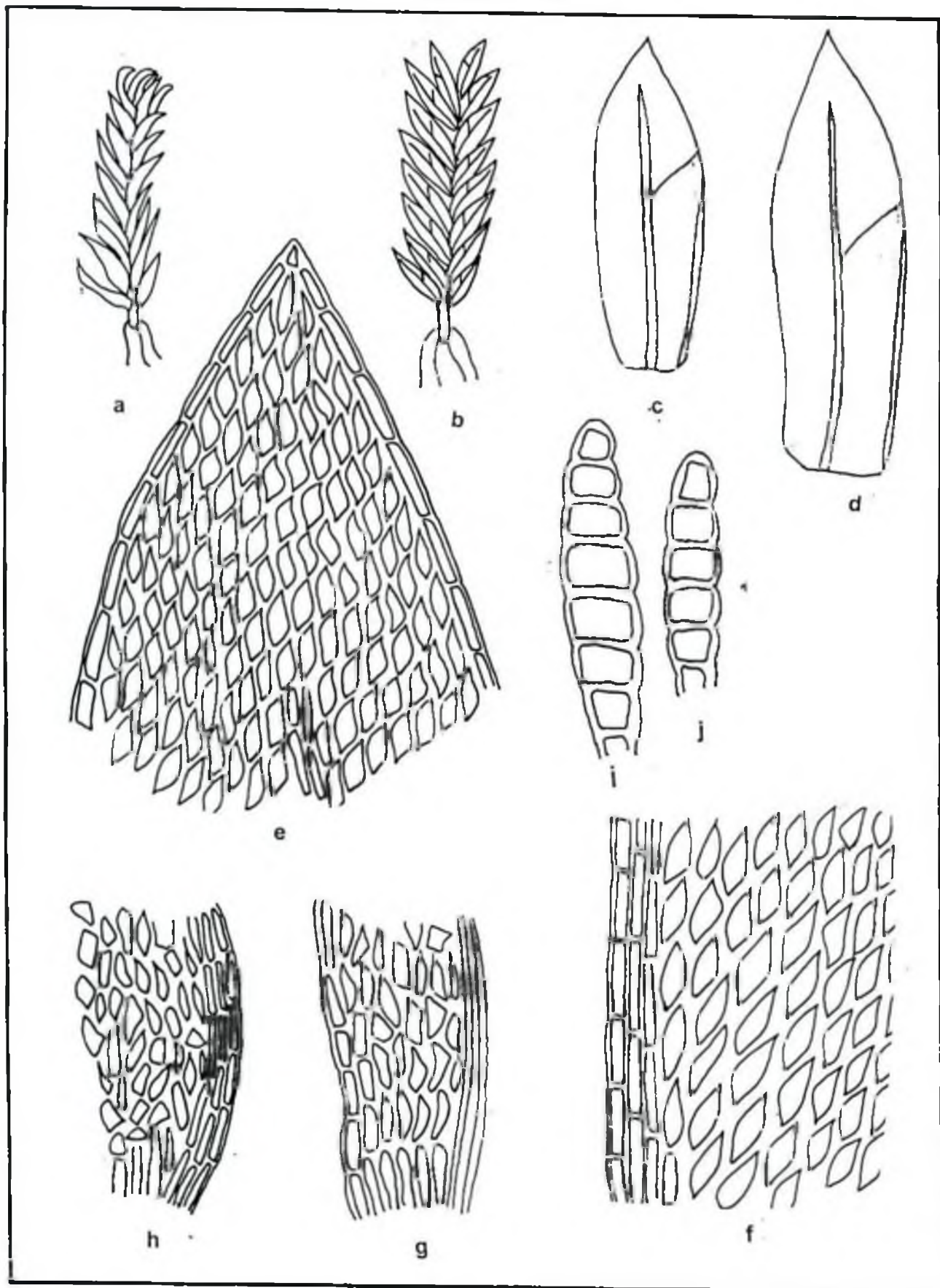
Habiganj: Chaumohoni, Madhabpur, on moist soil, Shirin Akhtar, 22.08.2007, **49**; Debpara, Nabiganj, on moist soil, Shirin Akhtar, 24.08.2007, **75**.

Sunamganj: Mollapara, Sunamganj Sadar, on sandy soil, Shirin Akhtar, 25.08.2007, **71**; Dinarpur, Azmariganj, on sandy soil, Shirin Akhtar, Jahirul Haque and Monirul Haque, 27.08.2008, **375**.

PLATE 14

Fissidens splachnobryoides Broth.

- | | | |
|--------|---------------------------------|-------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c & d. | Leaves | × 30 |
| e. | Leaf apex | × 225 |
| f. | Middle laminal cells | × 225 |
| g. | Basal cells in dorsal lamini | × 225 |
| h. | Basal cells in sheathing lamini | × 225 |
| i & j. | Gemmae | × 100 |



Fissidens splachnobryoides Broth.

2. ***Fissidens xiphioides*** Fleisch. , Hedwigia 38: 125 (1899)

Conomitrium bengalense Hamp. In C. Muell. , Linnaea 39 : 364 (1896) *nom. nud.*

Fissidens bengalensis Par. Index Bryol. 461 (1896) *nom. nud.*

PLATE 15

Plants robust, light to dark-green, 1.85-3.8mm high and up to 2.54mm broad with leaves. Stem with central strand unbranched, with 4-6 pairs of leaves. Leaves slightly curved when dry. Leaves oblong-lingulate to oblong-lanceolate, gradually bigger towards apex, ± 1.85 mm long and ± 0.56 mm wide. Sheathing lamina $1/2$ to little more than $1/2$ of the whole leaf, generally equal. Dorsal lamina narrowing down to base. Apical lamina more or less symmetrical. A limbidium of cartilaginous, elongated cells almost completely surrounds the leaf, 1 layer in apical lamina and dorsal lamina 2-3 layered at base of the sheathing lamina which become two layer at apex. Costa prominent, green to light-brown, ± 30 μ m broad at base, excurrent. Laminal cells lax, smooth, hexagonal ± 27 μ m diagonally; basal cells more elongated, especially in sheathing lamina, $\pm 28 \times 11$ μ m, cells begin bigger towards costa. Sporophyte not found.

Specimens examined

Sylhet: Jaflong Tea Estate, Jaintapur Tea Estate, on moist soil, Shirin Akhtar and Muzammel Haque, 13. 11. 2007, 135; Sadipur, Balagonj, on moist soil, Shirin Akhtar and Muzammel Haque, 12. 11. 2008, 501.

Maulvi Bazar: Chadnighat, Maulvi Bazar sadar, on moist soil, Shirin Akhtar and Jahirul Haque, 26.09.2007, 91; Najirabad, Maulvi Bazar sadar, on moist soil, Shirin Akhtar and Jahirul Haque, 26.10.2008, 503.

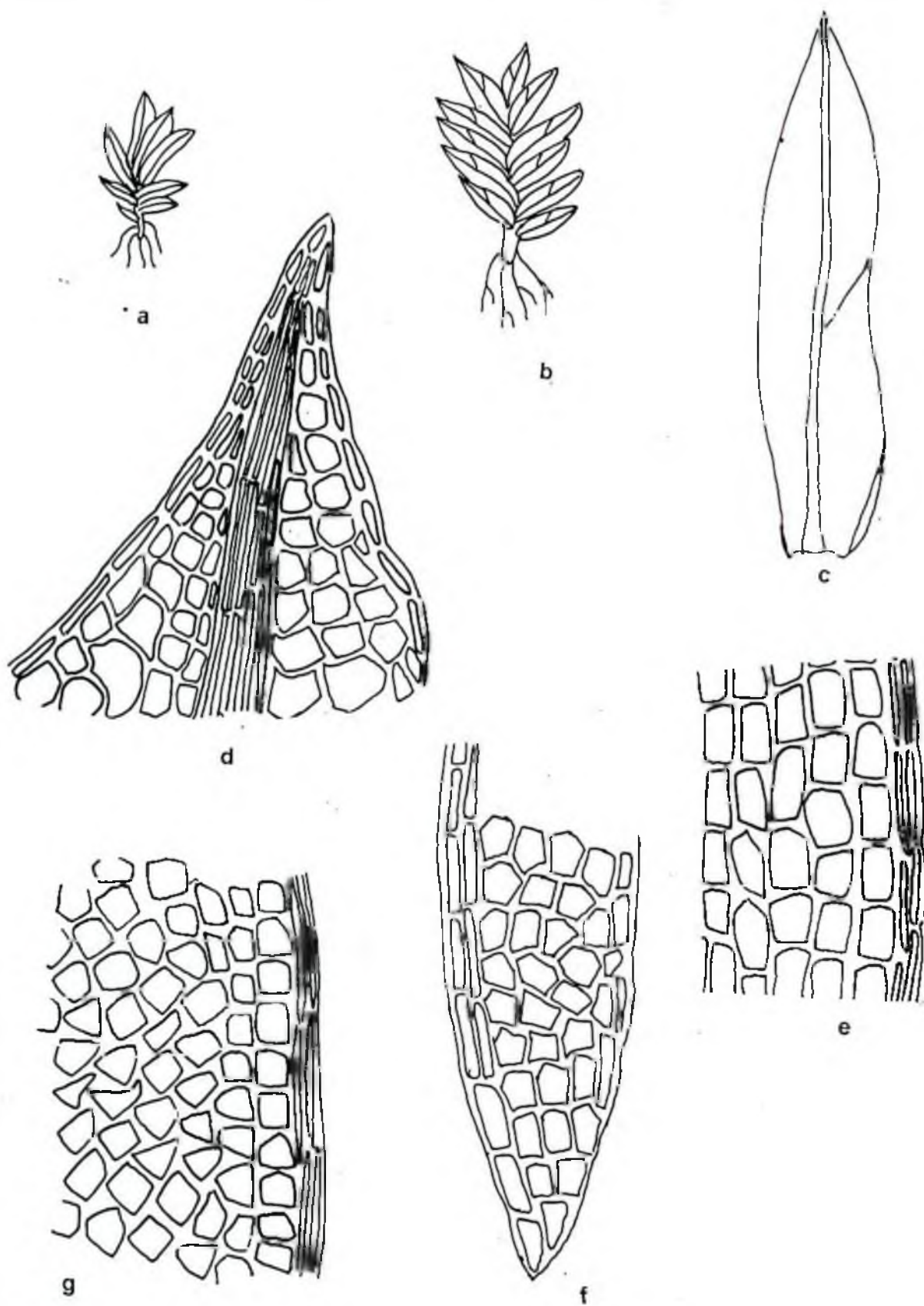
Habiganj: Noapara Tea Estate, Madhabpur, on moist soil, Shirin Akhtar and Jahirul Haque, 25.09.2007, 172; Surma Tea Estate, Madhabpur, on moist soil, Shirin Akhtar and Jahirul Haque, 24.09.2008, 497.

PLATE 15

Fissidens xiphioides Fleisch.

- | | | |
|----|---------------------------------|-------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c. | Leaf | × 30 |
| d. | Leaf apex | × 450 |
| e. | Middle laminal cells | × 450 |
| f. | Basal cells in dorsal lamini | × 450 |
| g. | Basal cells in sheathing lamini | × 450 |

PLATE 15



Fissidens xiphinoides Fleisch.

3. ***Fissidens zollingeri*** Mont. , Ann. Sci. Nat. Ser. **3, 4** : 114 (1845)

F. perelongatus C. Muell. , Gen. Musc. Fr. 58 (1900) *nom. nud.*

PLATE 16

Plants dark green in color ± 4 mm long and ± 2.23 mm broad with leaves, radiculose, unbranched, with 6-9 pairs of leaves. Leaves lax, not much curled but shrunk and flexuose when dry. Leaves oblong -lingulate , acuminate, ± 1.56 mm long and ± 0.32 mm wide. Sheathing lamini usually equal and covering about half of the whole leaf. Dorsal lamini narrowing down towards the costa. Apical lamina more or less symmetrical. A limbidium of elongated cartilaginous cells usually covering the whole leaf, 3-4 rows on sheathing lamini at base and 2 rows at the junction, 1-2 layered in dorsal and apical lamini. Costa light-brown, often slightly excurrent, ± 12.6 μ m broad at base. Laminal cells lax, pentagonal-hexagonal, tip cells $\pm 12.56 \times 11.24$ μ m, middle cells $\pm 13.52 \times 12.28$ μ m, basal cells, $\pm 13.45 \times 12.24$ μ m. Larger cells $\pm 18.23 \times 12$ μ m and much bigger cells specially towards costa $\pm 45 \times 22$ μ m. Sporophyte not found.

Specimens examined

Sylhet: Osmanpur, Balagonj, on moist soil, Shirin Akhtar and Jahirul Haque, 12.08.2007, **112**; Jaflong Tea Estate, on moist soil, Shirin Akhtar and Muzammel Haque, 13. 10. 2007, **107**; Sadipur, Balagonj, on moist soil, Shirin Akhtar and Muzammel Haque, 12. 09. 2008, **514**.

Maulvi Bazar: Longa Tea Estate, Kolaura, Shirin Akhtar and Jahirul Haque, on moist soil, 10.08.2007, **130**; Rajnagor Tea Estate, Rajnagor, on moist soil, Shirin Akhtar and Jahirul Haque, 10.08.2008, **511**.

465039

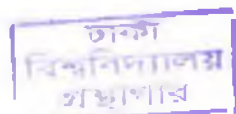
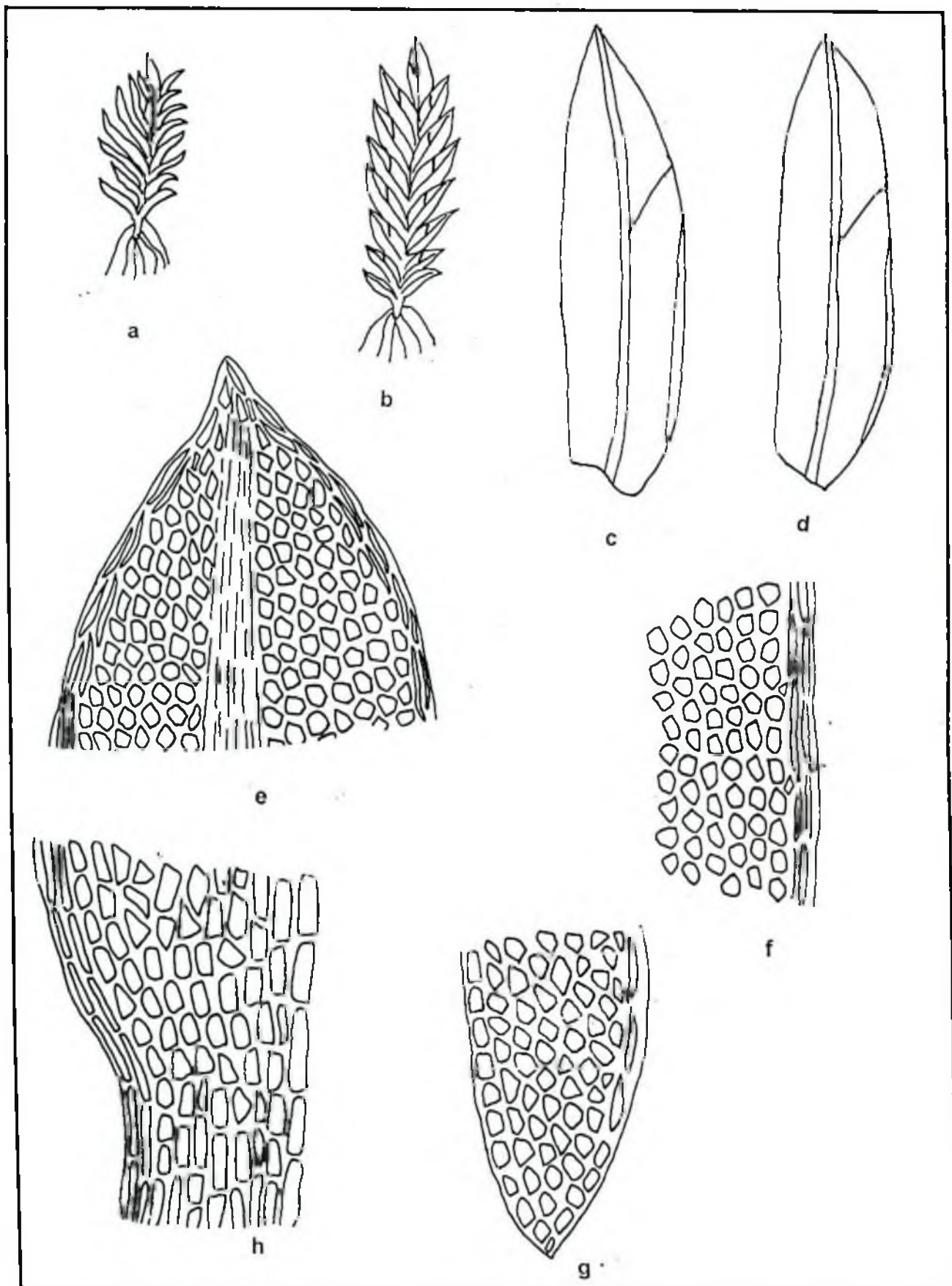


PLATE 16

Fissidens zollingeri Mont.

- | | | |
|--------|---------------------------------|-------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c & d. | Leaves | × 30 |
| e. | Leaf apex | × 450 |
| f. | Middle laminal cells | × 450 |
| g. | Basal cells in dorsal lamini | × 450 |
| h. | Basal cells in sheathing lamini | × 450 |

PLATE 16



Fissidens zollingeri Mont.

4. ***Fissidens virens*** Thwait. et Mitt. , J. Linn. Soc. Bot. **13** : 324 (1873)

F. axilliflorus Thwait. et Mitt. , J. Linn. Soc. Bot. **13** : 325 (1873) fid. Nork. in
Gang. , Mosses of East. India. And Adj. Reg. Fasc. **2** : 497 (1971).

PLATE 17

Plants tufted, green, normally ± 2.85 mm long and ± 1.95 mm broad, with 6-9 pairs of leaves. Leaves oblong-lanceolate, ± 1.19 mm long and ± 0.35 mm broad. Sheathing lamina usually equal sometimes may be unequal, more than half of the whole leaf length, Dorsal lamina narrowing down meeting costa at point of attachment or crowded at base. Apical lamina symmetrical with acute apex. Margin crenulate all along. Limbium of narrow, elongated, cartilaginous cells completely covering sheathing lamina, often slightly excurrent for one or two cells and extend in the apical lamina, 3 rowed at base and gradually become 1 rowed at apex. Costa prominent, excurrent in short apiculous. Laminal cells quadrate to hexagonal, $\pm 7.5 \times 4.6$ mm slightly longer at sheathing leaf base and near costa. Each cells a clear big papilla. Capsule short cylindrical, up to 4 mm long 0.3 mm in diameter. Spore more or less rounded 8-9 μ m in diameter.

Specimens examined

Sylhet: Habibnagar Tea Estate, Gonaighat, on moist soil, Shirin Akhtar and Jahirul Haque, 10.09.2007, **153**; Dahlia Tea Estate, Sylhet Sadar, on moist soil, Shirin Akhtar and Jahirul Haque, 21.09.2008, **408**.

Maulvi Bazar: Fatehapur, Rajnagar, on moist soil, Shirin Akhtar and Jahirul Haque, 24.10.2007, **155**; Hajinagar Tea Estate, on moist soil, Shirin Akhtar and Jahirul Haque, 18.10.2008, **520**.

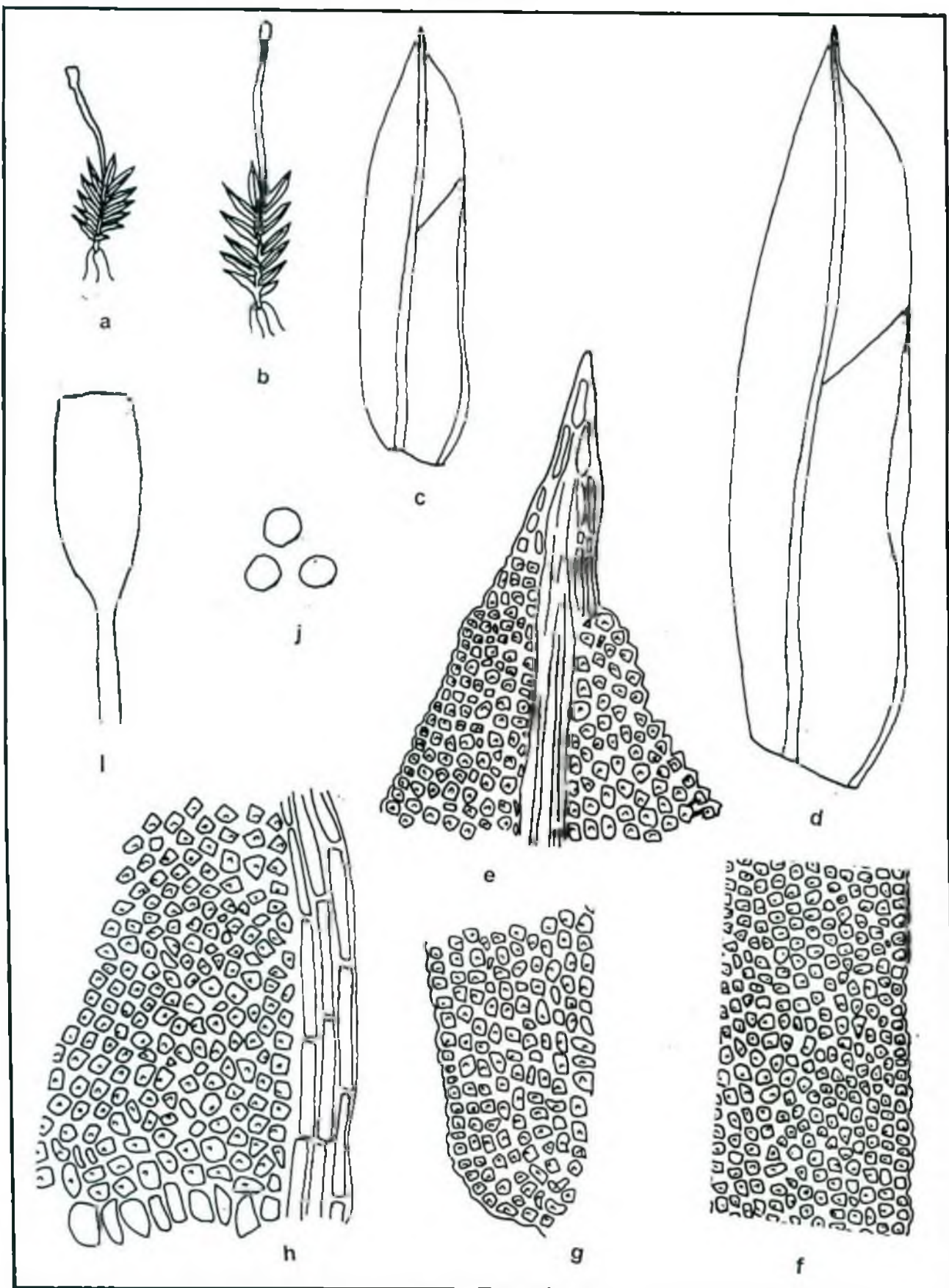
Sunamganj: Kalaruka, Chatok, on moist soil, Shirin Akhtar and Jahirul Haque, 17.10.2007, **169**; Karimpur, dirai, on moist soil, Shirin Akhtar and Jahirul Haque, 16.10.2008, **538**.

PLATE 17

Fissidens virens Thwait. *et* Mitt.

- | | | |
|--------|---------------------------------|-------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c & d. | Leaves | × 30 |
| e. | Leaf apex | × 450 |
| f. | Middle laminal cells | × 450 |
| g. | Basal cells in dorsal lamini | × 450 |
| h. | Basal cells in sheathing lamini | × 450 |
| i. | Capsule | × 30 |
| j. | Spores | × 450 |

PLATE 17



Fissidens virens Thwait. et Mitt.

5. *Fissidens semperfalcatus* Dix., J. Siam. Soc. Nat. Hist. Suppl. , 10 : 2 (1935)

PLATE 18

Plants gregarious, ± 6.5 mm high and ± 2.12 mm broad with leaves. Stem yellow-green with 15-18 pairs of leaves. Leaves usually falcate, middle leaves bigger than upper and lower leaves, ± 1.52 mm long and ± 0.29 mm broad. Sheathing lamina more than $1/2$ of the whole leaf, usually equal sometimes unequal. Dorsal lamina narrowing down at base. Apical lamina more or less symmetrical, often slightly bent to one side. Semilimbidium with cartilaginous cells completely borders sheathing lamina, sometimes extending slightly beyond it, 4-layered at base, gradually become 2-layered and finally 1 layered at apex. For the presence of papilosity of cells, margin of dorsal and apical lamina crenulate to serulate. Costa yellow, shortly excurrent with an apicule. All laminal cells unipapillose, quadrate to hexagonal, $\pm 7.7 \times 5.5 \mu\text{m}$, larger ($\pm 18.5 \times 3.5 \mu\text{m}$) at sheathing lamina towards costa. Capsule ovoid to short cylindrical, up to 6 mm long and 0.5 mm in diameter. Spore round, 9-12 μm in diameter.

Specimens examined

Sylhet: Jaflong Tea Estate, on moist soil, Shirin Akhtar and Muzammel Haque, 13. 11. 2007, 101; Sadipur, Balagonj, on moist soil, Shirin Akhtar and Muzammel Haque, 12. 11. 2008, 557.

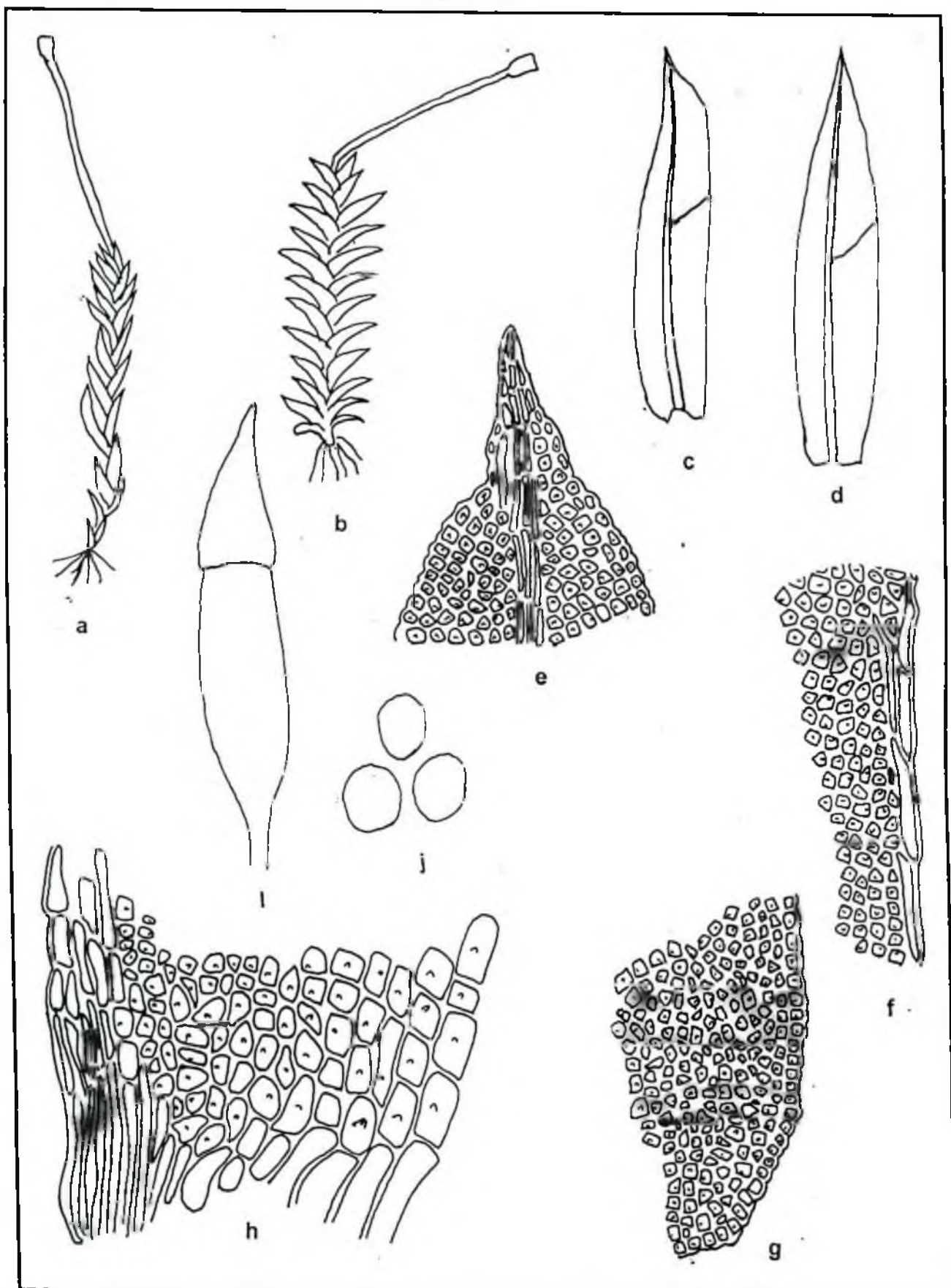
Maulvi Bazar: Chadnighat, Maulvi Bazar sadar, on moist soil, Shirin Akhtar and Jahirul Haque, 26.09.2007, 111; Najirabad, Maulvi Bazar sadar, on moist soil, Shirin Akhtar and Jahirul Haque, 26.10.2008, 495.

PLATE 18

***Fissidens semperfalcatus* Dix.**

- | | | |
|--------|---------------------------------|-------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c & d. | Leaves | × 30 |
| e. | Leaf apex | × 450 |
| f. | Middle laminal cells | × 450 |
| g. | Basal cells in dorsal lamini | × 450 |
| h. | Basal cells in sheathing lamini | × 450 |
| i. | Capsule | × 30 |
| j. | Spores | × 450 |

PLATE 18



Fissidens semperfalcatus Dix.

6. ***Fissidens nobilis*** Griff., Cal. J. Nat. Hist. **2**: 606 (1842)

F. filcinus Doz. et Molk., Ann. Sci. Nat. Bot. Ser. **3, 2**: 304 (1844)

PLATE 19

Plants green in color, branched or unbranched, ± 8.5 cm high and ± 7.5 mm broad with leaves. Stem consists of 30-40 pairs of leaves. Leaves lingulate, ± 5.5 mm long and ± 1.45 mm broad, crumpled when dry. Sheathing lamina usually equal, sometimes unequal with slight depression at end, covers $1/2$ to more than $1/2$ of the whole leaves. Dorsal lamina decurrent not much narrow at base. Except near at base, distinct reddish-brown border covers all around leaf. Upper part of the leaf margin is toothed and sometimes upper part of sheathing lamina also. 3-4 layered thick pentagonal to hexagonal cells are arranged in dorsal and apical lamina and 4-5 layered elongated-rectangular cells in sheathing lamina. Costa percurrent or shortly excurrent, brownish, nonpapillose, ± 0.95 mm broad at base. Upper laminal cell pentagonal-hexagonal $\pm 12.42 \times 9.5 \mu\text{m}$, middle laminal cells $\pm 14.42 \times 7.5 \mu\text{m}$, basal cells $\pm 15.42 \times 8.5 \mu\text{m}$. Sporophyte not found.

Specimens examined

Sylhet: Jaflong Hill forest, Kulaoura, on soil, Shirin Akhtar and Jahirul Haque, 12.10.2007, **115**; Deoan Bazar, Balagonj, on soil, Shirin Akhtar and Jahirul Haque, 10.09.2008, **543**; Monipur Tea Estate, Fenchuganj, on moist soil, Shirin Akhtar and Jahirul Haque, 17.09.2008, **471**.

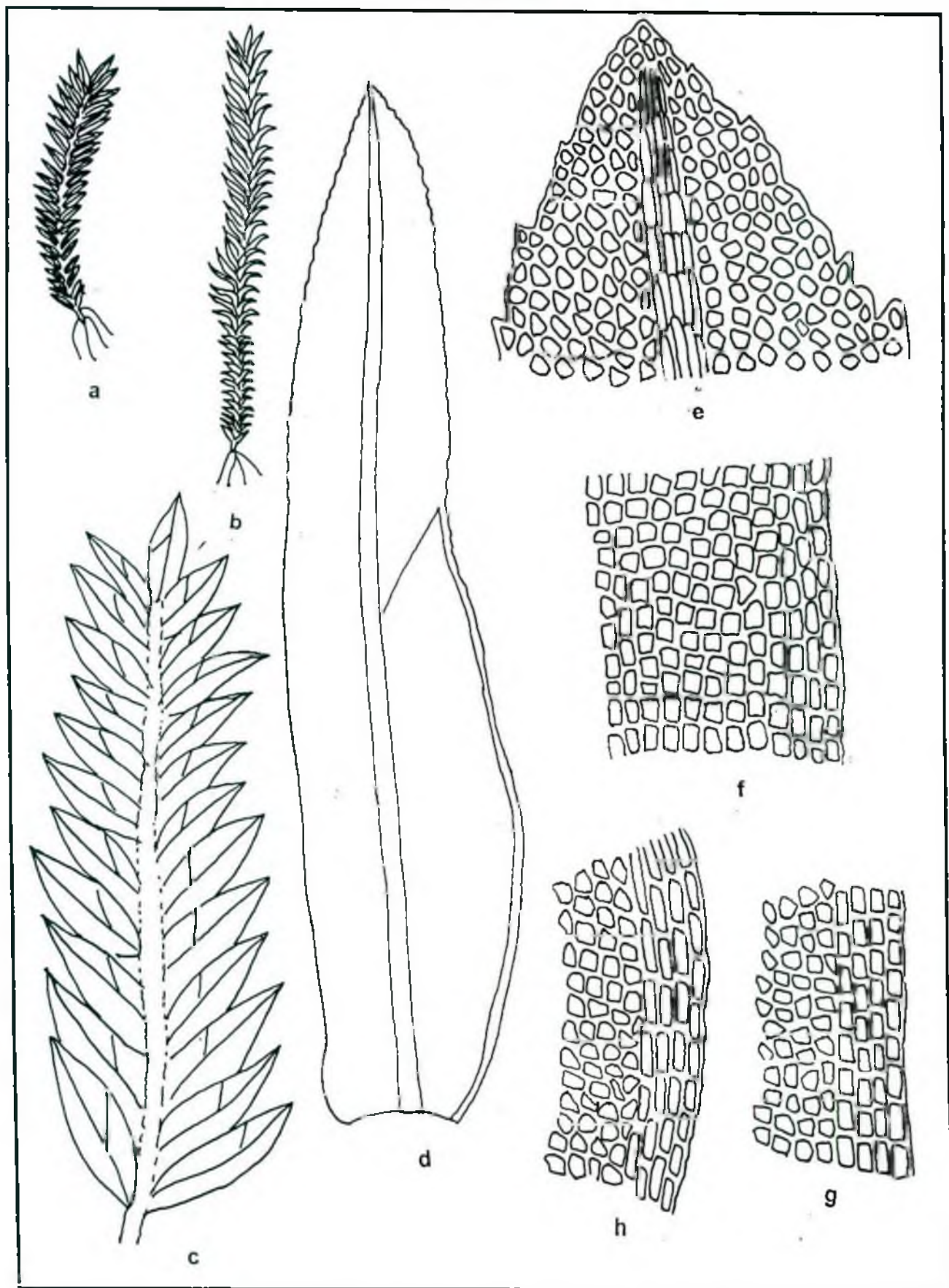
Maulvi Bazar: Lawacharra forest, Srimongol, on moist soil, Shirin Akhtar and Jahirul Haque, 18.09.2007, **157**; Fultala Tea Estate, Kulaura, on soil, Shirin Akhtar and Mozammel Haque, 22.09.2008, **523**.

Sunamganj: Kalaruka, Chatok, on moist oil, Shirin Akhtar and Jahirul Haque, 15.10.2007, **140**.

PLATE 19

Fissidens nobilis Griff.

- | | | |
|----|---------------------------------|-------|
| a. | Dry plant | × 2 |
| b. | Wet Plant | × 2 |
| c. | Wet Plant | × 10 |
| d. | Leaf | × 30 |
| e. | Leaf apex | × 450 |
| f. | Middle laminal cells | × 450 |
| g. | Basal cells in dorsal lamini | × 450 |
| h. | Basal cells in sheathing lamini | × 450 |



Fissidens nobilis Griff.

7. *Fissidens orishae* Gang. Nova Hedwigia 8: 140 (1964)

PLATE 20

Plants usually unbranched, yellow green in color, grow vigorously, ± 4.12 mm long and ± 1.32 mm wide with ± 13 pairs of leaves. Upper leaves usually curled but not much crumpled when dry and lower leaves may or may not be inflexed. Leaves oblong to lanceolate, ± 1.38 mm long and ± 0.40 mm broad. Sheathing lamini open, ± 0.94 mm long and ± 0.26 mm wide (more than half of the whole leaf), boarder at middle, narrowing towards base. Semilimbium incomplete consists of two rows of elongated pellucid cells at sheathing lamini base, then narrowing to one row finally vanishing in a number of small pellucid marginal cells before reaching the tip of the sheathing lamini. Dorsal lamina quickly narrowing down at base and vanishing just before the costa meet the stem. Costa brown, percurrent, ± 35 μ m broad at base. Margin crenulate. Leaf cells chlorophyllose, rounded-quadrate to hexagonal. Upper laminal cells $\pm 14.65 \times 9.67$ μ m, middle laminal cells $\pm 10.56 \times 9.32$ μ m, marginal cells $\pm 9.34 \times 6.32$ μ m, basal laminal cells (opposite to the sheathing lamini) $\pm 15.32 \times 9.97$ μ m and basal cells of sheathing lamini $\pm 12.21 \times 7.32$ μ m. Sporophyte not found.

Specimens examined

Sylhet: Monipur Tea Estate, Fenchugonj, on soil, Shirin Akhtar and Jahirul Haque, 20.10.2007, **179**.

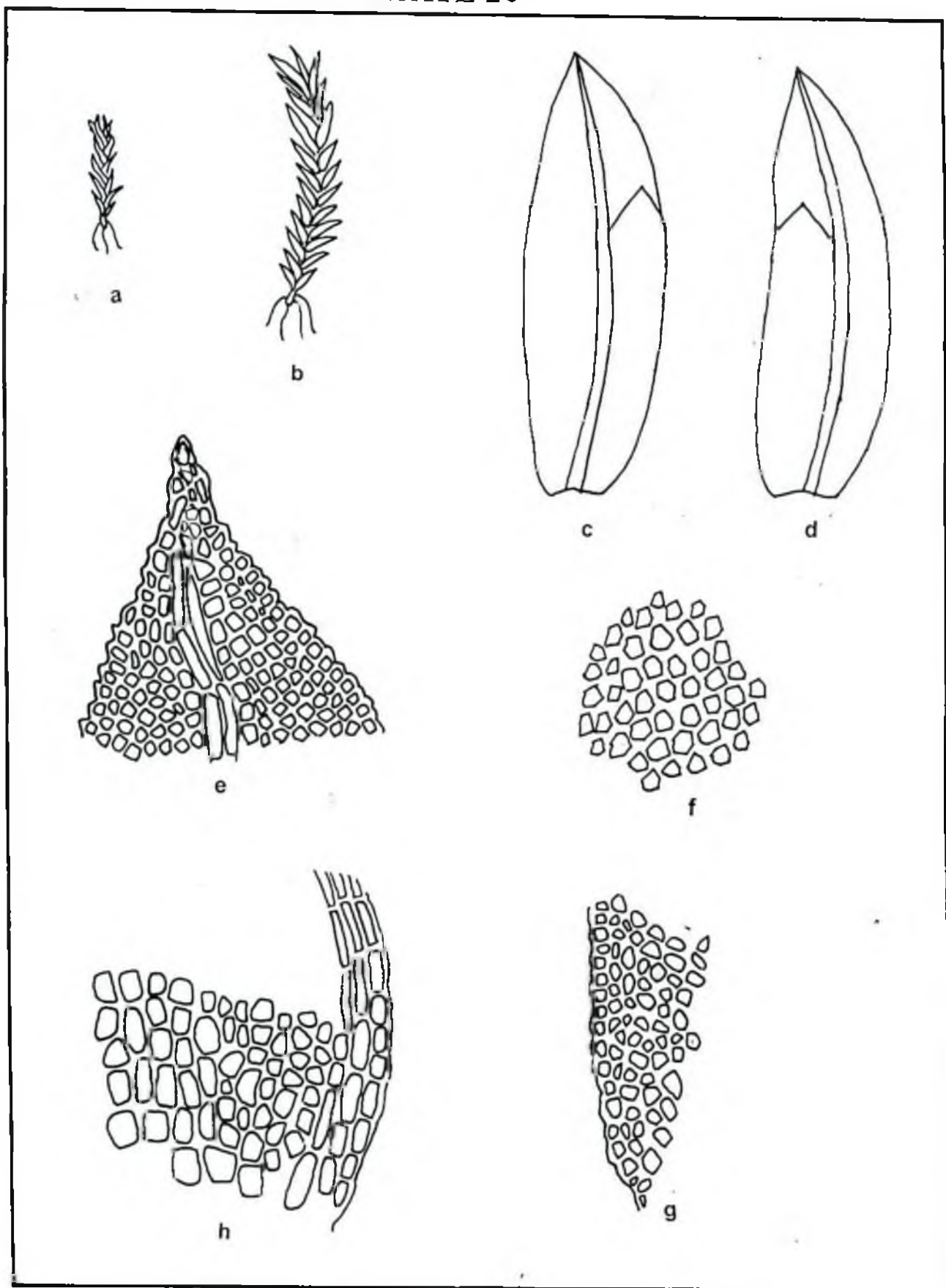
Sunamganj: Mollapara, Sunamgonj sadar, on soil, Shirin Akhtar and Jahirul Haque, 20.10.2008, **453**.

PLATE 20

Fissidens orishae Gang.

- | | | |
|--------|---------------------------------|-------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c & d. | Leaves | × 30 |
| e. | Leaf apex | × 450 |
| f. | Middle laminal cells | × 450 |
| g. | Basal cells in dorsal lamini | × 450 |
| h. | Basal cells in sheathing lamini | × 450 |

PLATE 20



Fissidens orishae Gang.

8. *Fissidens ganguleei* Nork. in Gang. ,Mosses in East. Ind.and Adj. Reg.
Fasc. 2 : 527-528(1971).

F. lancifolius Hamp. ex Gang. , Bull. Bot. Soc. Bengal **11** : 75 (1967) *hom. Illeg.*

PLATE 21

Plants mostly unbranched sometimes branched, green in color, tufted or scattered, ± 8.5 mm long and ± 1.85 mm broad with leaves. Stem brownish with central strand, consists of 11-18 pairs of leaves. Leaves ovate-lanceolate to oblong-lanceolate, ± 1.62 mm long and ± 0.38 mm broad, apex acuminate. Sheathing lamini mostly unequal, $1/2$ or slightly larger than $1/2$ of the whole leaf. Dorsal lamina slightly decurrent. Apical lamina acuminate and symmetrical. Leaves margin crenulate all along except base of the sheathing lamini. Costa brown, slightly excurrent, ± 32.40 μm wide at base. Tip cells of leaves smooth, pentagonal-hexagonal, $\pm 12.5 \times 8.85$ μm . Marginal cells rectangular- pentagonal, $\pm 7.63 \times 6.12$ μm . Middle laminal cells pentagonal-hexagonal, $\pm 12.45 \times 8.32$ μm . Basal laminal cells pentagonal-hexagonal, $\pm 12.54 \times 8.12$ μm and basal cells of sheathing lamina elongated, $\pm 15.12 \times 8.23$ μm . Sporophyte not found.

Specimens examined

Maulvi Bazar: Mirjapur Tea Estate, Srimangal, on soil, Shirin Akhtar and Mozammel Haque, 12. 08. 2007, **139**;

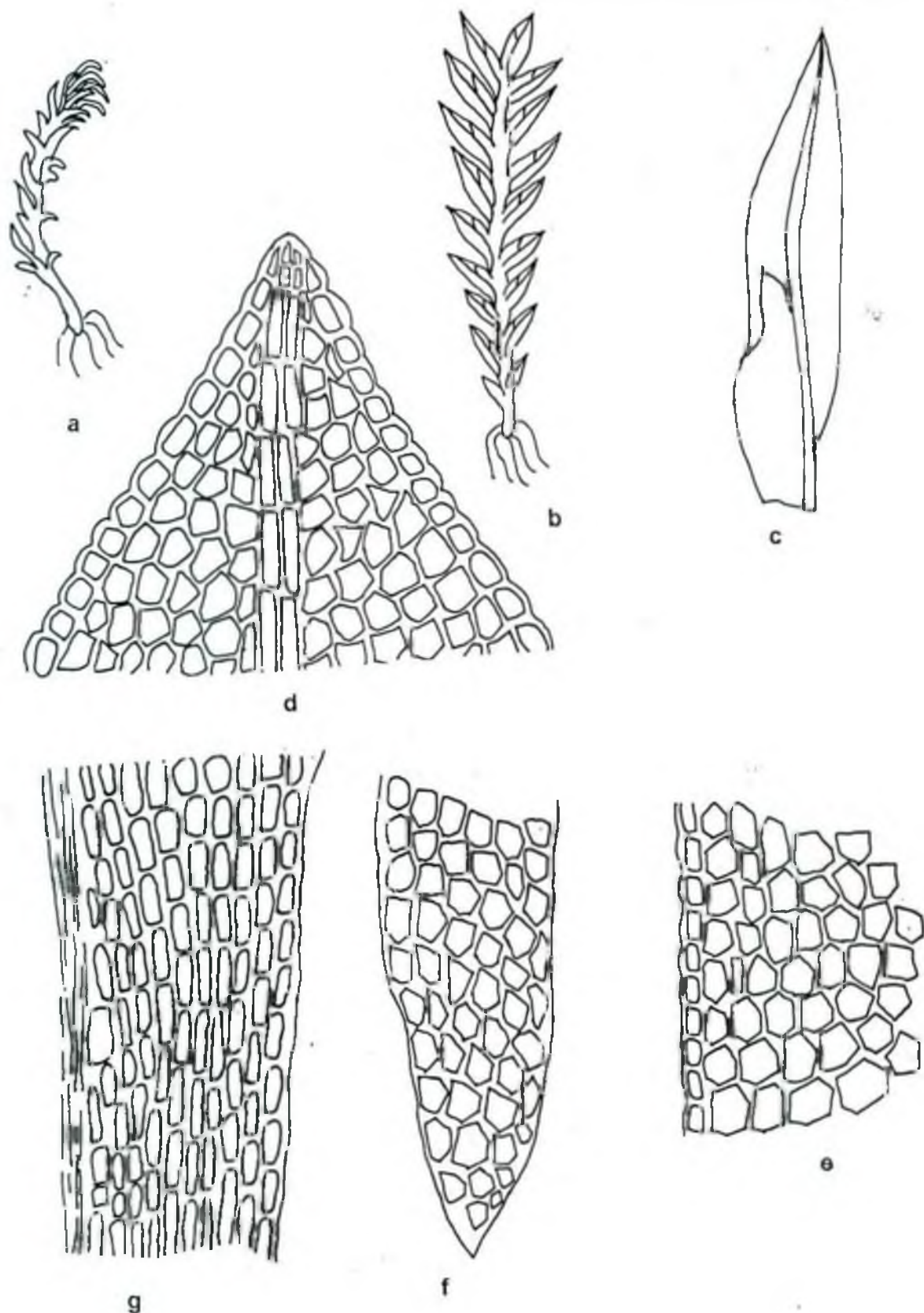
Sunamganj: Karimpur, Dirai, on soil, Shirin Akhtar and Jahirul Haque, 13. 08. 2008, **432**.

PLATE 21

Fissidens ganguleei Nork. in Gang.

- | | | |
|----|---------------------------------|-------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c. | Leaf | × 30 |
| d. | Leaf apex | × 450 |
| e. | Middle laminal cells | × 450 |
| f. | Basal cells in dorsal lamina | × 450 |
| g. | Basal cells in sheathing lamina | × 450 |

PLATE 21



Fissidens ganguleei Nork. in Gang.

9. *Fissidens javanicus* Dox. & Molk., Bryol. Jav. 1: 11 (1855)

F. acutifolius Mitt., Musc., Ind. Or. 137 (1859)

PLATE 22

Plants yellowish-green to yellowish-brown, generally unbranched, rarely branched, ± 0.92 cm high and ± 3.5 mm wide with leaves. Stem consists of 13-23 pairs of leaves and leaves arranged in feather like. At the axile of sheathing lamini on the stem sometimes granular cells appearing. Leaves oblong-lanceolate, acuminate, narrow, ± 2.85 mm long and ± 0.45 mm broad, leaves not much changed when dry. Sheathing lamini mostly unequal, $1/2$ or slightly more than $1/2$ of the whole leaf. Dorsal lamini narrowing down and attaching to the costa. Apical lamini symmetrical. A uniform thick brown border is surrounded of whole leaf except very base. 2-3 layered of very thick wall square to hexagonal cells at apex, 3-4 layered at base present in the dorsal lamini and sheathing lamini. Costa brown, percurrent or slightly excurrent, ± 29 μ m broad at base. Margin entire all along except at base. Apical cells quadrate to hexagonal $\pm 5.5 \times 4.5$ μ m, middle laminal quadrate-pentagonal-hexagonal cells $\pm 5.62 \times 4.32$ μ m and basal cells quadrate to hexagonal $\pm 6.62 \times 4.72$ μ m. Sporophyte not found.

Specimens examined

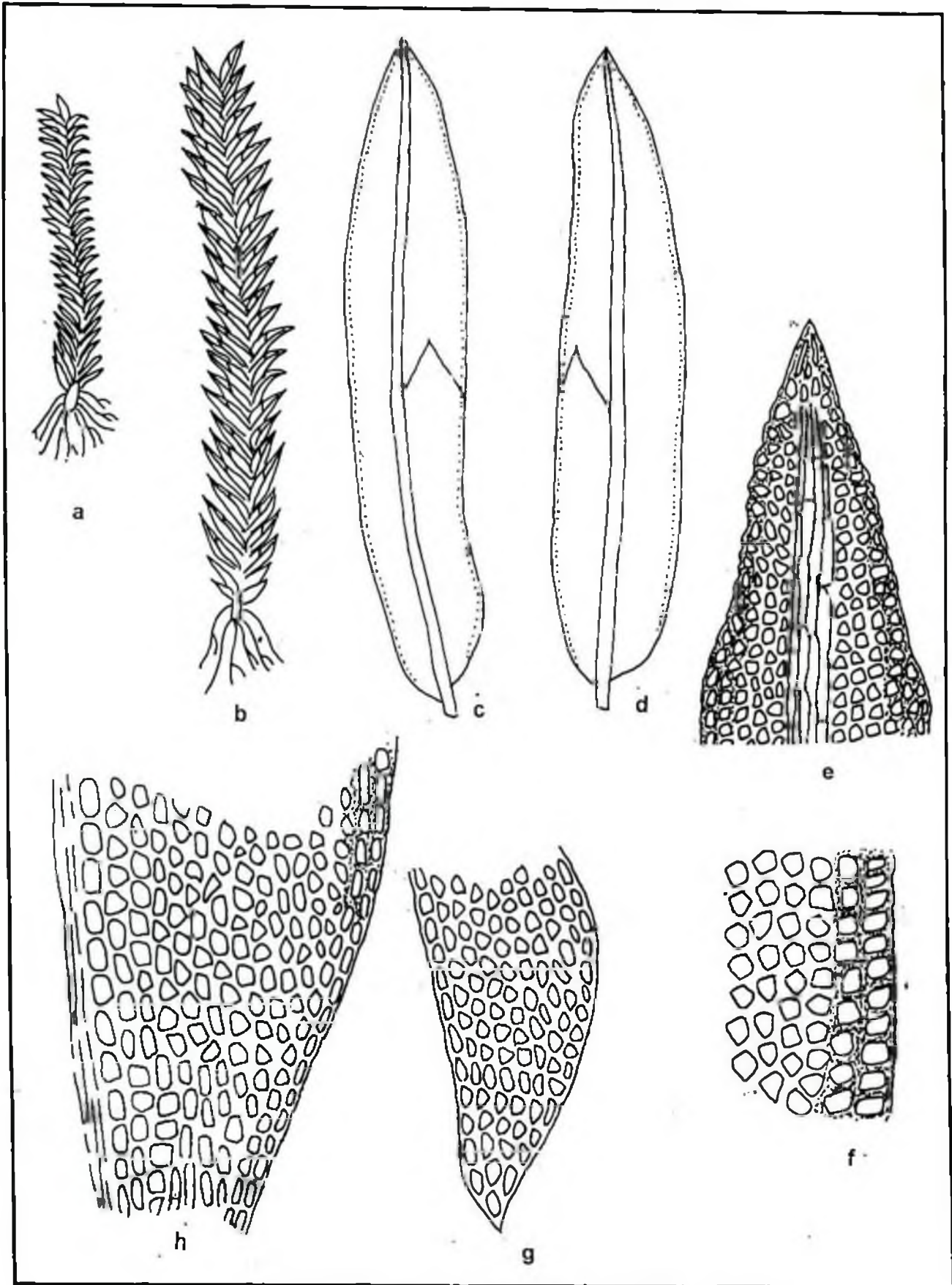
Sylhet: Monipur Tea Estate, Fenchuganj, on soil, Shirin Akhtar and Jahirul Haque, 12.09.2007, 197; Shripur Tea Estate, Sylhet Sadar, on soil Shirin Akhtar and Jahirul Haque, 11.09.2008, 429.

Habiganj: Debpara, Nabigonj, on soil, Shirin Akhtar and Jahirul Haque, 22.09.2007, 159; Sujatpur, Baniachong, on soil, Shirin Akhtar and Jahirul Haque, 28.09.2008, 477.

PLATE 22

Fissidens javanicus Dox & Molk.

- | | | |
|--------|---------------------------------|-------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c & d. | Leaves | × 30 |
| e. | Leaf apex | × 450 |
| f. | Middle laminal cells | × 450 |
| g. | Basal cells in dorsal lamina | × 450 |
| h. | Basal cells in sheathing lamina | × 450 |



Fissidens javanicus Dox. & Molk.

10. *Fissidens diversifolius* var. *rubricaulis* (Dix.) Norkett in Gangulee

Fissidens rubricaulis Dix. in J. Bomb. Nat. Hist. Soc., 39: 772 (1937)

PLATE 23

Plants dioicous, unbranched, ± 5.5 mm long and 1.65 mm wide with ± 10 pairs of leaves. Leaves somewhat flexuose but much crumpled when dry, oblong-lanceolate, ± 1.2 mm long and ± 0.35 mm broad at base. Sheathing laminae unequal, more or less $\frac{1}{2}$ of the leaf. Dorsal laminae narrowing down at base and vanishing at the point of leaf attachment. Leaf border at base, rectangular to oval up to sheathing portion, then narrowing down to an acute symmetrical apex. Leaf margin entire. Simple and smooth semilimbium of about 3 layers of elongated, yellowish, pellucid cells at base narrowing down to only 1 layer at apex completely border the sheathing laminae. Costa percurrent, brown in color. Leaf cells pellucid, smooth, rounded to hexagonal. Upper laminal cells $\pm 7.32 \times 5.98 \mu\text{m}$, middle laminal cells $\pm 6.98 \times 5.34 \mu\text{m}$, basal laminal cells $\pm 7.89 \times 6.86 \mu\text{m}$.

Perichaetial leaf not differentiated. Capsule pear shaped, brown in color ± 1.12 mm in diameter, seta red-orange, apical, there may be two on some apices, ± 6.12 mm long, irregularly bent when dry. Operculum conical, red-brown, ± 0.45 mm high. Spores light brown, more or less rounded, $\pm 32 \mu\text{m}$ in diameter.

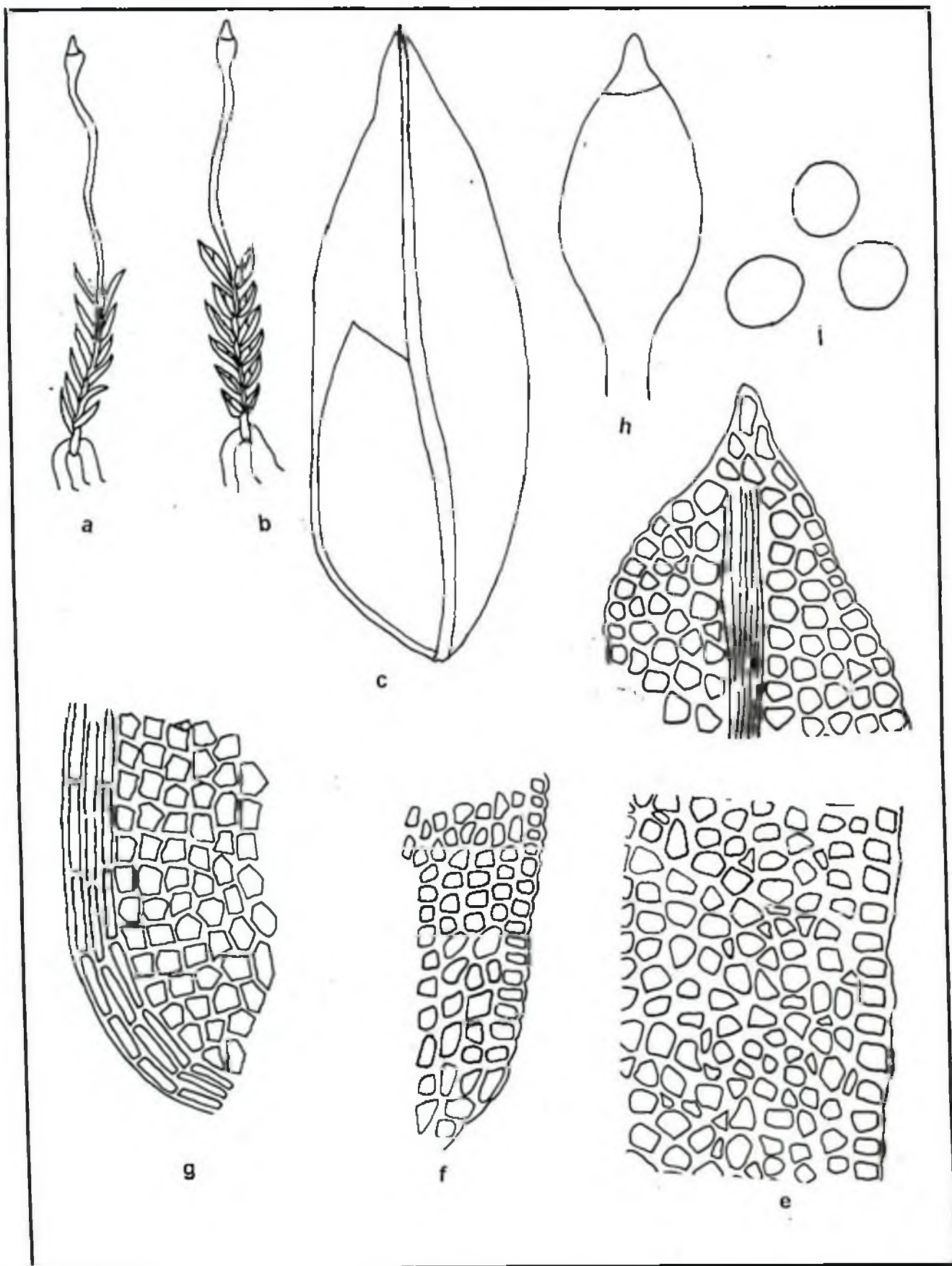
Specimens examined

Sylhet: Monipur Tea Estate, Fenchuganj, on soil, Shirin Akhtar and Jahirul Haque, 08.09.2007, 136.

PLATE 23

***Fissidens diversifolius* var. *rubricaulis* (Dix.) Norkett in Gangulee**

- | | | |
|----|---------------------------------|-------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c. | Leaf | × 30 |
| d. | Leaf apex | × 450 |
| e. | Middle laminal cells | × 450 |
| f. | Basal cells in dorsal lamina | × 450 |
| g. | Basal cells in sheathing lamina | × 450 |
| h. | Capsule with operculum | × 30 |
| i. | Spores | × 450 |



Fissidens diversifolius var. *rubicaulis* (Dix.) Norkett in Gangulee

11. ***Fissidens laxitextus*** Broth. ex Gangulee in Nova Hedwigia, **8** : 144 (1964)
Fissidens laxitextus Broth. in Bruehl in Rec. Bot. Surv. Ind., **13** (1) : 126
(1931) *nom. nud.*

PLATE 24

Plants usually unbranched, rarely branched, green in color, ± 5.12 mm long and ± 1.54 mm broad with leaves. Stem contains ± 13 pairs of leaves, upper leaves larger and lower leaves smaller. Leaves oblong-lingulate, slowly acuminate from a border base, become very much shrunk and shrivelled though not very much curled when dry, ± 1.21 mm long and ± 0.35 mm broad. Dorsal lamina slightly narrower at base, rounded and vanishing at the point of stem attachment. Sheathing laminae usually unequal meeting below margin. Apical part more or less symmetrical, leaf apex broadly pointed-acuminate. Costa light brown, percurrent, ± 34.43 μm at base. Laminal cell quadrate to irregularly hexagonal, smooth, more elongated at base. Upper laminal cells $\pm 9.65 \times 7.65$ μm , middle laminal cells, $\pm 10.43 \times 8.45$ μm and basal laminal cells $\pm 13.43 \times 8.34$ μm . Sporophyte not found.

Specimens examined

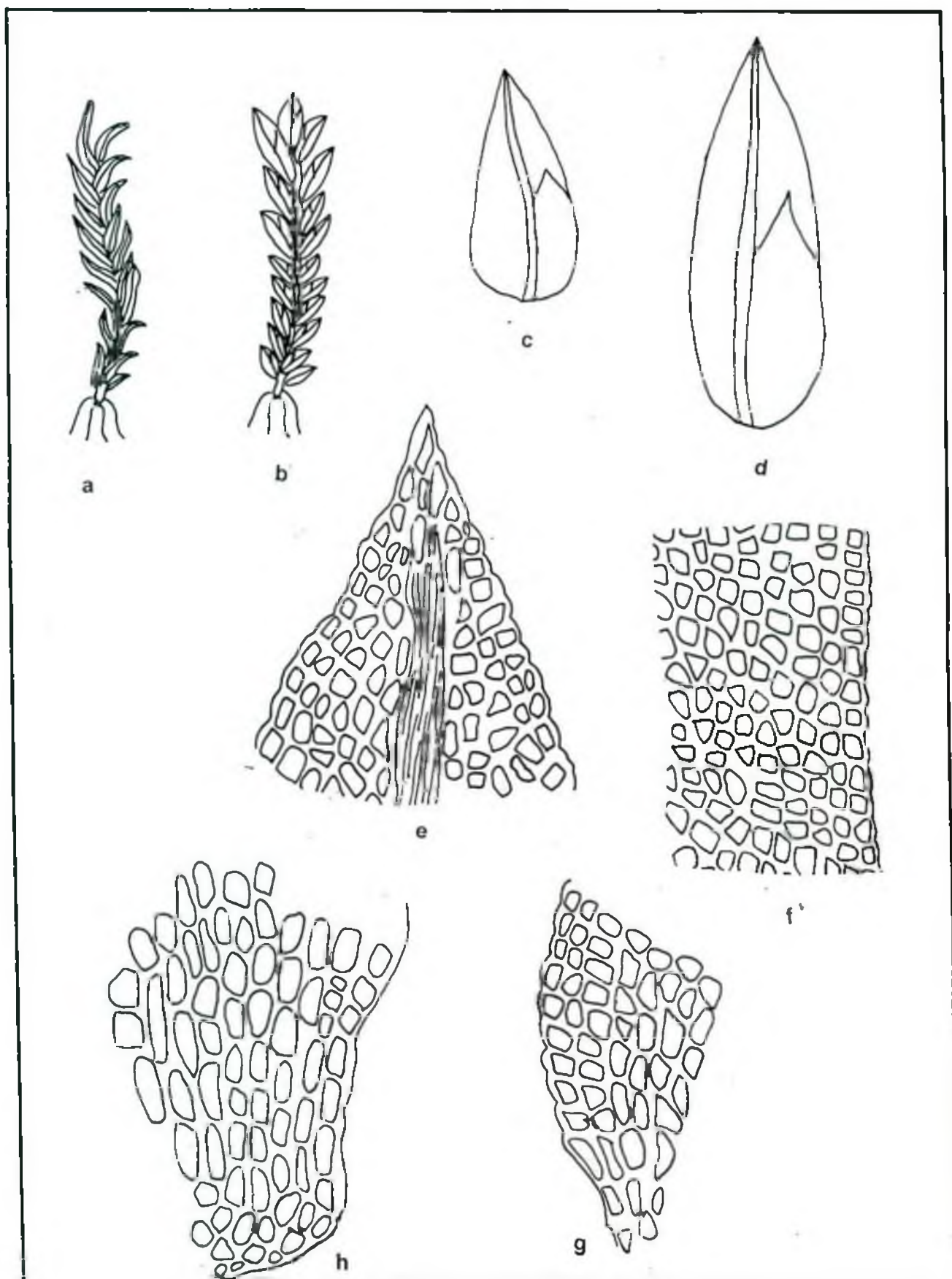
Sylhet: Jaflong Hill forest, Kulaoura, on soil, Shirin Akhtar and Jahirul Haque, 07.09.2007, 96.

Maulvi Bazar: Banugash Reserve forest, Kamolgonj, on soil, Shirin Akhtar and Jahirul Haque, 19.10.2008, 474.

PLATE 24

Fissidens laxitextus Broth. ex Gangulee

- | | | |
|--------|---------------------------------|-------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c & d. | Leaves | × 30 |
| e. | Leaf apex | × 450 |
| f. | Middle laminal cells | × 450 |
| g. | Basal cells in dorsal lamini | × 450 |
| h. | Basal cells in sheathing lamini | × 450 |



Fissidens laxitextus Broth.ex Gangulee.

12. ***Fissidens laxus*** Sull. et Lesq., Proc. Am. Arc. Art. Sc. 4: 276 (1959)

PLATE 25

Plants branched or unbranched, green in color, ± 4.5 mm long and ± 1.45 mm broad with leaves. Stem with central strand, 10-13 pairs of leaves. Leaves oblong-lingulate, ± 0.92 mm long and ± 0.24 mm broad, not much curled or contorted when dry. Sheathing lamini almost unequal, more or less $1/2$ of the whole leaf. Base of the dorsal lamini more or less rounded and dorsal lamini meeting towards stem not costa. Leaf apex acute and apical lamini more or less symmetrical. Margin of leaves crenulate to serrulate. Costa brown, percurrent or sometimes short excurrent, ± 26 μm broad at base. Upper laminal cells pentagonal to hexagonal, $\pm 10.32 \times 8.23$ μm , middle laminal cell quadret-pentagonal-hexagonal, $\pm 9.32 \times 8.23$ μm , basal laminal cell larger than upper and middle laminal cell rectangular-hexagonal, $\pm 12.36 \times 8.23$ μm , Sporophyte not found.

Specimens examined

Sylhet: Jaflong Tea Estate, Sylhet Sadar, on soil, Shirin Akhtar and Jahirul Haque, 22.10.2007, 120; Tajpur, balagonj, on soil, Shirin Akhtar and Jahirul Haque, 12.08.2009, 603.

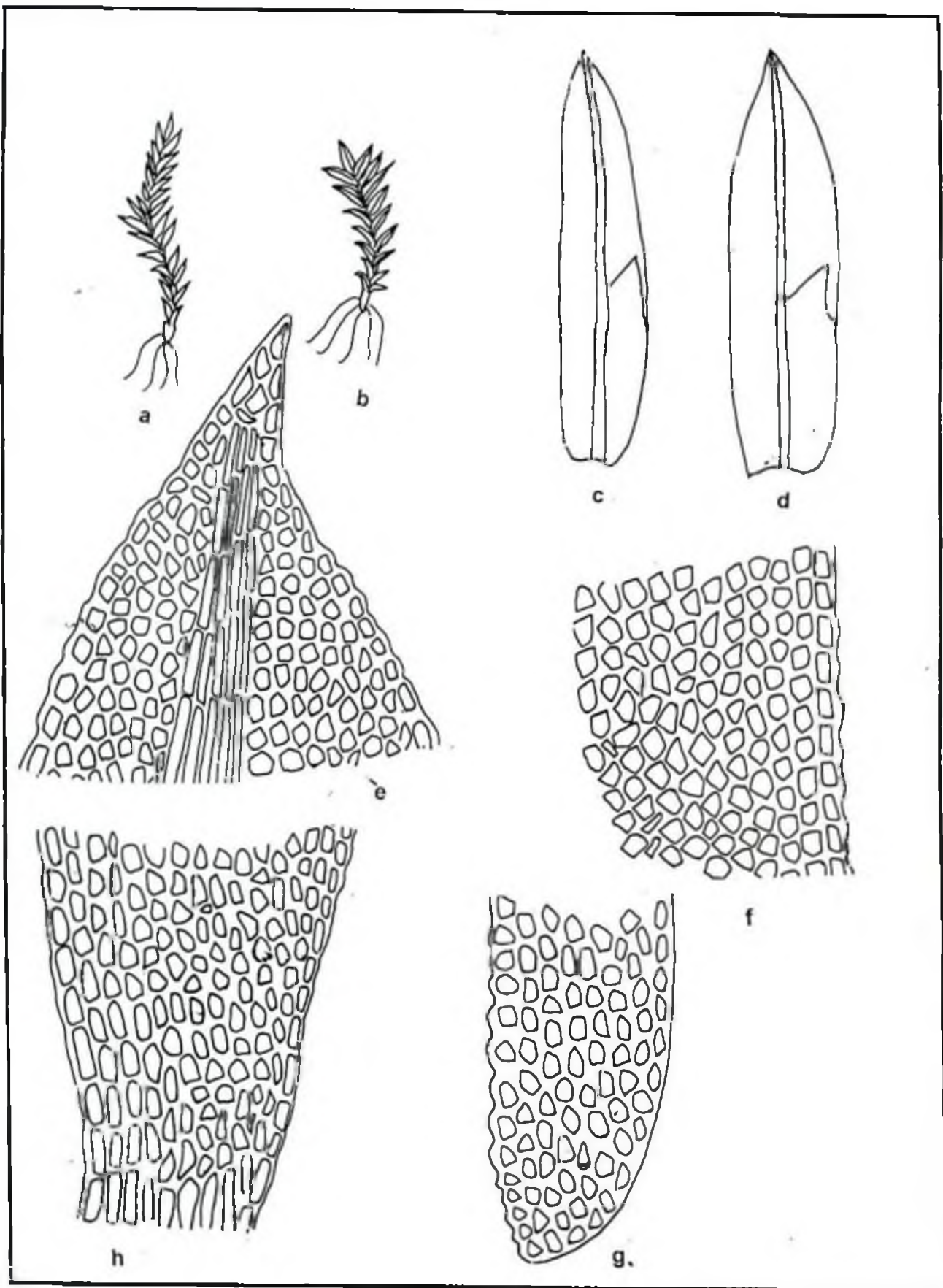
Maulvi Bazar: Jaflong Hill Forest, Kulaura, on soil, Shirin Akhtar and Jahirul Haque, 14.10.2008, 510, Madhabpur, Komolgonj, on soil, Shirin Akhtar and Jahirul Haque, 15.09.2007, 182.

Sunamganj: Rajnagor, Derai, on soil, Shirin Akhtar and Mozammel Haque, 13.09.2008, 519

PLATE 25

Fissidens laxus Sull. et Lesq

- | | | |
|--------|---------------------------------|-------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c & d. | Leaves | × 30 |
| e. | Leaf apex | × 450 |
| f. | Middle laminal cells | × 450 |
| g. | Basal cells in dorsal lamini | × 450 |
| h. | Basal cells in sheathing lamini | × 450 |



Fissidens laxus Sull. et Lesq

ORDER SYRRHOPODONTALES

Plants dioicous, usually small, epiphytes. Stem erect, without central strand. Leaves linear lanceolate to lingulate from broader sheathing base, many rowed, crowded at apex. Basal laminal cells very lax, hyaline, large rectangular or quadrate, upper laminal cells small and usually papillose, sometimes with border.

FAMILY CALYMPERACEAE

Plants small to fairly robust, tufted, epiphytes rarely growing on soil or rock. Stem without central strand, mostly erect. Leaves linear-lanceolate to lingulate, usually crowded at apex. Leaf cells at inner base large, hyaline, lax, forming cancellinae, upper cells small, round or hexagonal, often papillose. Costa strong, convex on back, often rough papillose. Gemmae usually present on leaf.

GENUS *CALYMPERES* Schwaegr in Web.

Tab. Exh. Calyptr. Operc. Gen. 2 (1813)

Lectotype: *C. lonchophyllum* Schwaegr. *fid.* Williams.

Plants small, epiphytic, forming tufts. Leaves lanceolate to lingulate from a broad whitish base, curled or curved when dry. Costa strong, excurrent, usually gemmiferous on the tips of upper leaves which are longer and narrower than the lower, Cancellinae of lax, hyaline cells prominent in leaf base. Chlorophyllose laminal cells small, usually papillose. Border usually thicker and often with submarginal elongated cells forming tenioli.

KEY TO THE SPECIES OF CALYMPERES

- | | |
|---------------------------------|-------------------------|
| 1. Costa of main leaf excurrent | <i>C. tenerum</i> |
| - Costa of main leaf percurrent | <i>C. noakhalsensis</i> |

1. ***Calymperes tenerum*** C. Muell. Linnaea 37 : 174 (1871)

C. dozyanum Besch. (non. Mitt.) , Ann. Sci. Nat. Bot. Ser. 8. 1 : 264, 283 (1895)

PLATE 26

Plants small, loosely tufted or scattered, greenish, usually with short rosette like spreading at apex, ± 12 mm high and ± 3 mm wide with leaves. Leaves erectopatent to spreading when wet, strongly curled and incurved when dry, arranged closely, more crowded at apex with rosette like spreading. Normal leaves lingulate, ± 1.32 mm long and ± 0.45 mm broad, apex obtuse, upper gemmiferous leaves longer and narrower at top, ± 2.32 mm long and ± 0.43 mm broad at base. Margin entire, may be slightly denticulate. Costa strong, percurrent in normal leaves, excurrent into a club-like structure in gemmiferous leaves, ± 67 μ m broad at base. Chlorophyllose laminal cells hexagonal to quadrate, swollen, $\pm 7.23 \times 4.23$ μ m. Cancellinae distinct, within leaf base, more or less rectangular, with flat top 4-5 rows of hyaline, big cells on each side of costa, $\pm 0.43 \times 0.16$ mm broad on both side of costa, gradually narrowing towards the margin. Tenioli absent. Laminal cells at base quadrate to short-rectangular, $\pm 10.12 \times 8.21$ μ m, upper laminal cells quadrate to hexagonal, $\pm 5.45 \times 4.23$ μ m. Abundant gemmae arise from gemmiferous leaf. Each gemma ellipsoid, ± 300 μ m long and ± 58 μ m broad with ± 10 cells. Fruiting body absent.

Specimens examined

Sylhet: Malnichora Tea Estate, Sylhet Sadar, on bark of a tree, Shirin Akhtar and Jahirul Haque, 24.10.2007, **134**; Jaflong Hill forest, Kulaura, on bark of a tree, Shirin Akhtar and Mozammel Haque, 26.10.2008, **562**.

Maulvi Bazar: Patharia Reserve Forest, Borolekha, on bark of a tree, Shirin Akhtar and Jahirul Haque, 24.07. 2008, **522**; Kholilpur, Maulvi Bazar Sadar, on bark of a tree, Shirin Akhtar and Jahirul Haque, 24.07.2009, **624**.

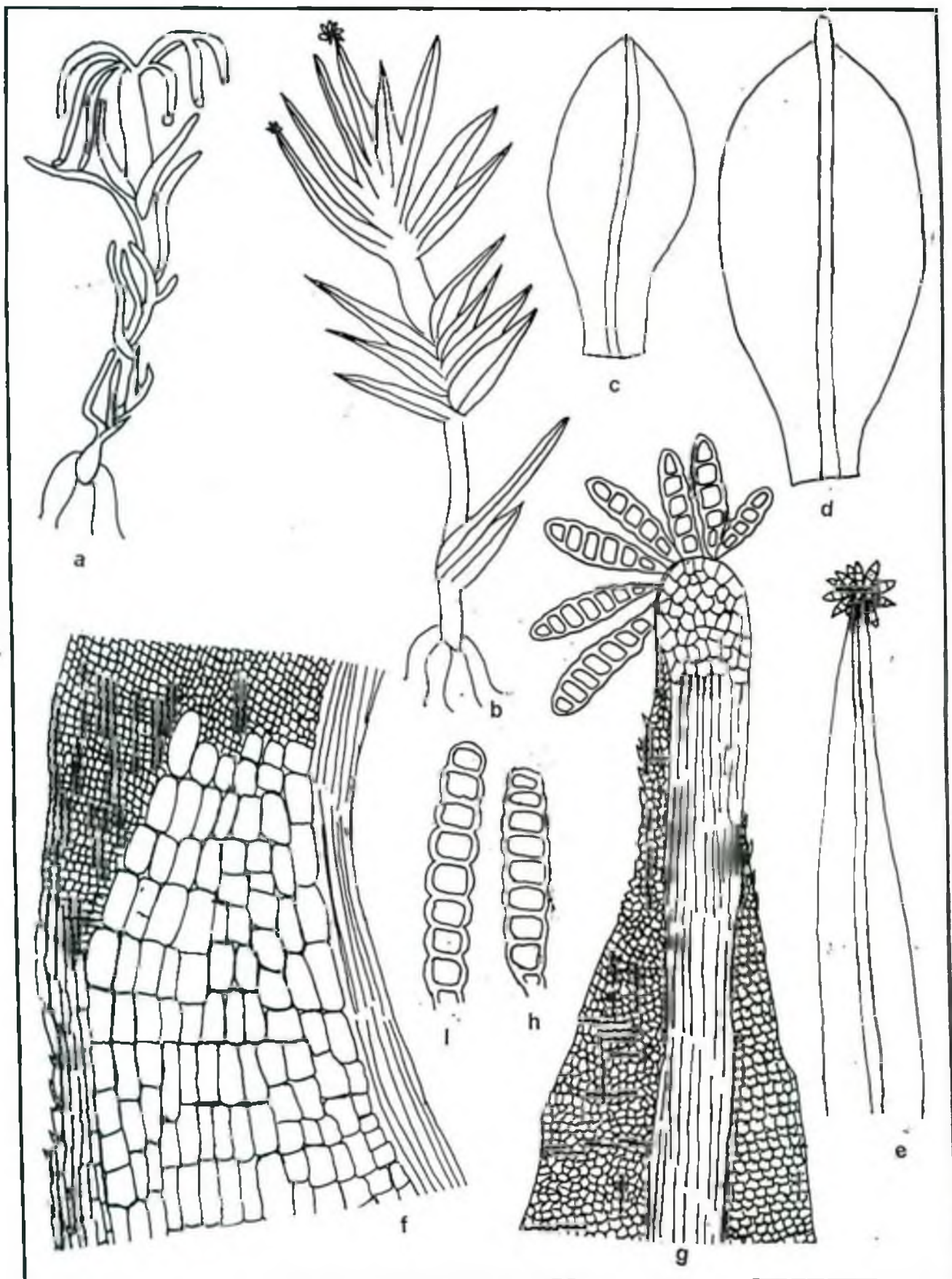
Habiganj: Tarof Hill Reserve Forest, Madhabpur, on bark on a tree, Shirin Akhtar and Jahirul Haque 23.08.2007, **163**; Madhabpur, on bark of a tree, Shirin Akhtar and Jahirul Haque, 25.10.2008, **419**.

Sunamganj: Mollapara, Sunamgonj Sadar, on bark of a tree, Shirin Akhtar and Jahirul Haque 21.09.2007, **144**; Vatipara, Derai, on bark of a tree, Shirin Akhtar and Monirul Haque 23.08.2009, **626**.

PLATE 26

Calymperes tenerum C. Muell.

- | | | |
|--------|-------------------------------|-------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c & d. | Normal leaves | × 30 |
| e. | Gemmiferous leaf | × 30 |
| f. | Laminal cells and cancellinae | × 150 |
| g. | Apex of gemmiferous leaf | × 100 |
| h & i. | Gemmae | × 150 |



Calymperes tenerum C. Muell.

2. ***Calymperes noakhalensis*** Bruehl *et* Sarkar in J. Dept. Sci. Cal. Uni., **10**: 3 (1929)

PLATE 27

Plants epiphytic, green in color. Stem ± 12 mm long, dense foliage. Leaves erectopatent, flexuose or variously twisted when dry; lower leaves oblong-spathulate, submucronate at apex due to slightly excurrent costa, ± 2.21 mm long and ± 0.45 mm broad above middle; middle and upper normal leaves narrow, spatulate or lingulate, rounded at apex, narrow at base, ± 4.5 mm long and ± 0.87 mm broad at upper half. Leaf margin minutely serrulate, undulate. Gemiferous leaves ± 5.65 mm long and ± 0.13 mm broad at upper part. Costa $1/3$ of lamina, broad at base, bearing a cluster of small, a spindle-shaped gemmae at leaf tip. Costa of normal leaves not reaching leaf tip. Deuter cells in a median row, accompanied on ventral side by 2 or 3 similar deuter cells; cells on both sides of deuter numerous, much smaller; peripheral cells on costa papillose on upper half. Boundary between cancellinae not step-like, cancellinae more or less rectangular. At the near costa leaf cells larger and transparent, $\pm 53.23 \times 43.23 \mu\text{m}$, upper cross walls more or less oblique, cells broad near costa but the breadth gradually diminishes towards margin, upper most cells distinctly shorter. Laminar cells irregularly quadrate, $\pm 8.32 \times 6.32 \mu\text{m}$, papillose. Tenioli extending from above base, $\pm 45.23 \times 8.45 \mu\text{m}$.

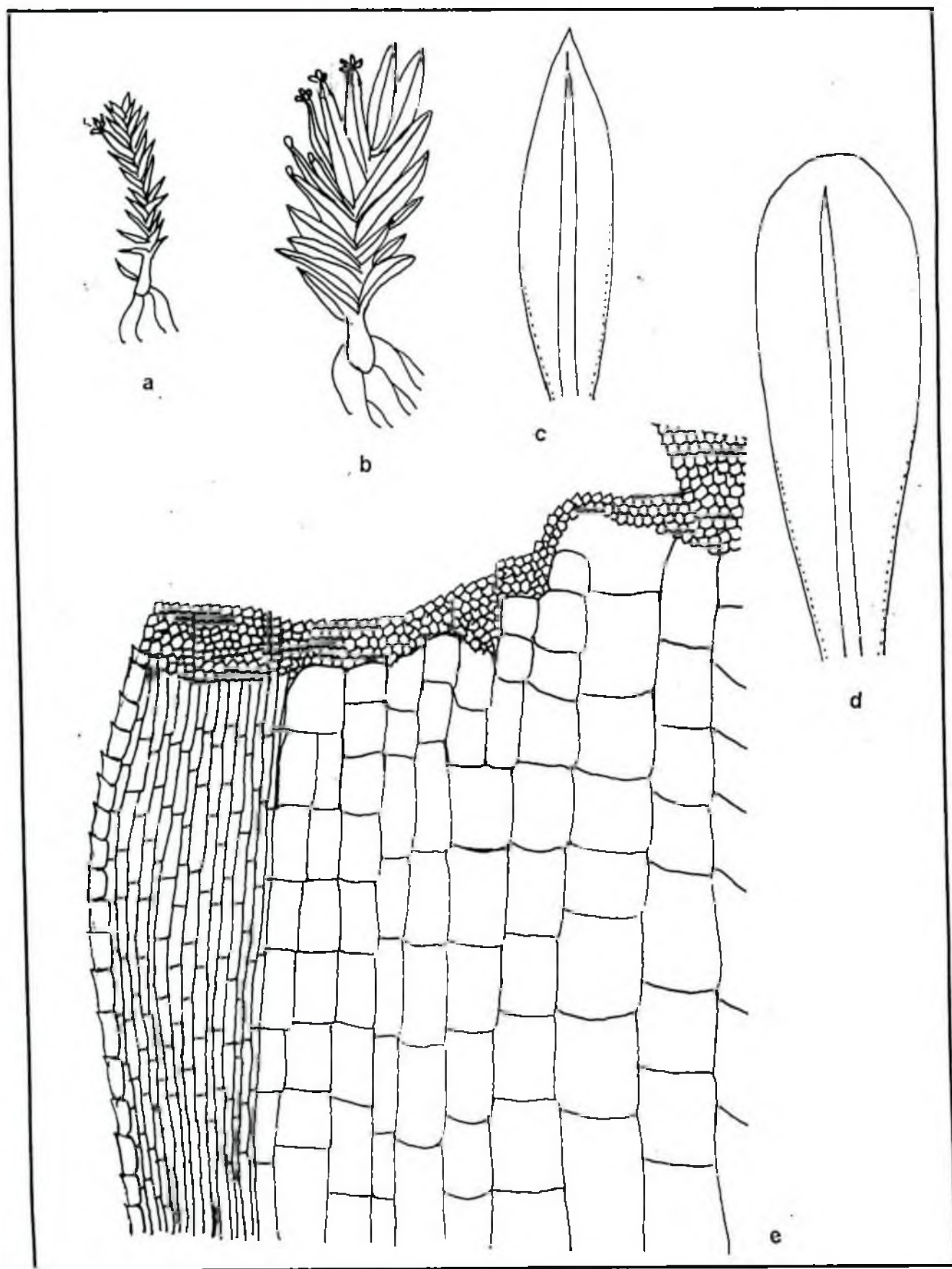
Specimens examined

Maulvi Bazar: Patharia Reserve Forest, borolekha, on bark of a tree, Shirin Akhtar and Jahirul Haque 16.07.2007, **164**.

PLATE 27

Calymperes noakhalensis Bruehl *et* Sarkar

- | | | |
|--------|-------------------------------|-------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c & d. | Normal leaves | × 30 |
| e. | Laminal cells and cancellinae | × 150 |

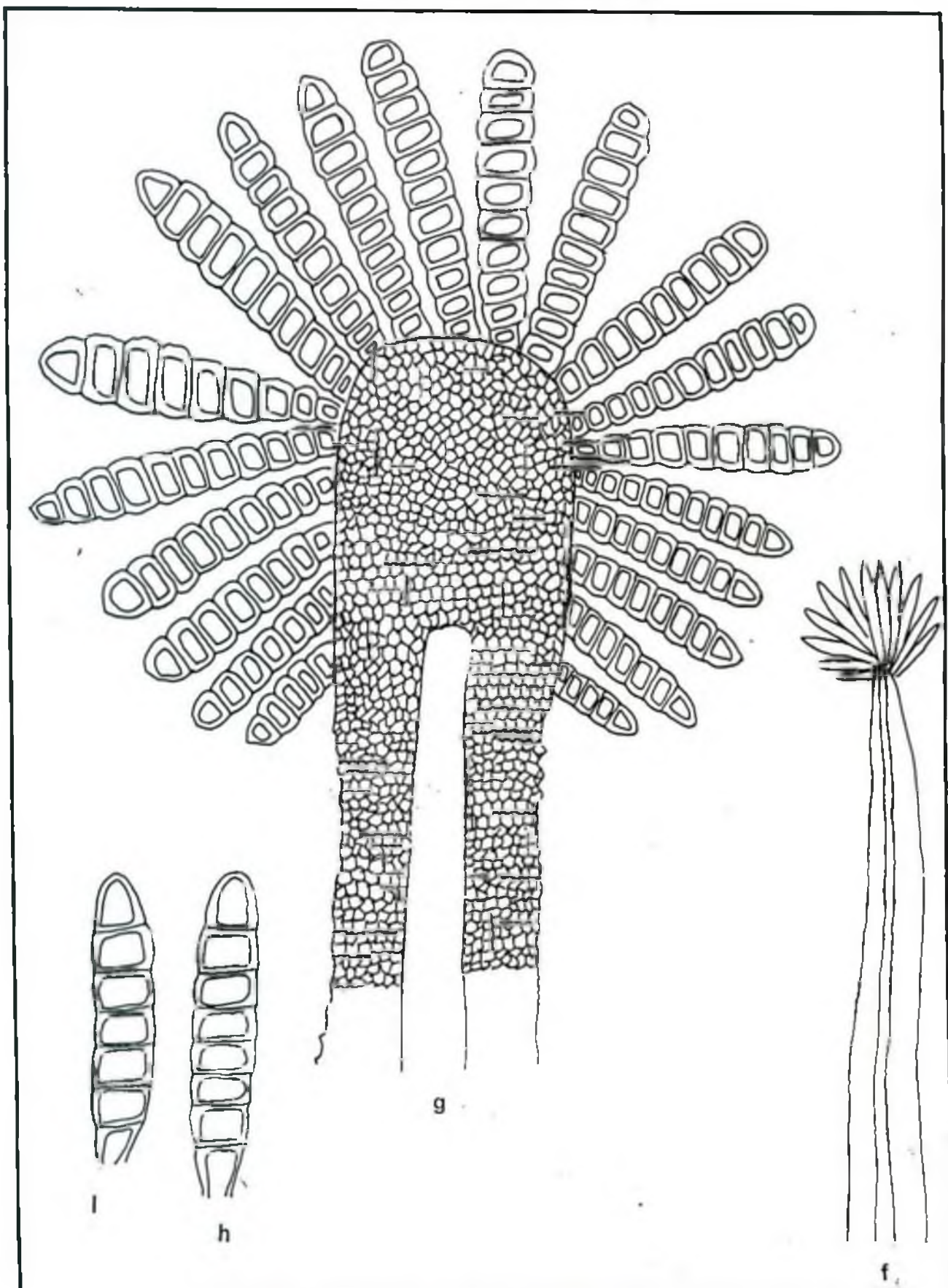


Calymperes noakhalensis Bruel et Sarkar.

PLATE 27
(CONT.)

Calymperes noakhalensis Bruehl *et* Sarkar

- | | | |
|--------|--------------------------|-------|
| f. | Gemmiferous leaf | × 30 |
| g. | Apex of gemmiferous leaf | × 100 |
| h & i. | Gemmae | × 150 |



Calymperes noakhalensis Bruel et Sarkar.

ORDER POTTIALES

Characters same as that of family.

FAMILY POTTIACEAE

Plants grow vigorously on different substratum, small to medium sized, mostly terrestrial, stem erect, unbranched or branched. Leaf many rowed, crowded, and more or less curled when dry, linear to ovate, apex acuminate or rounded. Costa strong, percurrent or excurrent. Leaf basal cells rectangular, $\pm$ hyaline, or papillate, thin-walled, quadrate-hexagonal, and obscure towards apex. Seta usually erect, long or short. Capsule erect or inclined, cleistocarpous or stegocarpous, ovoid to cylindrical, straight or curved. Operculum conic-rostrate. Calyptra hooded often narrower.

KEY TO THE GENERA OF POTTIACEAE

- | | |
|---|--------------------|
| 1. Leaves forming rosette at apex
of stem and leaf wider | <i>Hyophila</i> |
| - Leaves not forming rosette at apex
of stem and leaf narrower | <i>Semibarbula</i> |

GENUS *HYOPHILA* Brid.

Bryol. Univ. 1 : 760 (1827)

Plant dioicous, grow vigorously, usually small. Leaves oblong-lingulate or spatulate, margin inrolled when dry, apex obtuse or acute. Costa strong, ending percurrent or excurrent. Basal cells rectangular, hyaline, upper cells small, mammillose or papillose. Seta long, apical, erect, and slender. Capsule erect, cylindrical, rarely ovoid. Operculum conic-rostrate. Calyptra cucullate. Gemmae present.

KEY TO THE SPECIES *HYOPHILA*

- | | |
|--|--------------------|
| 1. Leaf cells papillate and costa percurrent | <i>H. comosa</i> |
| - Leaf cells not papillate and costa excurrent | <i>H. involuta</i> |

1. *Hyophila comosa* Dix. et Varde, Arch. Bot. 1 : 166 (1927)

PLATE 28

Plants usually unbranched, light green in color, densely tufted or sometimes scattered, ± 2.86 mm long and ± 2.42 mm broad with leaves. Leaves oblong-ligulate from a narrower base, erectopatent, upper leaves sometimes forming rosette like structure, ± 1.42 mm long and ± 0.63 mm broad. Leaves inrolled and curled when dry. Upper leaf margin crenulate not lower part, lower margin entire, or rough. Leaf apex obtuse to round, broadly acuminate. Costa red-brown, smooth, strong, percurrent, ± 72.5 μ m wide at base. Upper laminal cells rounded-quadrangle-pentagonal, chlorophyllose, moderately thin walled, $\pm 11.18 \times 10.32$ μ m, multipapillose. Basal laminal cells nonpapillose, more or

less rectangular; thin walled, transparent, $\pm 24.23 \times 10.12 \mu\text{m}$. Seta erect, apical, $\pm 9 \text{ mm}$ long and $\pm 121 \mu\text{m}$ in diameter. Capsule cylindrical, $\pm 1.75 \text{ mm}$ long and $\pm 0.48 \text{ mm}$ in diameter. Operculum of capsule conical, $\pm 0.72 \text{ mm}$ high. Spore more or less rounded $\pm 86.0 \mu\text{m}$ in diameter.

Specimens examined

Sylhet: Jaflong Tea Estate, Jauntipur, on moist wall, Shirin Akhtar and Jahirul Haque 26.10.2007, **102**; Malnichora Tea Estate, Sylhet Sadar, on brick, Shirin Akhtar and Jahirul Haque 20.10.2009, **647**.

Maulvi Bazar: Patharia Reserve Forest, Borolekha, on brick, Shirin Akhtar and Jahirul Haque, 26.12.2008, **565**; Kholilpur, Maulvi Bazar Sadar, on damp wall, Shirin Akhtar and Jahirul Haque, 24.09.2009, **628**.

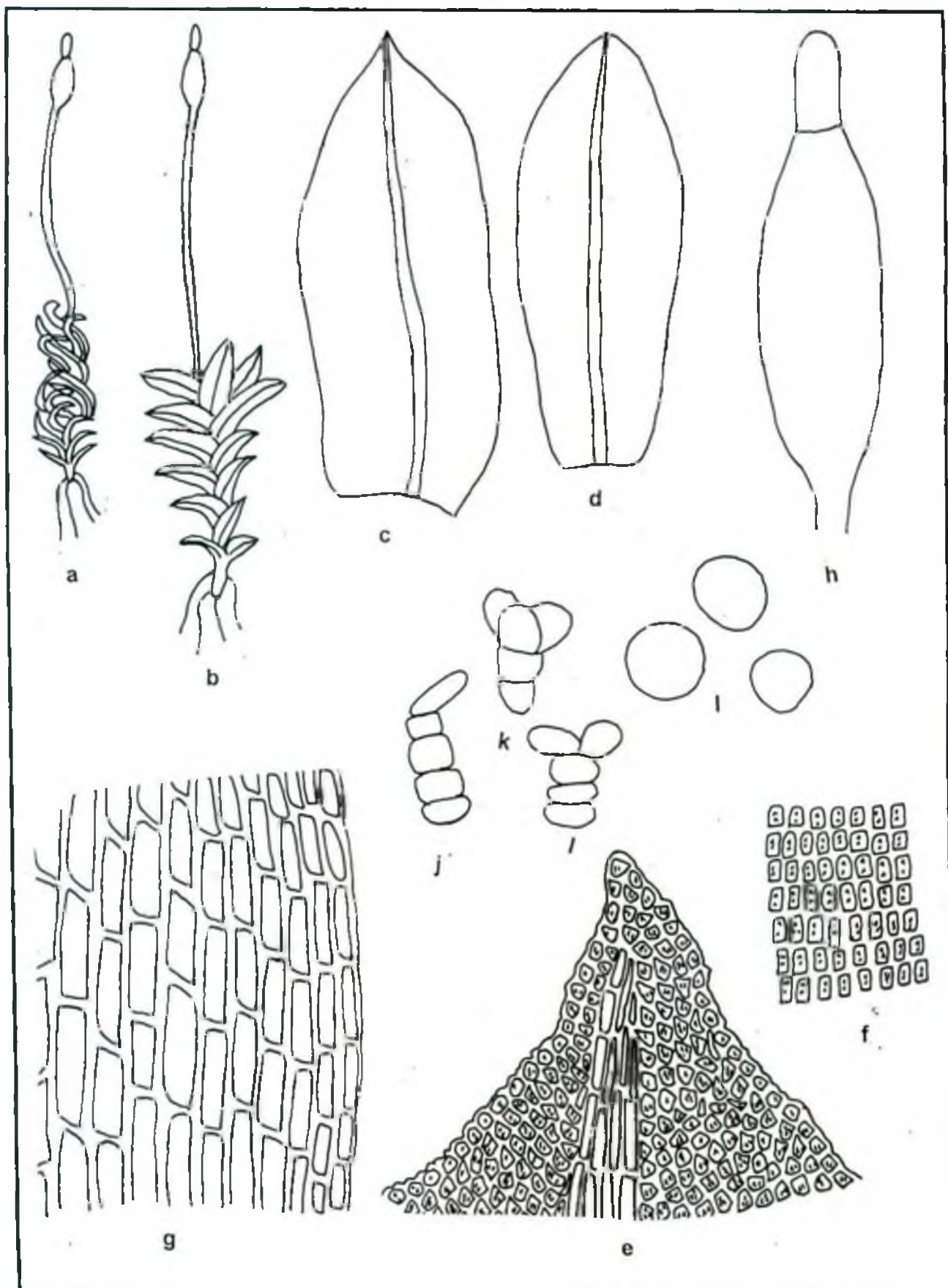
Habiganj: Tarof Hill Reserve Forest, Madhabpur, on brick, Shirin Akhtar and Jahirul Haque 23.08.2007, **143**; Madhabpur, on damp wall, Shirin Akhtar and Jahirul Haque, 23.10.2008, **436**.

Sunamganj: Mollapara, Sunamganj Sadar, on brick, Shirin Akhtar and Jahirul Haque 21.09.2007, **100**; Vatipara, Derai, on damp wall, Shirin Akhtar and Monirul Haque 23.08.2009, **622**.

PLATE 28

Hyophila comosa Dix. et Varde.

- | | | |
|-----------|------------------------|-------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c & d. | Leaves | × 30 |
| e. | Leaf apex | × 225 |
| f. | Middle laminal cells | × 225 |
| g. | Basal laminal cells | × 225 |
| h. | Capsule with operculum | × 30 |
| i, j & k. | Gemmae | × 225 |
| l. | Spores | × 450 |



Hyophila comosa Dix. et Varde,

2. *Hyophila involuta* (Hook.) Jaeg. , Ber. S. Gall. Naturw. Ges. 1871-72: 356(1873)
Gymnostomum involutum Hook. , Musc. Exot. 2 : 154 (1819)

PLATE 29

Plants dioicous, usually unbranched, sometime branched, green in color, tufted, erect, ± 0.75 cm high with leaves. Upper leaves forming rosette like structure. Leaves oblong-lingulate, ± 2.52 mm long and ± 0.86 mm broad in middle, the lower oblong part pale, apex broadly pointed, flat and wavy when moist. Leaves margin denticulate at apex, rolled when dry. Costa brown, percurrent, ± 122 μ m wide at base. Upper laminal cells mamilllose chlorophyllose, lightly obscure, rounded-quadrate, $\pm 8.12 \times 7.32$ μ m, with a few larger cells at the marginal teeth. Middle laminal cells rounded-quadrate, $\pm 5.62 \times 5.26$ μ m. Basal laminal cells smooth, more or less rectangular, $\pm 45.35 \times 19.25$ μ m. Seta erect, apical, light-brown at base, lighter above, ± 1.12 cm long and ± 0.45 mm in diameter. Capsule smooth, brown in color, cylindrical, erect, ± 1.85 mm long and ± 0.52 mm in diameter. Peristome absent. Operculum conic-rostrate, ± 0.69 mm high. Calyptra smooth, cucullate. Spores smooth, more or less rounded, ± 9.12 μ m in diameter.

Specimens examined

Sylhet: Jaflong Tea Estate, Jauntipur, on moist wall, Shirin Akhtar and Jahirul Haque 10.11.2007, **195**; Malnichora Tea Estate, Sylhet Sadar, on brick, Shirin Akhtar and Jahirul Haque 18.10.2009, **641**.

Maulvi Bazar: Patharia Reserve Forest, Borolekha, on brick, Shirin Akhtar and Jahirul Haque, 24.07.2008, **534**; Kholilpur, Maulvi Bazar Sadar, on damp wall, Shirin Akhtar and Jahirul Haque, 24.07.2009, **662**.

Habiganj: Tarof Hill Reserve Forest, Madhabpur, on brick, Shirin Akhtar and Jahirul Haque 23.08.2007, 127; Madhabpur, on damp wall, Shirin Akhtar and Jahirul Haque, 23.10.2008, 406.

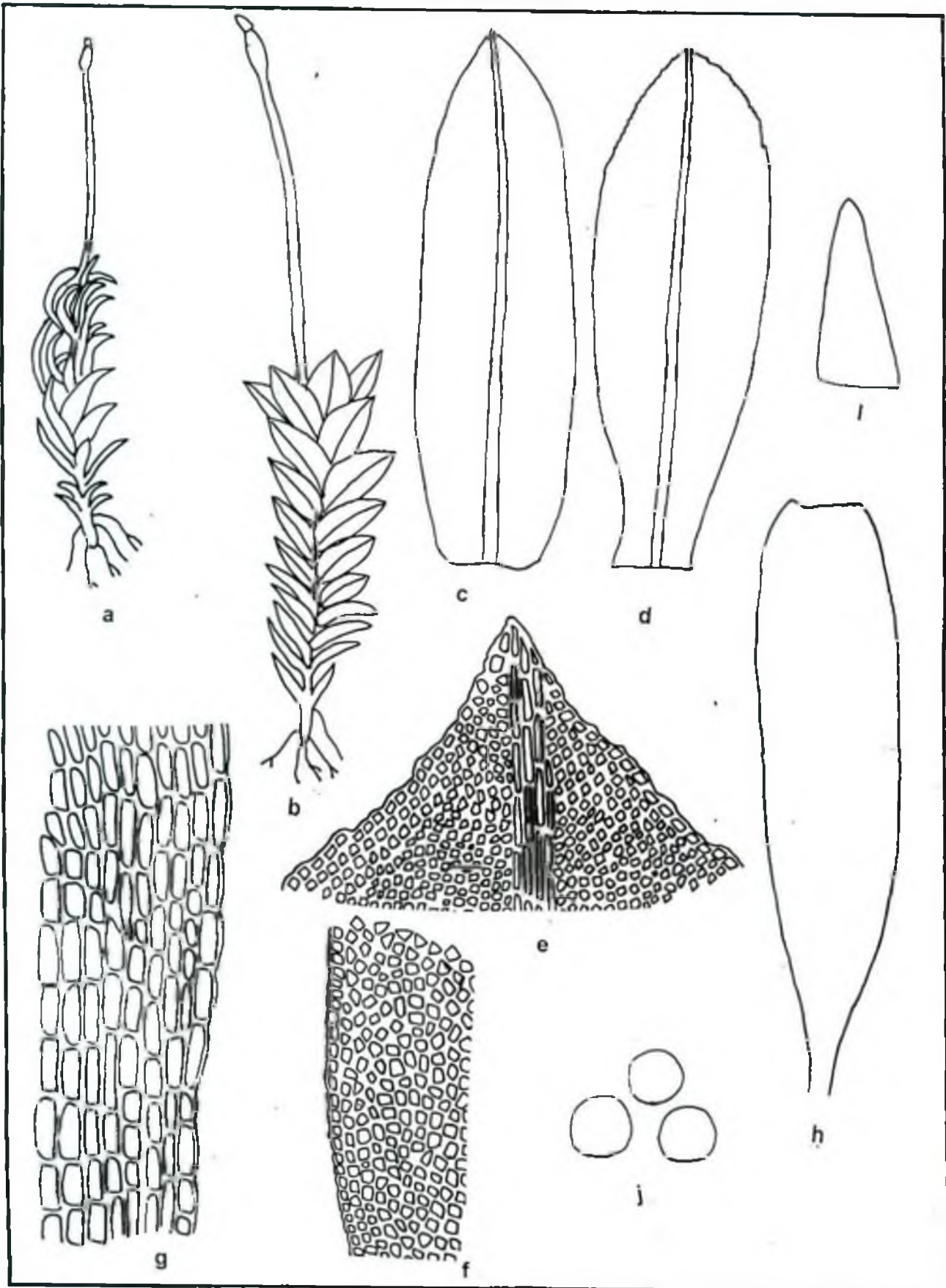
Sunamganj: Mollapara, Sunamgonj Sadar, on brick, Shirin Akhtar and Jahirul Haque 21.09.2007, 150; Vatipara, Derai, on damp wall, Shirin Akhtar and Monirul Haque 23.08.2009, 658.

PLATE 29

Hyophila involuta (Hook.) Jaeg.

- | | | |
|--------|---------------------------|-------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c & d. | Leaves | × 30 |
| e. | Leaf apex | × 225 |
| f. | Middle laminal cells | × 225 |
| g. | Basal laminal cells | × 225 |
| h. | Capsule without operculum | × 30 |
| i. | Operculum | × 30 |
| j. | Spores | × 450 |

PLATE 29



Hyophila involuta (Hook.) Jaeg.

GENUS **SEMIBARBULA** Herz. ex Hilp.

Beih. Bot. Centralbl., 50 (2) : 626 (1933)

Plants small, tufted, yellowish-green to green in color. Stem erect, laxly foliate. Moist leaves lingulate-lanceolate and inrolled when dry. Margin often inrolled, papillose-crenulate. Costa percurrent or short-excurrent. Leaf basal cells smooth, thin-walled, rectangular, pellucid, upper cells mostly quadrate, densely-papillose. Seta erect. Capsule cylindrical. Operculum conic-rostrate. Calyptra cuculate.

KEY TO THE SPECIES OF SEMIBARBULA

- | | |
|--|----------------------|
| 1. Leaf apex tapering
and costa excurrent | <i>S. ranuii</i> |
| - Leaf apex more or less round
and costa percurrent | <i>S. orientalis</i> |

1. ***Semibarbula ranuui*** Gangulee in Nova Hedwigia, 8 : 149 (1964)

PLATE 30

Plants loosely tufted, green in color, mostly unbranched, ± 4.35 mm long and ± 0.95 mm wide with leaves. Leaves oblong-lanceolate, ± 1.13 mm long and ± 0.27 mm wide at base, erectopatent to patent when moist, curled and incurved when dry. Leaf margin minutely dentate, apex tapering. Upper laminal cells rounded-quadrate to hexagonal, highly multipapillose, chlorophyllose, $\pm 7.89 \times 6.53$ μm . Middle laminal cells multipapillose, rounded to quadrate, $\pm 7.98 \times 6.35$ μm . Basal laminal cells large, hyaline, rectangular, thin walled, larger cells $\pm 32.04 \times 8.23$ μm and small cells $\pm 10.25 \times 9.62$ μm . Costa hyaline apiculus, prominent, excurrent, ± 42.08 μm wide at base. Seta erect, light brown, ± 7.85 mm long and ± 81 μm in diameter. Capsule cylindrical, erect, brown in color, ± 1.35 mm long and ± 0.50 mm in diameter. Spores smooth, brown, almost rounded, ± 46 μm in diameter.

Specimens examined

Sylhet: Monipur Tea Estate, Fenchugonj, on sandy soil, Shirin Akhtar and Monirul Haque, 10.10.2007, 175.

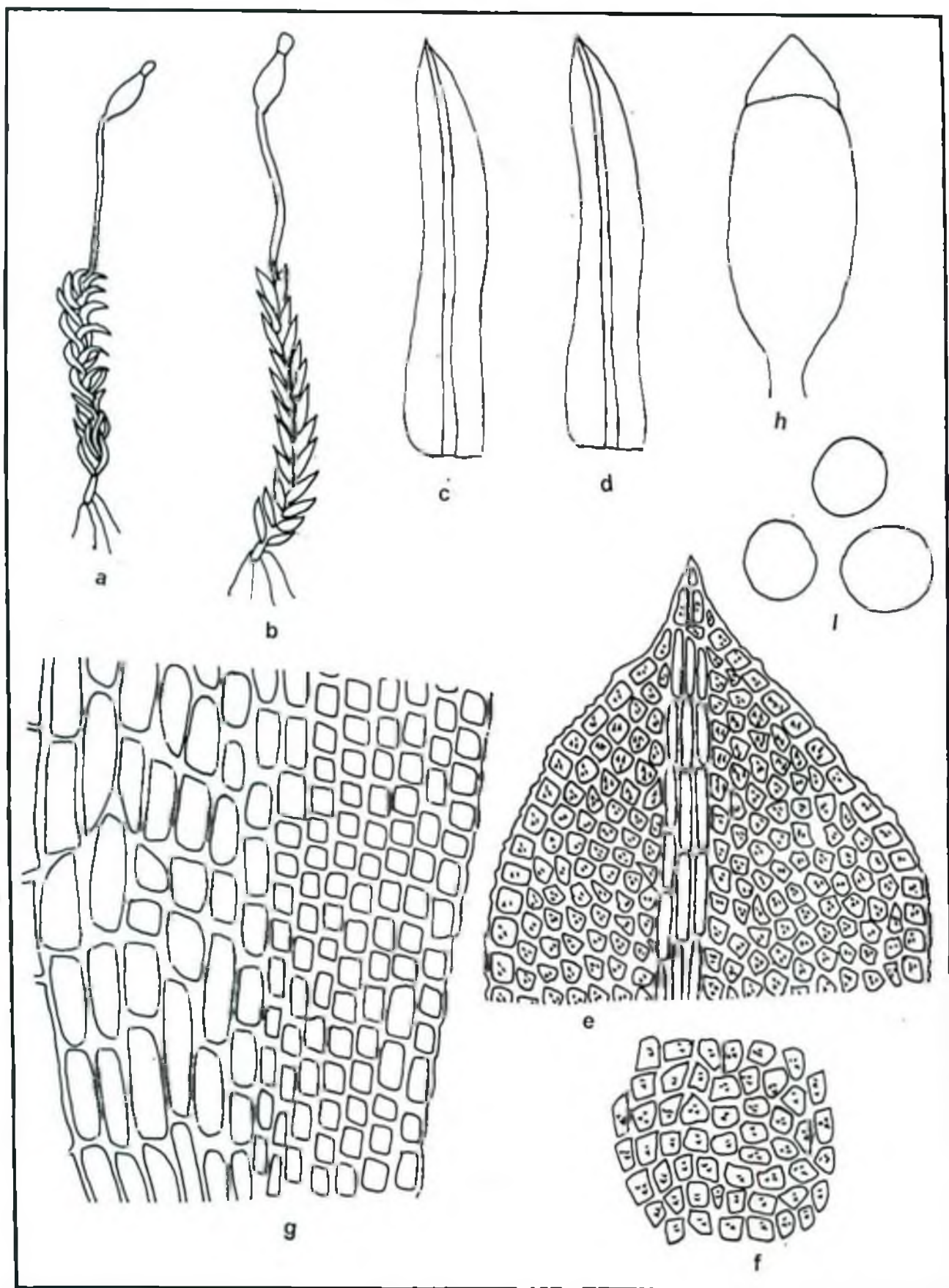
Maulvi Bazar: Alinagar Tea Estate, Komolgonj, on sandy soil, Shirin Akhtar and Monirul Haque, 18.10.2008, 518.

PLATE 30

Semibarbula ranuii Gangulee.

- | | | |
|------|------------------------|-------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c& d | Leaves | × 30 |
| e. | Leaf apex | × 450 |
| f. | Middle laminal cells | × 450 |
| g. | Basal laminal cells | × 450 |
| h. | Capsule with operculum | × 30 |
| i. | Spores | × 450 |

PLATE 30



Semibarbula ranuii Gangulee.

2. ***Semibarbula orientalis*** (Web.) Wijk. & Marg., in Taxon, 8 : 75 (1959)

Trichostomum indicum Schwaegr. Sp. Musc. suppl. 1 (1) : 142 (1811) *hom. illeg.*

PLATE 31

Plants usually dioicous; densely tufted, usually unbranched, yellow-green, ± 6.5 mm long and ± 1.45 mm broad with leaves. Leaves lax, oblong to ovate-lanceolate, erectopatent when moist, incurved and curled when dry borne spirally, ± 1.16 mm long and ± 0.31 mm broad at base. Leaf margin papillose, unbroken, usually flat. Leaf apex more or less round. Upper laminal cells rounded-quadrate-hexagonal, chlorophyllose, highly multipapillose, obscure, $\pm 6.89 \times 5.72$ μm . Leaf base covers lowest quarter. Basal laminal cells large, rectangular, hyaline, $\pm 18.21 \times 8.31$ μm . Costa brown, percurrent, strong, ± 30.82 μm wide at base, hyaline apiculus. Middle laminal cells multipapillose, rectangular-hexagonal, $\pm 7.12 \times 6.13$ μm . Seta usually brown at base, yellowish above, gradually lighter, slightly twisted when dry, ± 4.45 mm long and ± 54 μm in diameter. Capsule short-cylindrical, erect, brown in color, ± 1.24 mm long and 0.45 mm in diameter. Operculum conic-rostrate, ± 0.86 mm high. Calyptra cucullate. Spores smooth, spherical, ± 12 μm in diameter. Gemmae multicellular, abundant growing in apically as well as axillary cluster, brown in color. Each gemma ± 84.25 μm long and ± 31.2 μm wide.

Specimens examined

Sylhet: Lalkhal Tea Estate, Jaunyipur, on sandy soil, Shirin Akhtar and Jahirul Haque, 26.07.2009, 643.

Maulvi Bazar: Chadnighat, Maulvi Bazar sadar, on moist soil, Shirin Akhtar and Jahirul Haque, 26.07.2007,93; Najirabad, Maulvi Bazar Sadar, on sandy soil, Shirin Akhtar and Jahirul Haque, 26.07.2007, 86.

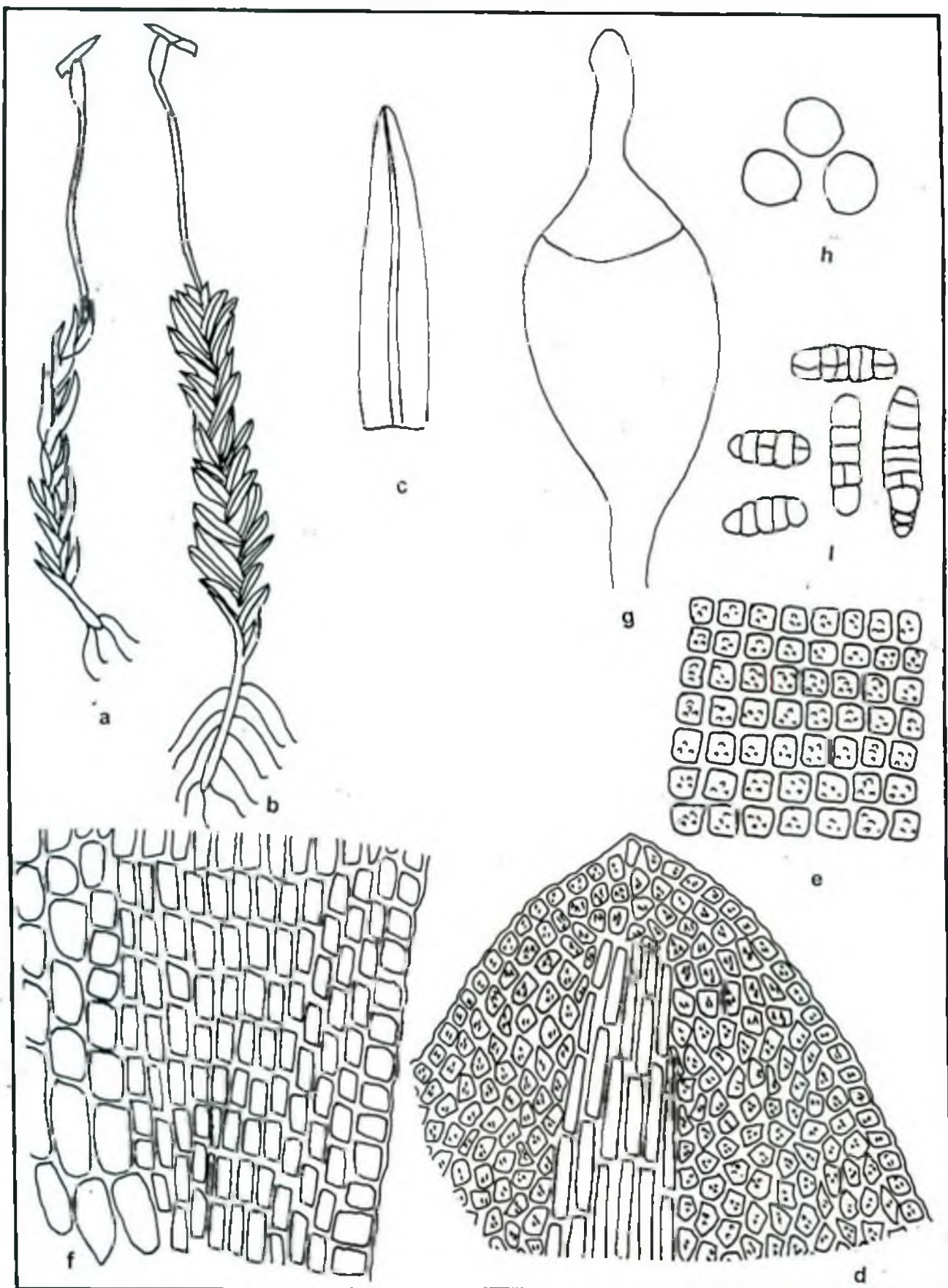
Habiganj: Chaumohoni, Madhabpur, on moist soil, Shirin Akhtar, 22.08.2007,77; Debpara, Nabiganj, on sandy soil, Shirin Akhtar, 24.08.2007,85.

Sunamganj: Mollapa ra, Sunamganj sadar, on sandy soil, Shirin Akhtar, 25.08.2007,105; Dinarpur, Azmariganj, on moist soil, Shirin Akhtar, Jahirul Haque and Monirul Haque, 27.08.2007,70.

PLATE 31

Semibarbula orientalis (Web.) Wijk. & Marg.

- | | | |
|----|------------------------|-------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c. | Leaf | × 30 |
| d. | Leaf apex | × 450 |
| e. | Middle laminal cells | × 450 |
| f. | Basal laminal cells | × 450 |
| g. | Capsule with operculum | × 30 |
| h. | Spores | × 450 |
| i. | Gemmae | × 150 |



Semibarbula orientalis (Web.) Wijk. & Marg.

ORDER FUNARIALES

Plants small to medium in size. Leaves often forming rosette at apex of the stem, broad-ovate or spatulate. Leaf cells very lax, thin walled, smooth. Capsule not cylindrical, usually diplolepidous.

FAMILY FUNARIACEAE

Plants terrestrial, small to medium in size, with broad, soft leaves, usually in comal tufts and with lax areolation. Costa slender, short excurrent. Leaf cells smooth, rectangular at base, rhomboidal above. Seta erect, elongated. Capsule erect and symmetrical, globose. Operculum usually plano-convex. Calyptra usually inflated, smooth, lobed or cucullate, long-beaked.

GENUS *PHYSCOMITRIUM* (Brid.) Fuernr.

Flora 13 : 9 (1829)

Plants tufted, green in color, erect, small, usually terrestrial. Stem simple with central strand. Leaves usually acuminate, erect-spreading, usually broad-ovate or spatulate, margin dentate or serrate above, flat below, with bordered elongated cells. Costa short excurrent. Leaf cells lax, rhomboidal above and rectangular above. Seta long. Capsule erect, symmetrical, globose. Spores warty to papillose.

1. *Physcomitrium pulchellum* (Griff.) Mitt., Musci. Ind. Or. 54 (1859)

Gymnostomum pulchellum Griff., Cal. J. Nat. Hist, 2 : 478 (1842)

PLATE 32

Plants dioicous; branched or unbranched, green in color, densely tufted, ± 3.5 mm long. Stem slender, radiculose. Leaves lax, ovate-lanceolate to spatulate-lanceolate, acuminate, erectopatent to spreading when moist, much shrunk when dry, ± 2.89 mm long and ± 1.45 mm broad at middle position. Leaf margin dentate or serrate above, flat below, with bordered elongated cells. Costa short excurrent, strong, ± 76 μm broad at base. Upper laminal cells thin walled, rectangular to rhomboidal, $\pm 41.32 \times 12.13$ μm , middle laminal cells also rectangular to rhomboidal $\pm 38.23 \times 11.43$ μm , basal laminal cells quadrate to rhomboidal, $\pm 45.25 \times 13.12$ μm . Leaf bordered by one layer of elongated, narrow vermicular cells, which becomes rectangular at base. Leaf border cells $\pm 89.76 \times 6.12$ μm . Seta erect, apical, orange in color, slightly sinuose when dry, ± 1.32 cm long and ± 0.13 mm in diameter. Capsule turbinate to pyriform with short apophysis ± 2.23 mm high and ± 2.12 mm in diameter. Operculum brown, conical-convex with truncate apex. Calyptra yellowish, lobed at base, ± 2.43 mm high. Spores brown, more or less rounded, warty papillose, ± 38 μm in diameter.

Specimens examined

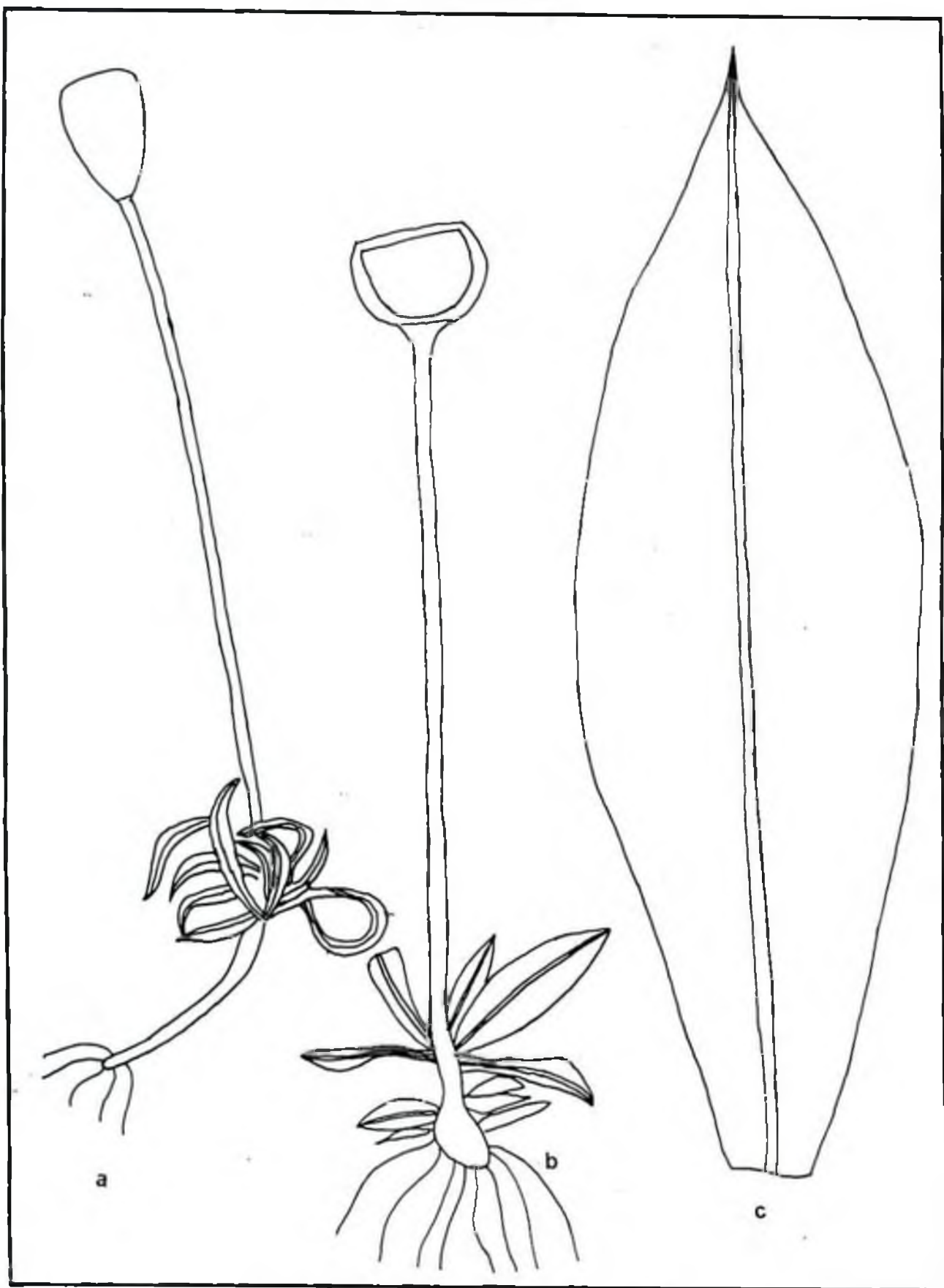
Sylhet: Morninchora Tea Estate, Fenchugonj, on moist soil, Shirin Akhtar and Mozammel Haque, 12.10.2007, 174; Jalalpur, Sylhet sadar, on moist soil, Shirin Akhtar and Mozammel Haque, 18.10.2009, 666.

Maulvi Bazar: Atiabagh Tea Estate, Borolekha, on soil, Shirin Akhtar and Jahirul Haque, 19.09.2008, 426; Patharia Reserve Forest, Juri, on soil, Shirin Akhtar and Jahirul Haque, 14.09.2009, 663.

PLATE 32

Physcomitrium pulchellum (Griff.) Mitt.

- | | | |
|----|---------------------------|------|
| a. | Dry plant with sporophyte | × 10 |
| b. | Wet plant with sporophyte | × 10 |
| c | Leaf | × 30 |



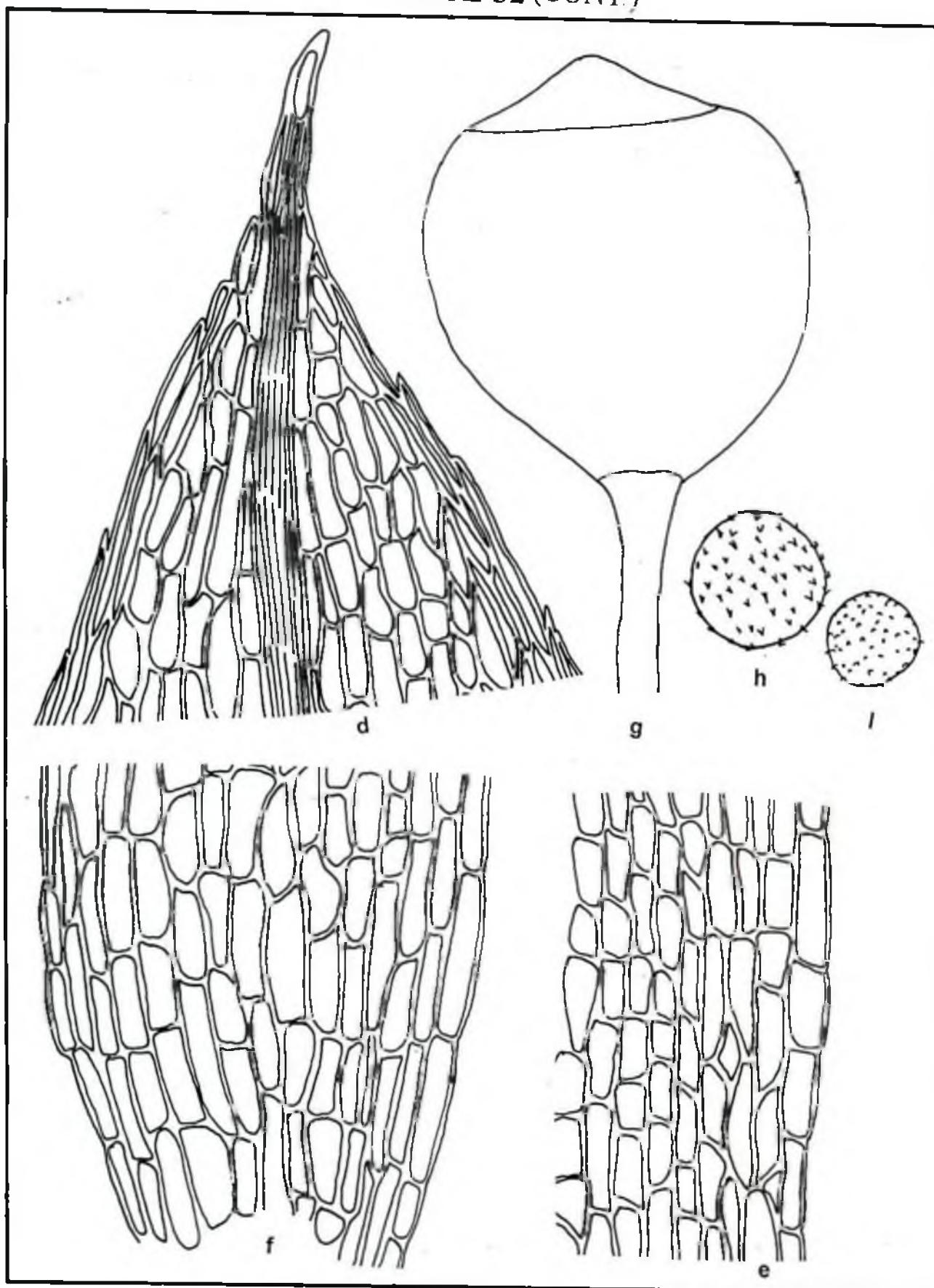
Physcomitrium pulchellum (Griff.) Mitt.

PLATE 32
(CONT.)

***Physcomitrium pulchellum* (Griff.) Mitt.**

- | | | |
|--------|------------------------|-------|
| d. | Leaf apex | × 225 |
| e. | Middle laminal cells | × 225 |
| f. | Basal laminal cells | × 225 |
| g. | Capsule with operculum | × 30 |
| h & i. | Spores | × 450 |

PLATE 32 (CONT.)



Physcomitrium pulchellum (Griff.) Mitt.

ORDER EUBRYALES

Plants often strong. Leaves of variable size, lanceolate to orbicular. Leaf cells smooth. Capsule mostly inclined to cernuous. Calyptra cucullate.

KEY TO THE FAMILIES OF EUBRYALES

- | | |
|--|---------------|
| 1. Leaf usually larger, apophysis always present | Bryaceae |
| - Leaf usually smaller, apophysis not always present | Bartramiaceae |

FAMILY BRYACEAE

Plants variable in size, usually tufted, stem erect, often with subfloral innovation. Rhizoids consist of numerous papilli which arise from base of stem or throughout its length. Leaves usually lanceolate, grow in many rows, the upper leaves larger, usually forming comal tufts, lower leaves normally small and distant, thin, shrunk in dry condition. Costa sub-percurrent, percurrent to long-excurrent. Basal cells rectangular to quadrate, upper cells prosenchymatous, rhomboid or linear towards apex, smooth. Seta smooth, elongated. Capsule pendulous, apophysis always present, distinct, curved and rolled when dry. Operculum short, conical. Spores usually small, rounded.

KEY TO THE GENERA OF BRYACEAE

- | | |
|-----------------------------------|---------------|
| 1. Leaf apex dentate or crenulate | <i>Pohlia</i> |
| - Leaf apex smooth or entire | <i>Bryum</i> |

GENUS *POHLIA* Hedw.

Sp. Musc. 171 (1801)

Plants densely tufted. Stem often red. Leaves lanceolate or linear-lanceolate. Upper margin denticulate. Costa narrow, excurrent. Leaf cells shorter, rectangular at base, very narrow rhomboid-hexagonal to linear above. Gemmae arise from stem.

Pohlia ampullacea Gang. , Mosses of East. Ind. And Adj. Reg. Fasc. 4 : 921
(1974)

Bryum ampullaceum Hamp in C. Muell. , Gen. Musc. Fr. 222 (1900) *nom. nud.*

PLATE 33

Plants erect, in loosely tufted, branched or unbranched, ± 5.12 mm long and ± 2.25 mm wide with leaves. Leaves acuminate, ovate-lanceolate, upper leaves forming crowded at apex, lower leaves small, distantly placed, erectopate, not much change when dry, ± 1.56 mm long and ± 0.43 mm wide at mid portion. Margin flat, entire below, mildly denticulate above. Costa excurrent in a short aristata, brown in color, strong , ± 45 μ m wide at base, gradually narrowing towards apex.

Upper laminal cells elongated-rhomboidal, $\pm 53.65 \times 7.6 \mu\text{m}$, middle laminal cell quadrate-rhomboidal, $\pm 87.45 \times 9.67 \mu\text{m}$ and basal cells more or less rectangular, $\pm 45.43 \times 8.74 \mu\text{m}$. Most of the part of stem consist of numerous gemmae; gemmae $\pm 300 \times 36 \mu\text{m}$. Sporophyte not found.

Specimens examined

Sylhet: Jaflong Tea Estate, Jauntipur, on stone, Shirin Akhtar and Monirul Haque, 12.10.2007, **186**; Jaflong Hill Forest, on stone, Shirin Akhtar and Jahirul Haque, 22.09.2009, **664**.

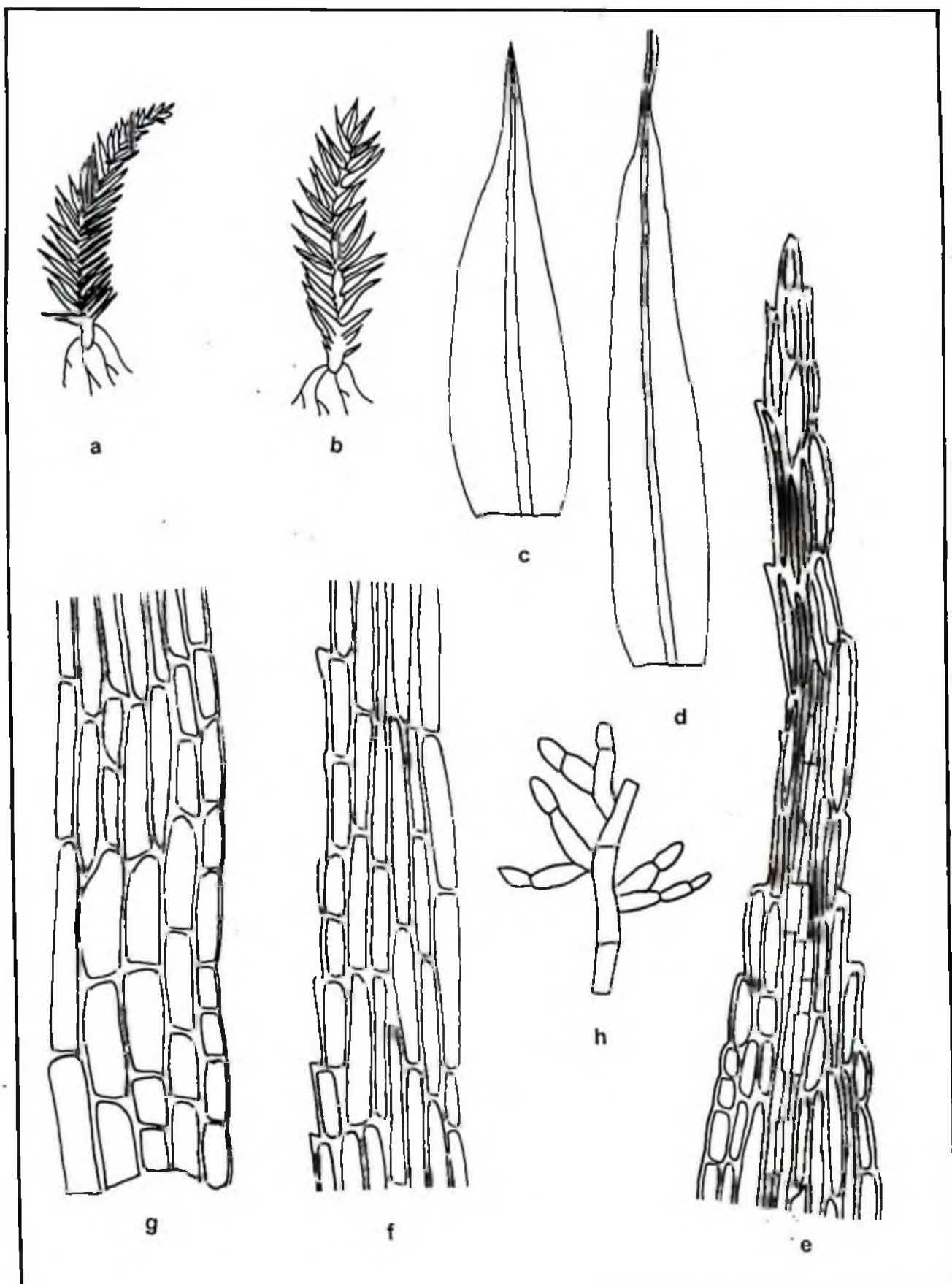
Moulvi Bazar: Banugasha Reserve Forest, Kamolganj, on brick, Shirin Akhtar and Monirul Haque, 19.10.2008, **412**; Karimpur Tea Estate, Rajnagor, on stone, Shirin Akhtar and Jahirul Haque, 23.10.2008, **512**.

PLATE 33

***Pohlia ampullacea* Gang**

- | | | |
|--------|----------------------|-------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c & d. | Leaves | × 30 |
| e. | Leaf apex | × 225 |
| f. | Middle laminal cells | × 225 |
| g. | Basal laminal cells | × 225 |
| h. | Branched gemmae | × 225 |

PLATE 33



Pohlia ampullacea Gang.

GENUS *BRYUM* Hedw.

Sp. Musc. 178 (1801) Emend. Schimp. , Syn. ed. 1 (1860)

Lectotype : *B. argenteum* Hedw. , *fid.* Britt.

Plants grow vigorously, different in sized with erect stem. Lower leaves small and distant, upper leaves larger, usually crowded and tufted. Basal laminal cells sub-rectangular, upper laminal cells rhomboidal and smooth, and marginal cells usually narrower than others. Costa percurrent or excurrent.

KEY TO THE SPECIES OF *BRYUM*

1. Aristata present

B. coronatum

- Aristata absent

2

2. Costa excurrent

B. cellulare

- Costa percurrent

B. apiculatum

1. ***Bryum coronatum*** Schwaegr., Sp. Musc. 1 (2) : 71, 103 (1816)

B. angustifolium Brid., Sp. Musc. 3 : 31 (1817)

PLATE 34

Plant dioicous; green in color, densely tufted, ± 1.02 cm high. Stem with central strand, usually branched sometimes unbranched, highly tomentose, sterile plants longer than fertile plants and fewer branches and less tomentose. Lower leaves smaller and upper leaves larger. Upper leaves ovate to oblong-lanceolate, erect to erectopatent, slightly contorted when dry, ± 2.95 mm long and ± 0.85 mm broad at middle position. Margin entire. Costa excurrent in a middle-denticulate yellowish aristata, strong, green-brown in color. The length of aristata ± 0.45 mm long. Upper laminal cells rhomboid to hexagonal $\pm 86.23 \times 14.43$ μm , middle laminal cells quadrate-pentagonal-hexagonal, $\pm 112 \times 13.53$ μm , basal laminal cells $\pm 45.12 \times 13.43$ μm . Capsule pendulous, thick, oblong or broad-cylindrical, ± 2.34 mm long and 0.86 mm in diameter, spongy apophysis clearly seen. Spore more or less rounded, smooth, yellowish, ± 8.54 μm in diameter.

Specimen examined

Sylhet: Jaflong Tea Estate, Jauntipur, on brick, Shirin Akhtar and Monirul Haque, 12.10.2007, **199**; Jaflong Hill Forest, on brick, Shirin Akhtar and Jahirul Haque, 22.09.2009, **605**.

Maulvi Bazar: Banugash Reserve Forest, Kamolganj, on brick, Shirin Akhtar and Monirul Haque, 19.10.2008, **456**; Karimpur Tea Estate, Rajnagar, on brick, Shirin Akhtar and Jahirul Haque, 23.10.2008, **526**.

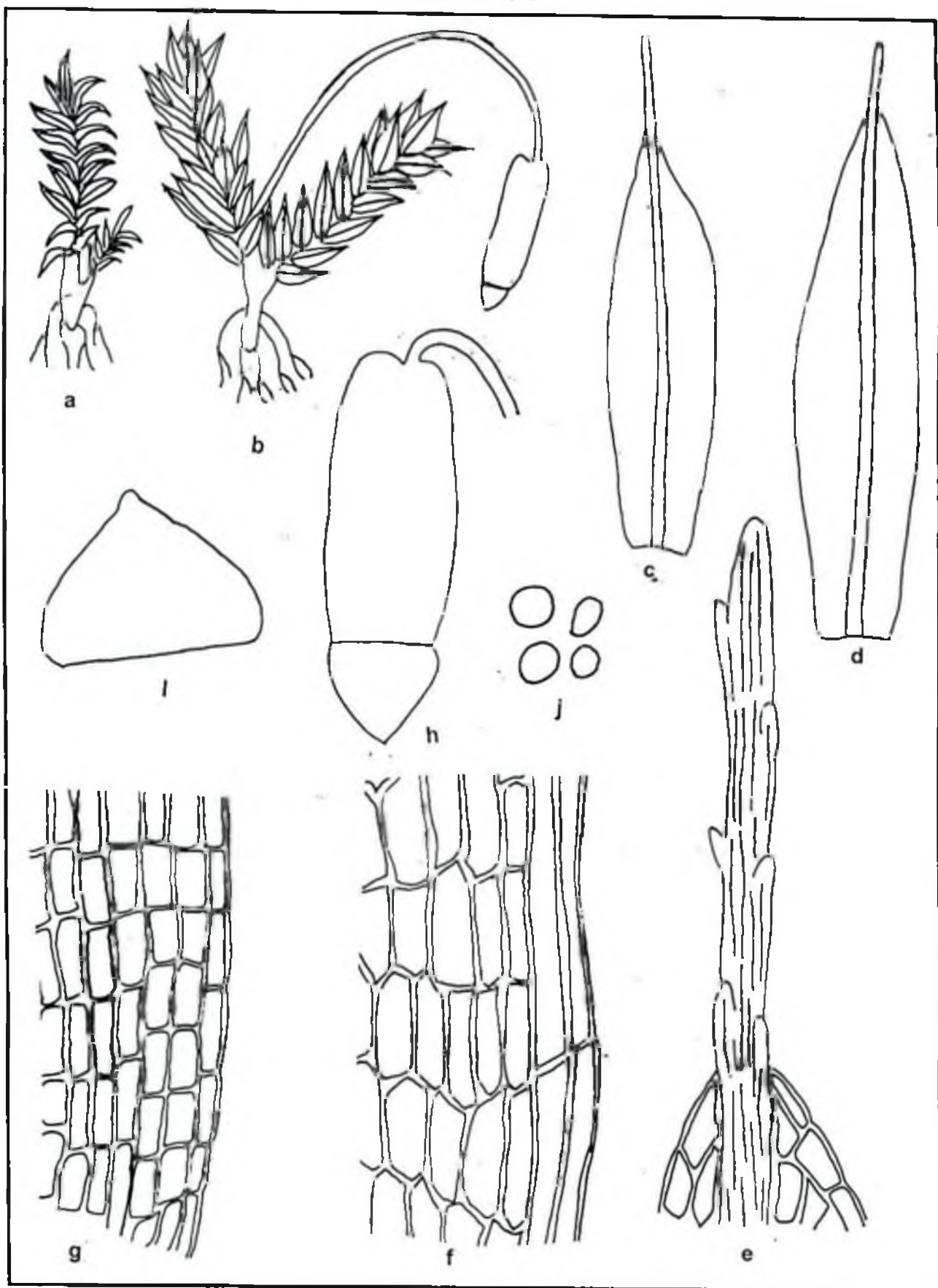
Sunamganj: Mollapara, Sunamganj Sadar, on brick wall, Shirin Akhtar and Jahirul Haque, 17.09.2008, **448**.

PLATE 34

***Bryum coronatum* Schwaegr.**

- | | | |
|--------|-------------------------|-------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c & d. | Leaves | × 30 |
| e. | Leaf apex with aristata | × 225 |
| f. | Middle laminal cells | × 225 |
| g. | Basal laminal cells | × 225 |
| h. | Capsule | × 20 |
| i. | Operculum | × 30 |
| J. | Spores | × 450 |

PLATE 34



Bryum coronatum Schwaegr.

2. ***Bryum cellulare*** Hook. Schwaegr. , Sp. Musc. Suppl. 3 (1) : 214 (1827)

Pohlia turbinata Schwaegr. , Sp. Musc. Suppl. 2 (2) : 150 (1827)

PLATE 35

Plants loosely turfted, filiform, green in color, ± 5.11 mm high. Stem branched or unbranched, densely and uniformly foliate. Rhizoids finely papillose. Leaves erect, thin, carinate, ovate to elliptic with obtusely apiculate apex, imbricate, appressed to stem, ± 0.57 mm long and ± 0.41 mm wide, younger leaves smaller not much changed when dry. Margin flat, entire. Costa excurrent, reddish, ± 29 μ m broad at base. Apical laminal cells more or less rhomboidal, $\pm 45.31 \times 14.52$ μ m, middle laminal cells quadrate to rhomboidal $\pm 40.5 \times 12.45$ μ m, basal cells rectangular- rhomboidal, $\pm 54.51 \times 10.79$ μ m. Sporophyte not found.

Specimens examined

Sylhet: Jaflong Tea Estate, Jauntipur, on soil, Shirin Akhtar and Jahirul Haque 10.11.2007, **171**; Malnichora Tea Estate, Sylhet Sadar, on soil, Shirin Akhtar and Jahirul Haque 18.10.2009, **627**.

Maulvi Bazar: Patharia Reserve Forest, Borolekha, on soil, Shirin Akhtar and Jahirul Haque, 24.07.2008, **540**; Kholilpur, Maulvi Bazar Sadar, on soil, Shirin Akhtar and Jahirul Haque, 24.07.2009, **637**.

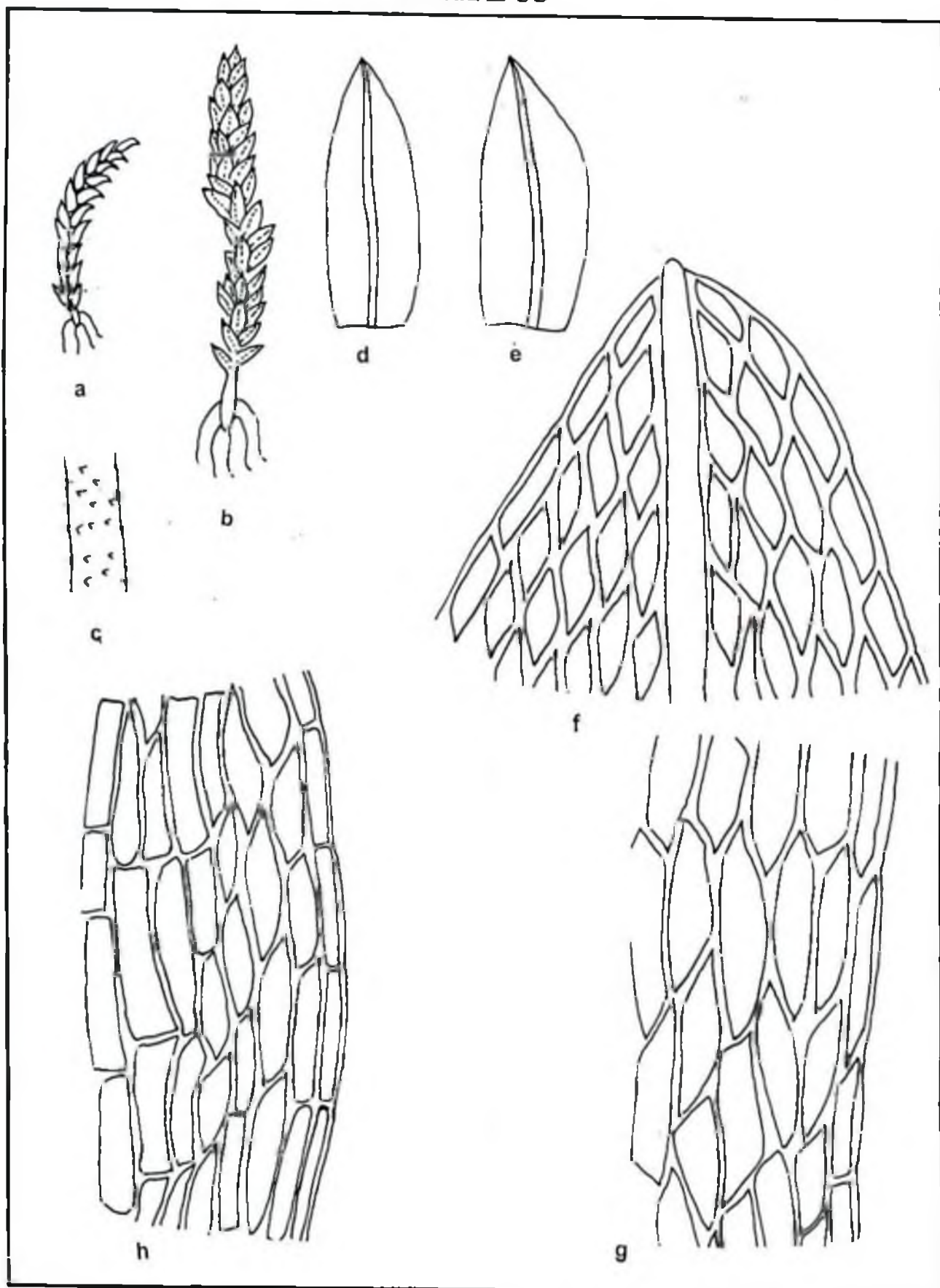
Habiganj: Tarof Hill Reserve Forest, Madhabpur, on slope of tilla, Shirin Akhtar and Jahirul Haque 23.08.2007, **128**; Madhabpur, on soil, Shirin Akhtar and Jahirul Haque, 23.10.2008, **488**.

PLATE 35

Bryum cellulare Hook.

- | | | |
|--------|--|-------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c. | A portion of rhizoid showing
papillae | × 450 |
| d & e. | Leaves | × 30 |
| f. | Leaf apex | × 225 |
| g. | Middle laminal cells | × 225 |
| h. | Basal laminal cells | × 225 |

PLATE 35



Bryum cellulare Hook.

3. ***Bryum apiculatum*** Schwaegr.

B. nitens Hook., Icon. Pl. Rar. **1** : 19 f. 6. (1836)

PLATE 36

Plants lustrous, green in color, in dense tufts, ± 23.91 mm high and ± 2.75 mm wide with leaves. Stem branched or unbranched. Leaves lax below densely grow at apex, shrunk but not much changed when dry. Leaves ovate-lanceolate, concave, carinate, ± 1.33 mm long and ± 0.38 mm wide at middle position. Margin entire. Irregular rhizoids with gemma arise from lower portion of stem. Costa percurrent, brown in color, ± 34 μ m wide at base. Upper laminal cells more or less rhomboidal $\pm 52.42 \times 11.21$ μ m middle laminal cells also more or less rhomboidal, $\pm 75.34 \times 14.14$ μ m, basal laminal cells rectangular to rhomboidal, $\pm 112 \times 21.23$ μ m, and.

Specimens examined

Sylhet: Jaflong Tea Estate, Jauntipur, on moist wall, Shirin Akhtar and Jahirul Haque 10.11.2007, **126**; Malnichora Tea Estate, Sylhet Sadar, on soil, Shirin Akhtar and Jahirul Haque 18.10.2009, **650**.

Maulvi Bazar: Patharia Reserve Forest, Borolekha, on soil, Shirin Akhtar and Jahirul Haque, 24.07.2008, **565**; Kholilpur, Maulvi Bazar Sadar, on thick soil formed on cement wall, Shirin Akhtar and Jahirul Haque, 24.07.2009, **636**.

Habiganj: Tarof Hill Reserve Forest, Madhabpur, on brick, Shirin Akhtar and Jahirul Haque 23.08.2007, **192**; Madhabpur, on damp wall, Shirin Akhtar and Jahirul Haque, 23.10.2008, **434**.

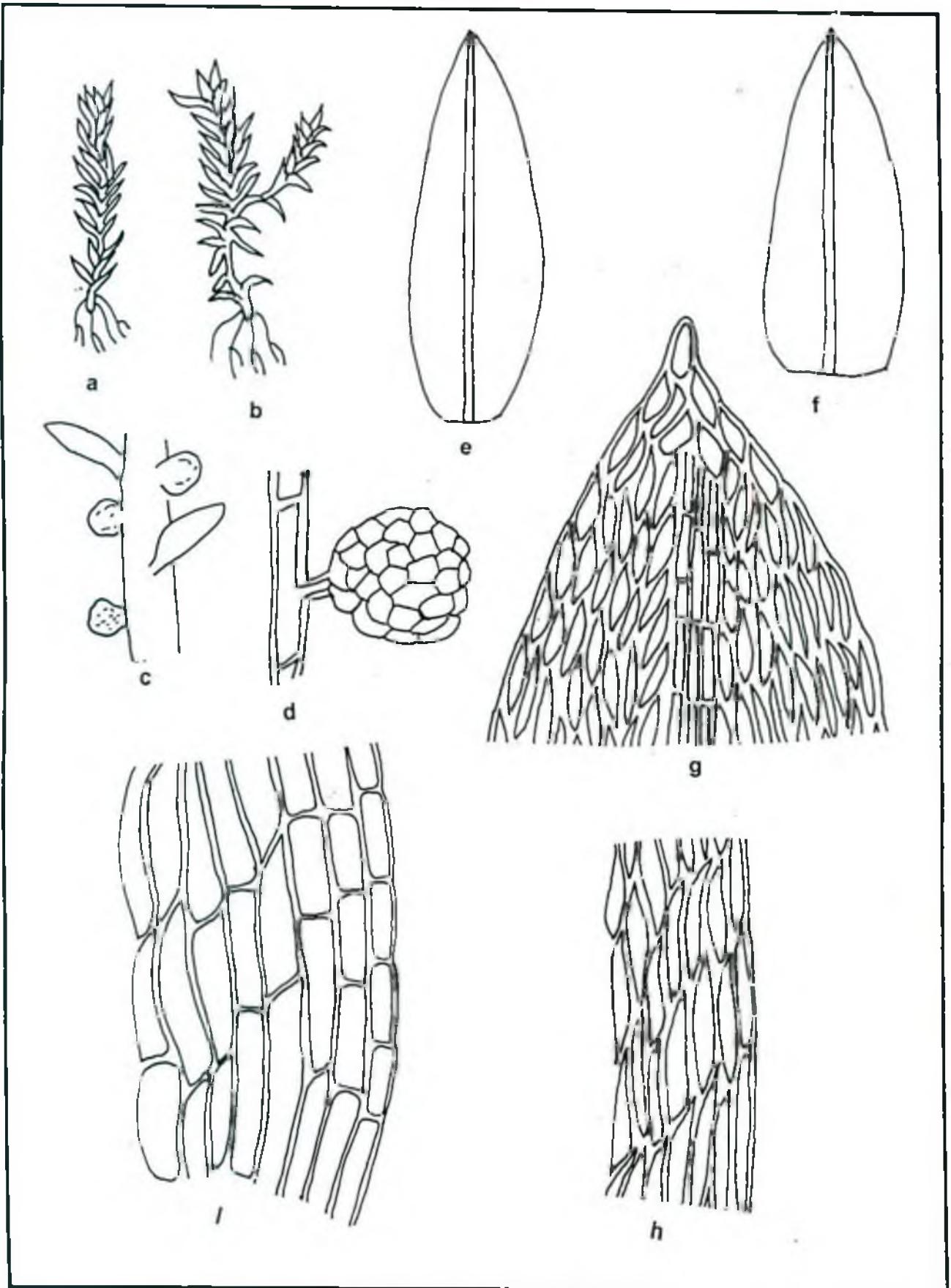
Sunamganj: Mollapara, Sunamganj Sadar, on soil, Shirin Akhtar and Jahirul Haque 21.09.2007, **104**; Vatipara, Derai, on soil, Shirin Akhtar and Monirul Haque 23.08.2009, **633**.

PLATE 36

Bryum apiculatum Schwaegr.

- | | | |
|--------|--------------------------------------|-------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c. | A portion of shoot showing
gemmae | × 30 |
| d. | Tuber on rhizoid | × 100 |
| e & f. | Leaves | × 30 |
| g. | Leaf apex | × 225 |
| h. | Middle laminal cells | × 225 |
| i. | Basal laminal cells | × 225 |

PLATE 36



Bryum apiculatum Schwaegr.

FAMILY BARTRAMIACEAE

Plants various in size, densely tufted. Stem tomentose. Leaves ovate to lanceolate Costa percurrent, often dentate at back. Leaves ovate-lanceolate, acuminate, margin sometimes dentate. Leaf cells narrow-rectangular or sub-rectangular.

GENUS **PHILONOTIS** Brid.
Bryol. Univ 2 : 15 (1827)

Plants various in sizes, tufted or sometimes forming mat, usually filiform. Stem usually tomentose, mostly elongate, laxly erect with subfloral whorls of innovations. Leaves ovate-lanceolate, acuminate, sometimes margin dentate. Costa percurrent. Laminal cells mostly rectangular.

Philonotis hastata (Dub.) Wijk. & Marg., Taxon 8 : 74 (1959)

Hypnum hastatum Dub. In Moritzi, Syst. Verz. Zoll. Pfl. 132 (1846)

Bartramia laxissima C. Muell. , Syn. 1 : 480 (1848) *nom. illeg.*

PLATE 37

Plants grow in dense, forming mats, filiform, soft, green in color, loosely attached to the surface. Stem radiculose up to half of the whole length Shoots laxly erect, most of them are unbranched rarely branched, ± 21 mm long and 1.21 mm wide with leaves. Leaves short-lanceolate with broad base, acuminate or sometimes with blunt obtuse apex, erectopatent, thin, curled and appressed to stem when dry, ± 0.52 mm long and ± 0.29 mm wide at base. Margin crenulate with mamillae of the cells, but mamillae not distinct. Costa percurrent, brown in color, ± 29 μ m wide at base. Laminal cells lax, thin

walled, basal cells large, broad-rectangular. Upper laminal cells hexagonal-rhomboid, $\pm 18.42 \times 09.43 \mu\text{m}$ basal laminal more or less rectangular $\pm 45.43 \times 15.15 \mu\text{m}$, shorter and narrower towards margin, middle cells also rectangular, $\pm 35.88 \times 11.18 \mu\text{m}$, Sporophyte not found.

Specimens examined

Sylhet: Jaflong Hill Forest, Sylhet Sadar, on soil and brick, Shirin Akhtar and Monirul Haque, 26.02.2007, **346**; Jalalabadh, Sylhet sadar, on soil, Shirin Akhtar and Monirul Haque, 10.08.2008, **428**.

Maulvi Bazar: Patharia Reserve Forest, Borolekha, on brick wall and soil, Shirin Akhtar and Jahirul Haque, 24.07.2008, **567**; Kholilpur, Maulvi Bazar sadar, on thick soil formed on cement wall, Shirin Akhtar and Jahirul Haque, 24.07.2009, **656**.

Habiganj: Tarof Hill Reserve Forest, Chunarughat, on soil, Shirin Akhtar and Jahirul Haque, 26.07.2008, **556**.

PLATE 37

Philonotis hastata (Dub.) Wijk. & Marg.

- | | | |
|--------|----------------------|-------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c & d. | Leaves | × 30 |
| e. | Leaf apex | × 225 |
| f. | Middle laminal cells | × 225 |
| g. | Basal laminal cells | × 225 |

PLATE 37



a



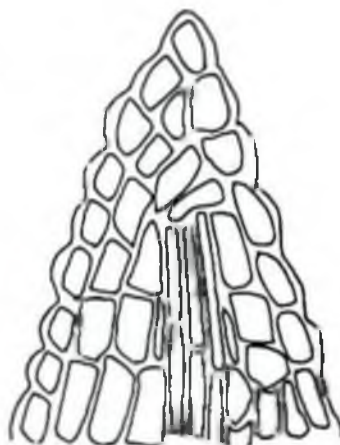
b



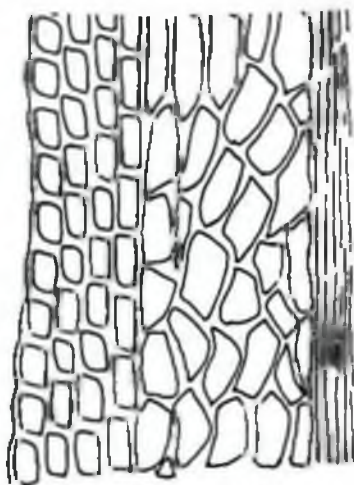
c



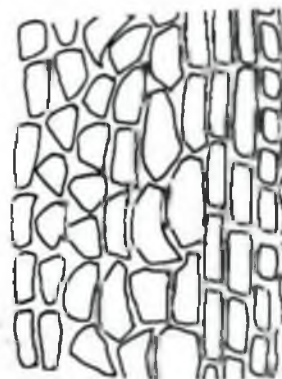
d



e



g



f

Philonotis hastata (Dub.) Wijk. & Marg.

ORDER **ISOBRYALES**

Characters same as Family of Erpodiaceae

KEY TO THE FAMILIES OF ISOBRYALES

- | | |
|---------------------------|-------------|
| 1. Leaves ovate, ecostate | Erpodiaceae |
| -Leaves not so, costate | Neckeraceae |

FAMILY **ERPODIACEAE**

Plants small, or delicate, creeping, irregularly branched, soft corticolous, moderately ridiculous on underside lax, forming mat. Leaves usually crowded in several rows, appressed, spreading and complanate when moist, rarely complanate when dry. Leaves symmetric or asymmetric, ovate sometimes concave, short acute, ecostate, margin entire, cells hexagonal, oblate-hexagonal or rhombic to short-rhomboidal.

GENUS **ERPODIUM**

Plants small soft, corticolous, in loose mats, with creeping, irregularly branched, mostly radiculose on the under side. Leaves imbricate, crowded and appressed or sometimes spreading and more or less complant when dry, spreading and complanate when moist. Stem leaves and branch leaves more or less similar, often asymmetric, ovate, sometimes concave short acute, ecostate, margin entire, cells hexagonal, oblate-hexagonal or rhombic to short-rhomboidal.

Erpodium mangiferae C. Muell. in Linnaea, **37** : 178 (1872)

Erpodium bellii in J. Linn. Soc., **13** : 307 (1873)

PLATE 38

Plants yellow-green, creeping, freely and irregularly branched, branches short, blunt, sometimes radiculose on the underside, Stem and branch leaves more or less similar, crowded and appressed, sometimes spreading and usually complanate, branch may be semi-erect ± 9 mm long and ± 1.45 mm wide with leaves forming a loose mat. Leaves ovate, sometimes concave, short acuminate, in several rows, more flattened on the main stem, erectopate to erect spreading when moist and appressed to stem when dry but much deformed, ± 0.82 mm long and 0.51 mm broad. Costa absent. Leaf margin entire and flat. Leaf cell oval-hexagonal with primordial utricle. Upper laminal cells, $\pm 36.12 \times 19.23$ μm , middle laminal cells also oval-hexagonal, $\pm 18.12 \times 14.12$ μm , and basal laminal cells, $\pm 26.32 \times 17.12$ μm at one side and opposite side $\pm 23.21 \times 15.12$ μm . Sporophyte not found.

Specimens examined

Sylhet: Jaflong Hill Forest, Sylhet Sadar, on bark of tree, Shirin Akhtar and Jahirul Haque, 23.10.2009, **661**; Jalalpur, Sylhet Sadar, on bark of tree, Shirin Akhtar and Jahirul Haque, 20.11.2008, **414**; Bagha, Jaintapur, on bark of tree, Shirin Akhtar and Jahirul Haque, 23. 10. 2007, **56**; Manikpur, Jakirgang, on bark of tree, Shirin Akhtar and Mozammel Haque, 26. 12. 2008, **375**.

Maulvi Bazar: Patharia Reserve Forest, Borolekha, on bark of tree, Shirin Akhtar and Jahirul Haque, 12.09.2008, **416**; Chadnighat, Maulvi Bazar Sadar, on bark of tree, Shirin Akhtar and Jahirul Haque, 26.07.2007, **74**;

Najirabad, Maulvi Bazar sadar, on bark of tree, Shirin Akhtar and Jahirul Haque, 26.07.2007, 54.

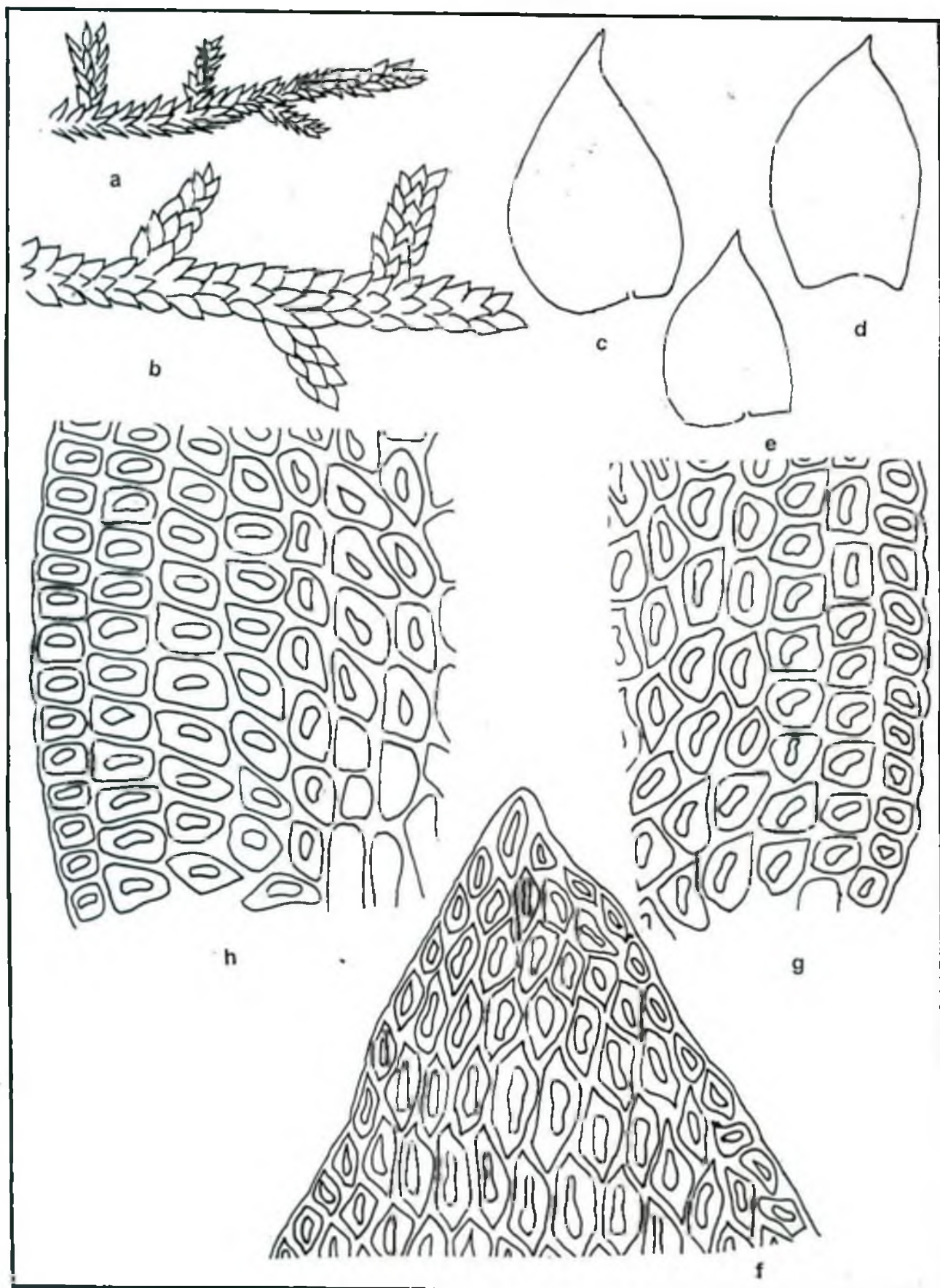
Habiganj: Roghunondon Reserve Forest, Madhabpur, on bark of tree, Shirin Akhtar and Jahirul Haque, 20.10.2008, 544; Chaumohoni, Madhabpur, on bark of tree, Shirin Akhtar, 22.08.2007,80; Debpara, Nabiganj, on bark of tree, Shirin Akhtar, 24.08.2007,64.

Sunamganj: Mollapara, sunamganj, on bark of tree, Shirin Akhtar, 25.10.2007,141; Dinarpur, Azmariganj, on bark of tree, Shirin Akhtar, Jahirul Haque and Monirul Haque, 27.08.2007, 95.

PLATE 38

Erpodium mangiferae C. Muell.

- | | | |
|-----------|--|-------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c, d & e. | Leaves | × 30 |
| f. | Leaf apex | × 225 |
| g. | Basal laminal cells at one
side of the leaf | × 225 |
| h. | Basal laminal cells at other
side of the leaf | × 225 |



Erpodium mangiferae C Muell.

FAMILY NECKERACEAE

Plant fairly robust, medium in size. Main stem creeping, without any central strand, radiculose, secondary stems mostly erect and pendulous, irregularly branched or frequently. Leaves generally crowded, inserted in many rows, broadly oblong-lingulate or various shaped, rounded or truncate at apex. Leaf cells usually smooth, small and isodiametric to oblong at mid leaf, subquadrate or rhomboidal near at apex, oblong-rhomboidal to linear to base.

GENUS *HOMALIODENDRON*

Plants glossy, without central strand, main stem creeping, secondary stem more or less ascending, usually complanate and flabelliform. Leaves polymorphic, the lower stem leaves small, appressed, lanceolate, apiculate, leaves on small branches complanate, 2-ranked, spreading, seldom concave and spreading on all sides, usually not transversely undulate but some what longitudinally furrowed, very seldom transversely undulate, board or oblong-lingulate to rounded-spathulate, broad apex, sometimes entire near the base. Costa single, ending in 2/3 of the leaf length. Leaves cells smooth, firmed walled, upper laminal cells rounded or rough polygonal, middle laminal cells rhomboid, and near base elongated.

KEY TO THE SPECIES OF *HOMALIODENDRON*

- | | |
|--|-----------------------|
| 1. Leaf spathulate, tip rounded | <i>H. exiguum</i> |
| - Leaf oblong-lingulate, tip acuminate | <i>H. flabellatum</i> |

1. *Homaliodendron exiguum* (Bosch & Lac.) Fleisch. In Musci. Fl. Buitenz, **3** : (1908).

Homalia exigua Bosch & Lac. In Bryol. Jv. , **2** : (1862)

Homalia valentinii C. Muell. In Ann. Sc. Nat. Bot. Ser. 6, **10** : 274-(1880)

PLATE 39

Plant pale green in color, tufted. Secondary shoot rigid, erect ± 3.5 cm long. Branches few, complanate, more or less pinnate, distant flagellate at tips. Leaves on main stem 2-ranked horizontally spread, sometimes very slightly longitudinally plicate when dry, asymmetrically spatulate, ± 0.84 mm long and ± 0.39 mm wide, tip rounded, margin minutely crenulated at top and less in lower down, sometimes inflexed on one side at base. Costa single, ending at mid portion of leaves. Leaves cells smooth. Upper laminal cells incrassate, small, rounded-polygonal and middle laminal cells rounded-polygonal to rhomboidal, $\pm 24 \times 16 \mu\text{m}$ and basal laminal cells elongated linear at base, $\pm 52 \times 9 \mu\text{m}$. More or less two rows of smaller, flattened cells from the margin in lamina. Sporophyte not found.

Specimens examined

Sylhet: Jaflong Reserve Forest, Sylhet Sadar, on bark of tree, Shirin Akhtar and Monirul Haque, 12.03.2007, **384**; Khan Tea Estate, Sylhet Sadar, on bark of tree, Shirin Akhtar and Monirul Haque, 15.03.2008, **332**.

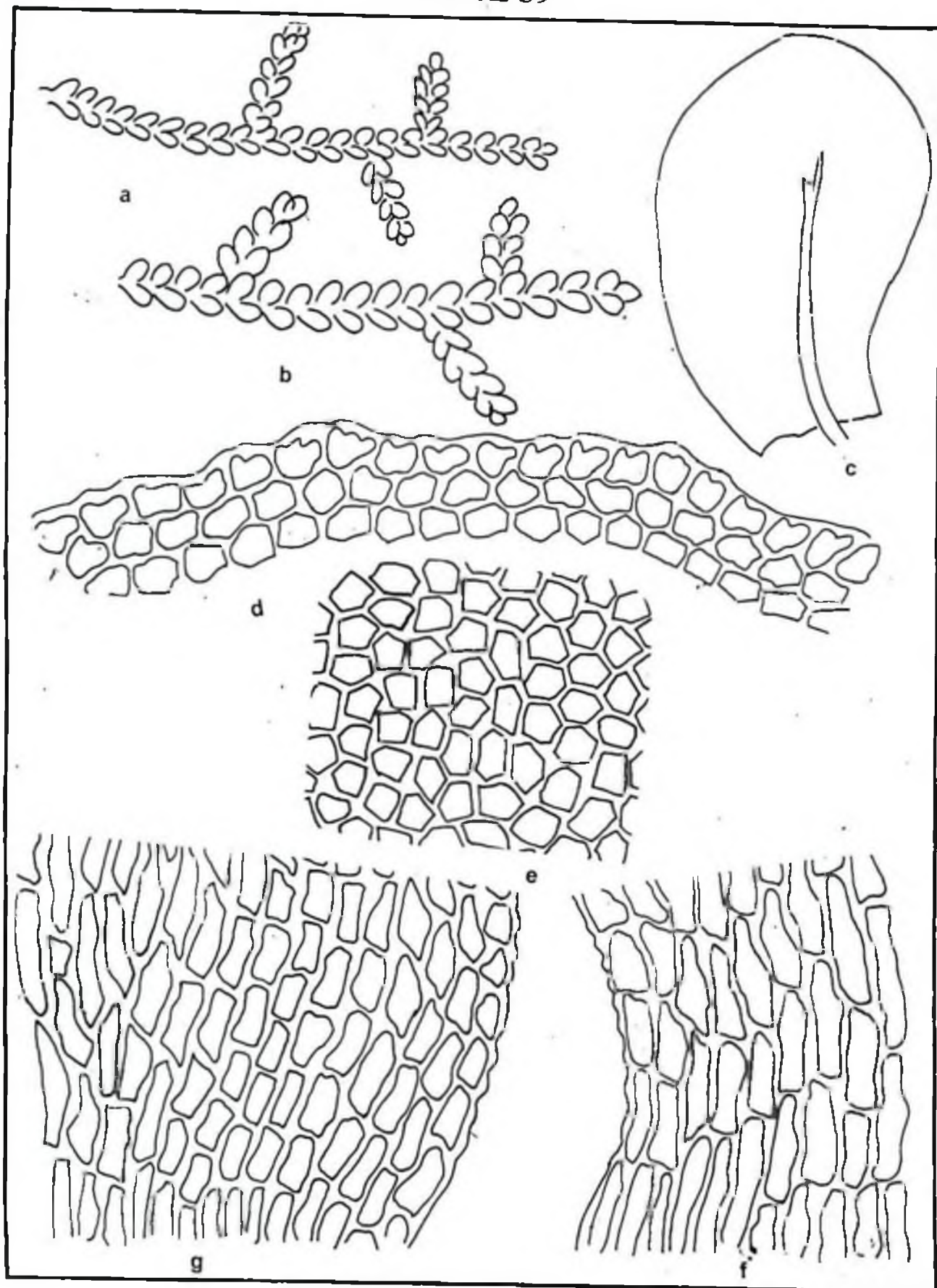
Moulvi Bazar: Atiabagh Tea Estate, Borolekha, on bark of tree, Shirin Akhtar and Mozammel Haque, 23.02.2008, **284**. Banugonj Reserve Forest, Kamolganj, on bark of tree, Shirin Akhtar and Mozammel Haque, 04.03.2008, **324**.

PLATE 39

Homaliodendron exiguum (Bosch & Lac.) Fleisch.

- | | | |
|----|--|-------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c. | Single leaf | × 30 |
| d. | Leaf apex | × 300 |
| e. | Middle laminal cells | × 300 |
| f. | Basal laminal cells at one
side of the midrib | ×300 |
| g. | Basal laminal cells at other
side of the leaf | ×300 |

PLATE 39



Homaliodendron exiguum (Bosch & Lac.) Fleisch

2. *Homaliiodendron flabellatum* (Sm.) Fleisch. In Hedwigia, 45 : 74 (1906)

Hookeria flabellata Sm. In Trans. Linn. So. , 9 : 280 (1808)

Leskea flabellata (Sm.) Schwaegr. In Sp. Musc. Suppi 1 (2) 164 (1816)

PLATE 40

Plants glossy in lax, tufted, robust, on dead bark, light green to yellowish green. Primary stem creeping, secondary stems inclined or ascending complanet and flabelliform. Leaves usually spreading, leaves on main stem are larger and more serrate than branch stem leaves. Leaves oblong-lingulate, horizontal to somewhat erect, sometimes longitudinally plicate when dry, assymetrically, ± 3.21 mm long and ± 1.62 mm wide, apex obtuse. acute pointed, serrate, margin serrate above, finely crenulate below, sometimes inflexed one side at base. Costa single, ending below apex. Leaf cells incrassate, smooth, rhomboidal, polygonal, upper laminal cells $\pm 14. \times 8.12$ μm , middle laminal cells $\pm 18.13 \times 9.32$ μm and basal laminal cells $\pm 43. \times 9.32$ μm , Sporophyte not found.

Specimens examined

Sylhet: Jaflong Reserve Forest, Sylhet sadar, on bark of tree, Shirin Akhtar and Monirul Haque, 12.03.2008, 372; Khan Tea Estate, Sylhet Sadar, on bark of tree, Shirin Akhtar and Monirul Haque, 15.03.2008, 355.

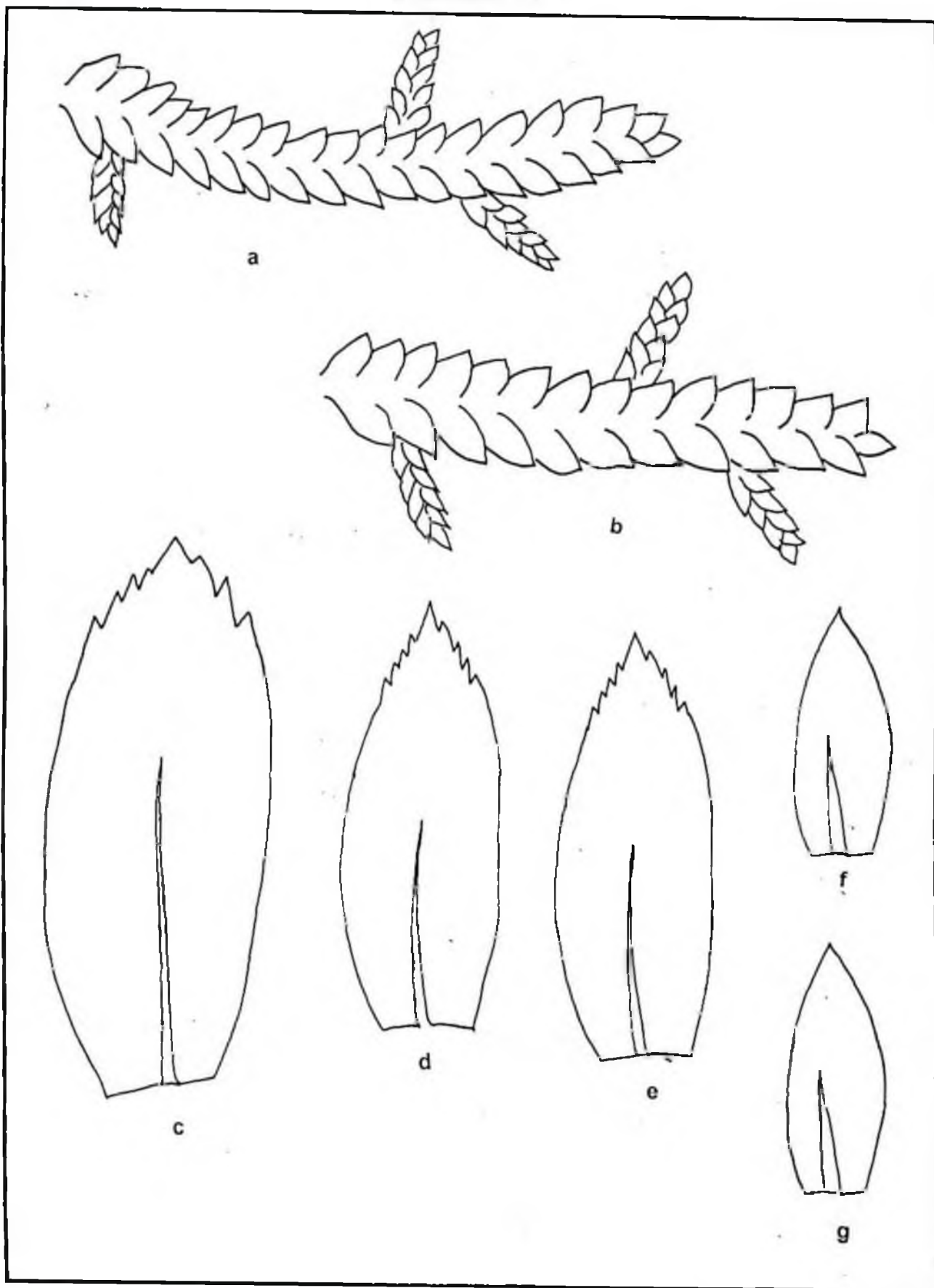
Moulvi Bazar: Patharia Reserve Forest, Borolekha, on bark of tree, Shirin Akhtar and Jahirul Haque, 12.02.2007, 312.

PLATE 40

***Homaliodendron flabellatum* (Sm.) Fleisch.**

- | | | |
|-----------|---------------|------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c, d & e. | Larger leaves | × 30 |
| f & g. | Small leaves | ×30 |

PLATE 40

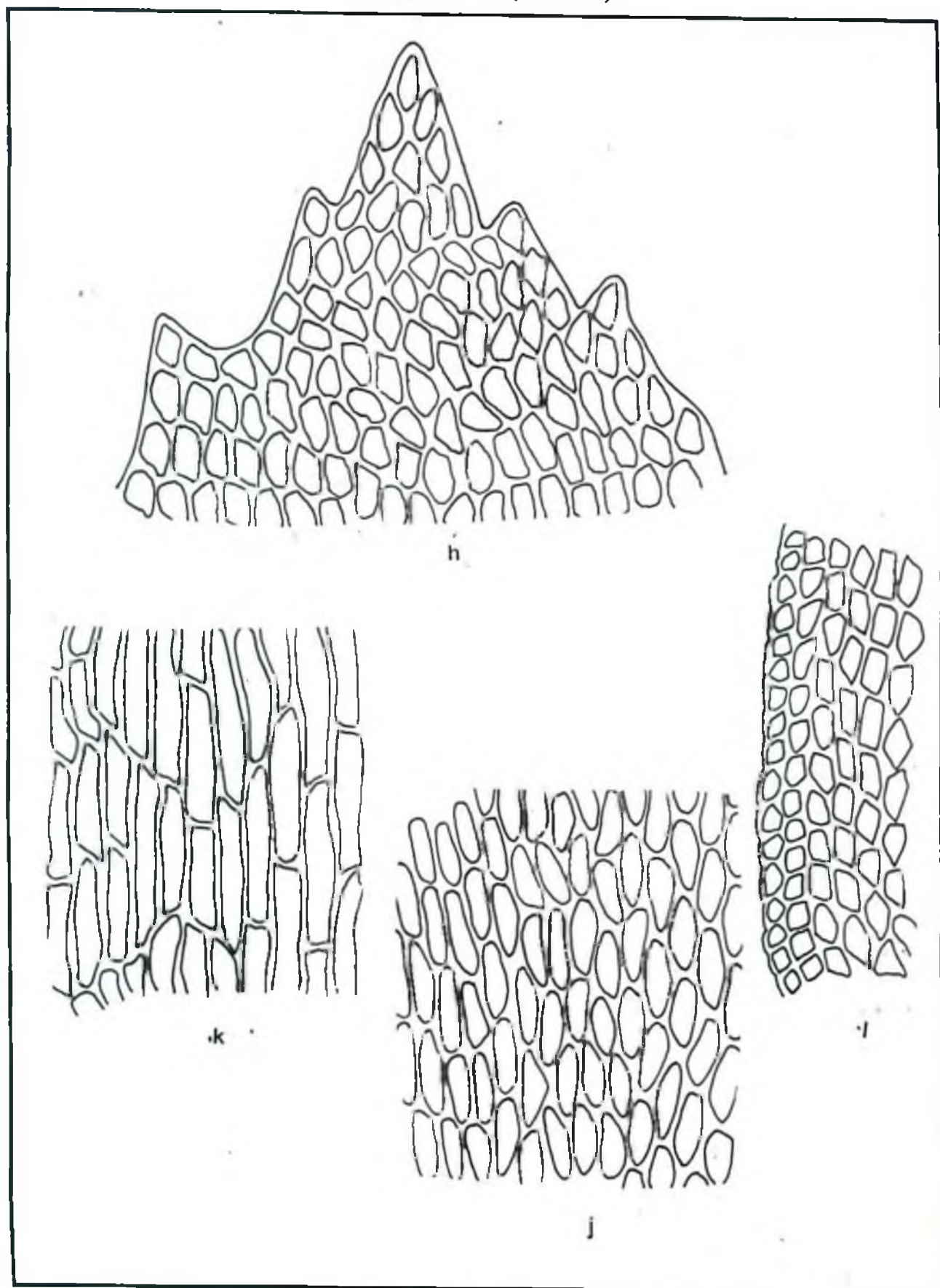


Homaliodendron flabellatum (Sm.) Fleisch.

PLATE 40
(CONT.)

***Homaliodendron flabellatum* (Sm.) Fleisch.**

- | | | |
|----|----------------------------------|-------|
| h. | Leaf apex | × 300 |
| i. | Middle laminal cells with border | × 300 |
| j. | Upper middle laminal cells | × 300 |
| k. | Basal laminal cells | ×300 |



Homaliodendron flabellatum (Sm.) Fleisch.

ORDER HYPNOBRYALES

Characters same as Family of Brachytheciaceae

KEY TO THE FAMILIES OF HYPNOBRYALES

- | | | |
|----|--|-------------------------|
| 1. | Costa double | 5 |
| | - Costa single or absent | 2 |
| 2. | Leaf apex dentate | 3 |
| | - Leaf apex smooth or entire | 4 |
| 3. | Leaf larger, gradually narrow to a long slender, costa present | Brachytheciaceae |
| | - Leaf smaller, not so, costa absent | Hylocomiaceae |
| 4. | Leaf ovate, costa absent | Entodontaceae |
| | - Leaf lanceolate, costa present | Plagiotheciaceae |
| 5. | Leaves falcate-secund, cells prosenchymatous | Amblystegiaceae |
| | - Leaves not so, cells otherwise | 6 |
| 6. | Stem leaves and branch leaves are similar, leaves cells papillae | Sematophyllaceae |
| | - Stem leaves and branch leaves are not uniform, leaves cells nonpapillate | Hypnaceae |

FAMILY BRYACHYTHECIACEAE

Plants monoecious, loosely or densely tufted, slender to robust often glossy. Main stem irregularly pinnately branched, creeping. Leaves erectopatent or appressed when moist, straight or imbricate when dry, Stem with central strand. Leaves triangular ovate or ovate lanceolate, or cordate lanceolate, more or less concave often plicate or plane, sometimes or very rarely falcate, acuminate, acute or long acuminate, denticulate to entire, margin plane or recurved. Costa reaching 3/4th of the leaf. Leaves cells smooth, elongated, rhomboid or vermicular, basal laminal cells usually short and wide, alar cells usually differentiated, quadrate, often decurrent.

GENUS BRACHYTHECIUM

Plants moderately robust, forming mat. Main stem irregularly pinnately branched, creeping, Stem leaves and branch leaves differentiated, loosely imbricate to spreading often complanate, sometimes falcate-secund, plicate to plane, acute to acuminate, mostly concave, decurrent, ovate to ovate lanceolate or triangular-ovate, margin entire to serrate. Costa single reaching 3/4 th of the leaf. Median cells of leaves long or short, elongated-rhomboidal, smooth, alar distinct with quadrate or rectangular cells.

Brachythecium acuminatum (Hedw.) Aust. Musci. Appal. No.310. 1870.

Leskea acuminata Hedw. , sp. Musc. , P. 224, 1801.

PLATE 41

Plants shiny, green to light green, forming in mat. Main stem creeping, closely branched, branched erect, short and usually subglabrous when dry, ± 1.23 cm long and ± 2.45 mm broad with leaves. Stem leaves and branch leaves are

similar in length but stem leaves are more wider than branch leaves. Leaves usually crowded, erect when dry, erect spreading when moist, somewhat plicate or sometimes nearly smooth, ± 1.89 mm long, ovate or ovate lanceolate, gradually acuminate, slender acute, often twisted at apex, sometimes margin reflex below, serrulate in the upper half. Costa $3/4$ of the leaf length. Upper laminal cells rhomboidal $\pm 38.21 \times 7.24$ μm , basal laminal cells $\pm 18.54 \times 7.32$ μm , alar cells sub quadrate in several rows $\pm 15.76 \times 7.87$ μm . Sporophyte not found.

Specimens examined

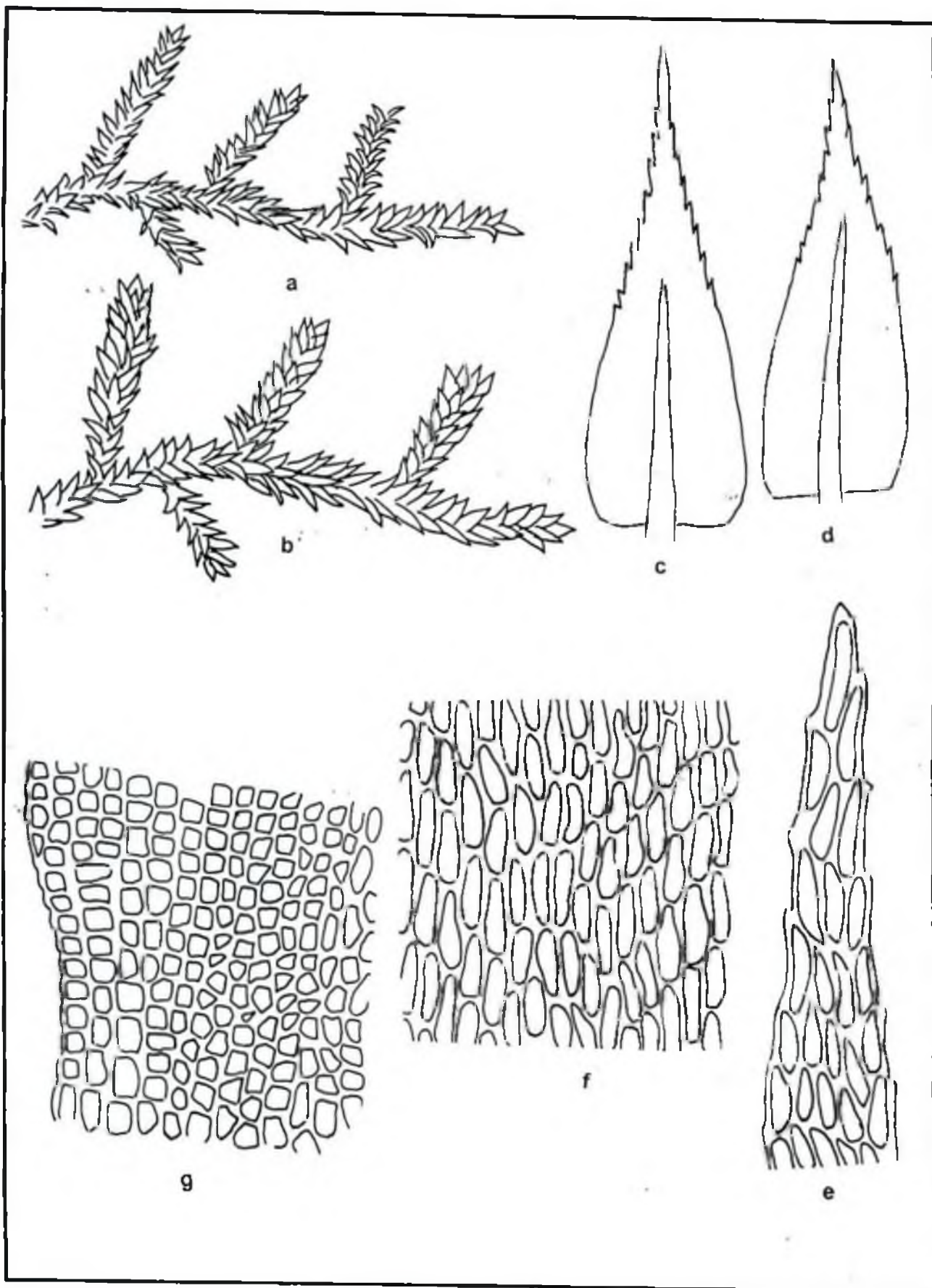
Sylhet: Fatehpur, Gonaighat, on bark of tree, Shirin Akhtar, Jahirul Haque and Mozammel Haque, 12.10.2008, **411**; Fatehpur Tea State, on bark of tree, Shirin Akhtar, Jahirul Haque and Md. Rafiqul Haque, 12.03.2008, **392**; Jaflong Hill Forest, base of a tree on logs, Shirin Akhtar, Jahirul Haque and Mozammel Haque, 12.10.2007, **201**.

Habiganj: Tarof Hill Reserve Forest, Madhabpur, on bark of tree, Shirin Akhtar, Jahirul Haque and Mozammel Haque, 16.09.2008, **542**, Teghoria, Habiganj Reserve Forest, on bark of tree, Shirin Akhtar, Jahirul Haque and Mozammel Haque, 17.10.2007, **53**.

PLATE 41

Brachythecium acuminatum (Hedw.) Aust.

- | | | |
|-------|----------------------|-------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c & d | Leaves | × 30 |
| e. | Leaf apex | × 300 |
| f. | Middle laminal cells | × 300 |
| g. | Basal laminal cells | × 300 |



Brachythecium acuminatum (Hedw.) Aust.

FAMILY HYLOCOMIACEAE

Plants in glossy tufted, mostly tufted. Main stem prostrate or erect ascending, regularly or irregularly bipinnate, densely foliate. Leaves heteromorphic, i.e. stem leaves and branch leaves are differentiated, acute, acuminate, dentate at least upper half. Costa mostly lacking. Leaves elongated, prosenchymatous, smooth. Alar cells not differentiated.

GENUS MACROTHAMNIELLA

Same as family characters

Macrothamniella pilosula (Mitt.) Fleisch. In Musci Fl. Buitenz., 4 : 1476 (1923)

Stereodon pilosulus Mitt. In Musci Ind. Or. : 113 (1859)

Leptohymenium pilosulum (Mitt.) Jaeg. In Ber S. Gall. Naturw.

Ges. M 1876-77 : 279 (1878)

PLATE 42

Plants small, slender, tufted, yellow-green to green in color. Main stem creeping, branches erect, sometimes semidendroid in habit, ± 1.34 cm long and ± 1.02 mm broad with leaves. Leaves concave, ovate-lanceolate, dense, appressed to stem when dry, ± 0.64 mm long and 0.24mm broad at base.. Leaves margin denticulate at upper portion, apex more or less acute. Costa indistinct. Leaves cells linear, rhomboidal, not porous. Upper laminal cells $\pm 45.65 \times 7.32\mu\text{m}$, middle laminal cells $\pm 53.12 \times 5.89\mu\text{m}$, basal laminal cells $\pm 41.43 \times 7.10.23\mu\text{m}$. Alar not differentiated. Sporophyte not found.

Specimens examined

Sylhet: Malnichora Tea Estate, Sylhet sadar, on bark of a tree, Shirin Akhtar and Jahirul Haque, 24.10.2007, **170**; Jaflong Hill forest, Kulaura, on bark of a tree, Shirin Akhtar and Mozammel Haque, 26.10.2008, **571**.

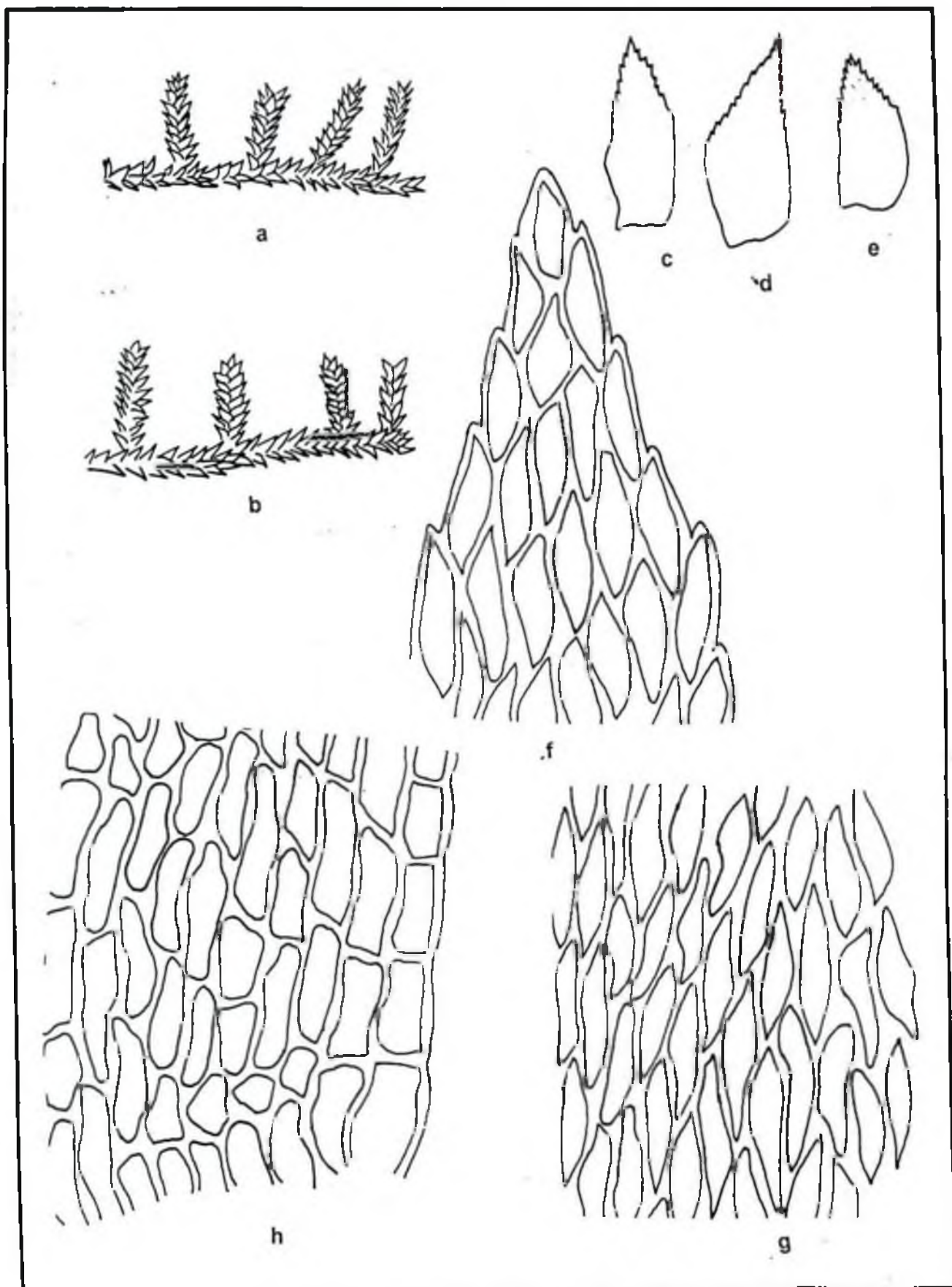
Maulvi Bazar: Patharia Reserve Forest, Borolekha, on bark of a tree, Shirin Akhtar and Jahirul Haque, 24.07.2008, **530**; Kholilpur, Maulvi Bazar Sadar, on bark of a tree, Shirin Akhtar and Jahirul Haque, 24.07.2009, **665**.

Habiganj: Tarof Hill reserve forest, Madhabpur, on bark of a tree, Shirin Akhtar and Jahirul Haque 23.08.2007, **216**; Madhabpur, on soil, Shirin Akhtar and Jahirul Haque, 23.10.2008, **446**.

PLATE 42

Macrothamniella pilosula (Mitt.) Fleisch.

- | | | |
|----------|----------------------|-------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c, d& e. | Leaves | × 30 |
| f. | Leaf apex | × 450 |
| g. | Middle laminal cells | × 450 |
| h. | Basal laminal cells | ×450 |



Macrothamniella pilosula (Mitt.) Fleisch.

FAMILY ENTODONTACEAE

Plants slender, medium in size, forming loosely tufted. Main stem creeping, irregularly to pinnately or sub pinnately branched, branches generally julaceous. Stem and branches leaves are more or less similar. Leaves crowded in many rows, usually appressed when dry, sometimes more or less complanate, mostly symmetric of various shapes. Costa absent. Leaves linear of oblong linear, smooth, those at the basal angle quadrate, rectangular or transversely rectangular, sometimes in many oblique rows alar cells very much differentiated.

GENUS *ERYTHRODONTIUM*

Plants slender, medium in size, forming loosely tufted. Main stem creeping, irregularly to pinnately or sub pinnately branched, branches generally julaceous. Leaves broadly oval or ovate-oblong, imbricate when dry, shortly apiculate from a short decurrent base. Leaf cells narrowly elliptical, alar cells in oblique series, rounded-quadrate or transversely rectangular, forming a large conspicuous group extending obliquely about half length of the leaf.

Erythrodontium julaceum (Schwaegr.) Par. in Index. Bryol. **2**: 436 (1896)

Neckera julacea Hook. Ex. Schwaegr. In Sp. Musc. Suppl. **3** (1): 245 (1828)

Leptohymenium julaceum (Schwaegr.) Hamp. In Linnnaea, **20**: 83 (1847)

PLATE 43

Plants green in color, rigid, slender to moderately robust, ± 1.98 cm long and 2.21mm broad with leaves. Main stem creeping, irregularly to pinnately or sub pinnately branched, branches generally julaceous. Leaves broadly oval or

ovate-oblong, imbricate when dry, shortly apiculate from a short decurrent base, ± 1.23 mm long and ± 0.72 mm wide. Leaves margin entire. Costa absent. Upper laminal cells narrowly elliptic to linear, $\pm 42.12 \times 12.72$ μm , middle laminal cells same as tip cells, $\pm 48.32 \times 11.98$ μm . Alar cells rounded-quadrate transversely rectangular, $\pm 22.21 \times 9.44$ μm forming large conspicuous triangular patches of cells extending oblique about half way up the margin render it easily distinguishable.

Specimens Examined

Sylhet: Jaflong Tea Estate, Jauntapur, on bark of tree, Shirin Akhtar and Jahirul Haque 10.11.2007, **122**; Malnichora Tea Estate, Sylhet Sadar, on bark of tree, Shirin Akhtar and Jahirul Haque 18.10.2009, **662**.

Maulvi Bazar: Patharia Reserve Forest, Borolekha, on bark of tree, Shirin Akhtar and Jahirul Haque, 24.07.2008, **560**; Kholilpur, Maulvi Bazar Sadar, on bark of tree, Shirin Akhtar and Jahirul Haque, 24.07.2009, **634**.

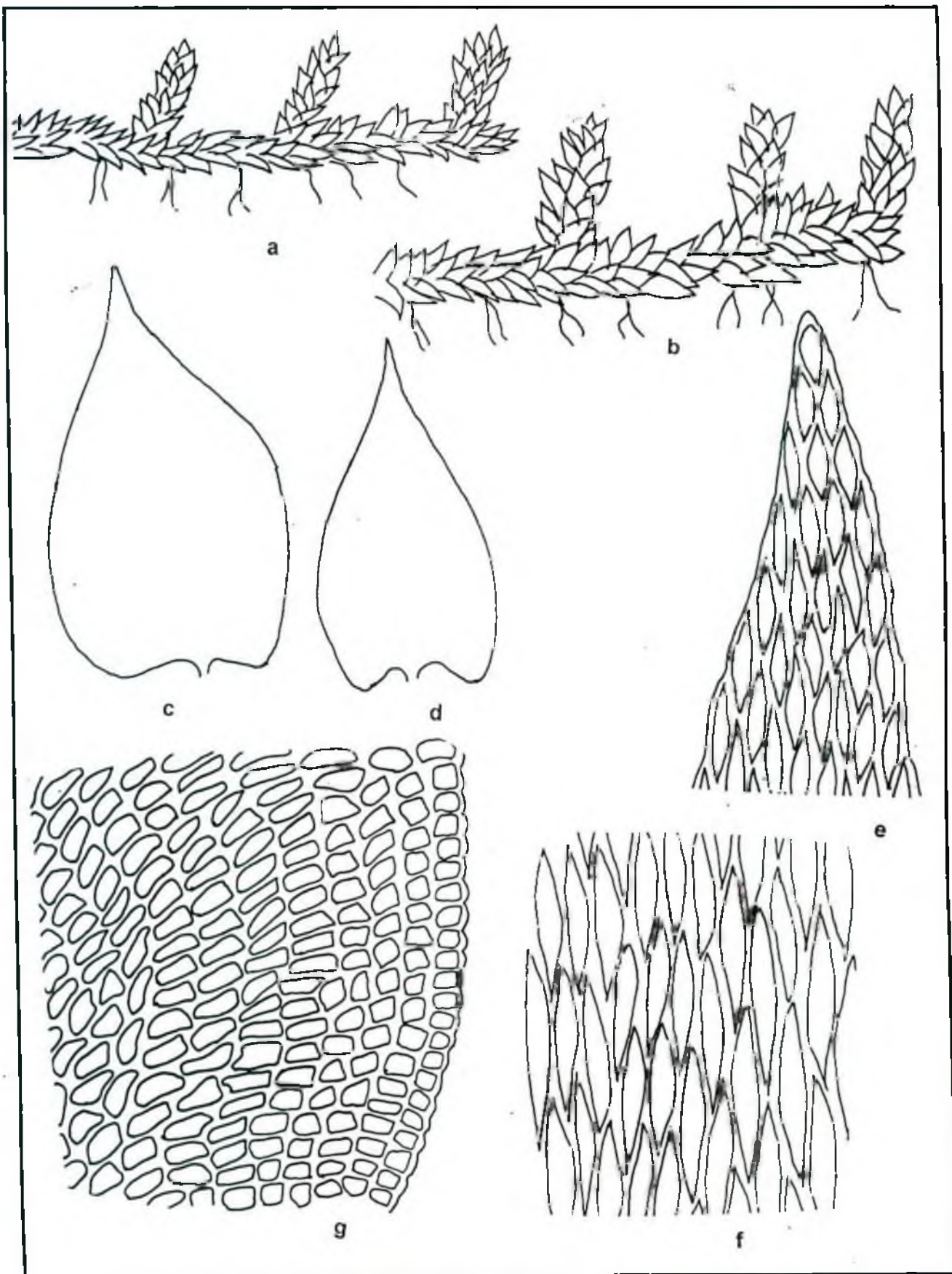
Habiganj: Tarof Hill Reserve Forest, Madhabpur, on bark of tree, Shirin Akhtar and Jahirul Haque 23.08.2007, **183**; Madhabpur, on damp wall, Shirin Akhtar and Jahirul Haque, 23.10.2008, **404**.

Sunamganj: Mollapara, Sunamganj sadar, on bark of tree, Shirin Akhtar and Jahirul Haque 21.09.2007, **106**; Vatipara, Derai, on bark of tree, Shirin Akhtar and Monirul Haque 23.08.2009, **632**.

PLATE 43

***Erythrodontium julaceum* (Schwaegr.) Par.**

- | | | |
|-------|----------------------|-------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c & d | Leaves | × 30 |
| e. | Leaf apex | × 300 |
| f. | Middle laminal cells | × 300 |
| g. | Basal laminal cells | × 300 |



Erythrodontium julaceum (Schwaegr.) Par.

FAMILY PLAGIOTHECIACEAE

Plants grow in dense, forming mat, shiny. Main stem usually creeping with irregularly and rarely pinnately dense, branches most or less flattened, complanate, foliate. Stem and branches leaf similar, concave, lanceolate, obtuse or acute to acuminate. The dorsal and ventral leaves are mostly symmetric and generally appressed, the lateral leaves often larger. Costa single and more or less elongated. Leaf cells smooth, oval-rhombic, and rhomboidal to linear. Basal cells oblong-rectangular and clearly differentiated at the basal angle or scarcely differentiated. Capsule erect, more or less inclined to horizontal, symmetric or nearly so. Operculum concave-conic.

GENUS STEREOPHYLLUM

Plants shiny, flat, slender to medium in size, dark green to golden green, forming mat. Main stem irregularly branched, prostrate, complanate, ridiculous at lower portion of stem. Leaves crowded, oblong-lanceolate, oblong-ovate, broadly lingulate, rounded-obtuse to acute or short pointed, the lateral leaves somewhat asymmetrical, margin entire, plane or rarely incurved. Costa single, 1/2 or 3/4 th of the leaf length. Leaf cells smooth, linear, shorter near base, sub quadrate to quadrate at alar.

Stereophyllum anceps (Bosch & Lac.) Broth., in Nat. Pfl. 1 (3) 898 (1907)

Hypnum anceps Bosch & Lac. in Bryol. Jav. In Bryol. Jav., 2 : 161 260 (1867)

Rhynchostegium anceps (Bosch & Lac.) Jaeg. : Ber. S. Gall. Naturw.

Ges., 1876-77 : 372 (1878)

Stereophyllum philippilense Broth. In Philipp. J. sci., 31 ; 294 (1926)

PLATE 44

Plants monoecious, yellow green, silky, slender, epiphytic. Main stem creeping, irregularly branched. Leaves crowded, oblong-lanceolate, oblong-ovate, broadly lingulate, rounded-obtuse to acute or short pointed, the lateral leaves somewhat asymmetrical, margin entire, plane or rarely incurved. Costa single 1/2 or 3/4 th of the leaf length. Leaf cells smooth, linear, shorter near base, sub quadrate to quadrate at alar. Upper laminal cells elongated, rhomboidal, $\pm 43.54 \times 10.12 \mu\text{m}$, middle laminal cells linear rhomboid, $\pm 56.43 \times 12.42 \mu\text{m}$, alar cells are irregularly elongated rectangular $\pm 35.54 \times 18.76 \mu\text{m}$ and alar cells wall wavy.

Sporophyte not found.

Specimen examined

Sylhet: Fathepur, Gonaighat, on bark of tree, Shirin Akhtar, Jahirul Haque and Mozammel Haque, 12.10.2008, **418**; Fatehpur Tea Estate, on bark of tree, Shirin Akhtar, Jahirul Haque and Md. Rafiqul Haque, 12.03.2008, **327**; Jaflong Hill Forest, on bark of tree, Shirin Akhtar, Jahirul Haque and Mozammel Haque, 12.10.2007, **218**

Moulvi Bazar: Banugash Reserve Forest, on bark of tree, Shirin Akhtar and Jahirul Haque, 12.09.2008, **473**; Kalikabari Tea Estate, on bark of tree, Shirin Akhtar and Jahirul Haque, 23.10.2007, **132**; Kholilpur, Maulvi Bazar Sadar, on bark of tree, Shirin Akhtar and Jahirul Haque, 24.07.2009, **616**.

Habiganj: Roghunondon Reserve Forest, Madhabpur, on bark of tree, Shirin Akhtar and Jahirul Haque, 12.02.2008, **390**; Noapara Tea Estate, Madhabpur, on bark of tree, Shirin Akhtar and Jahirul Haque,

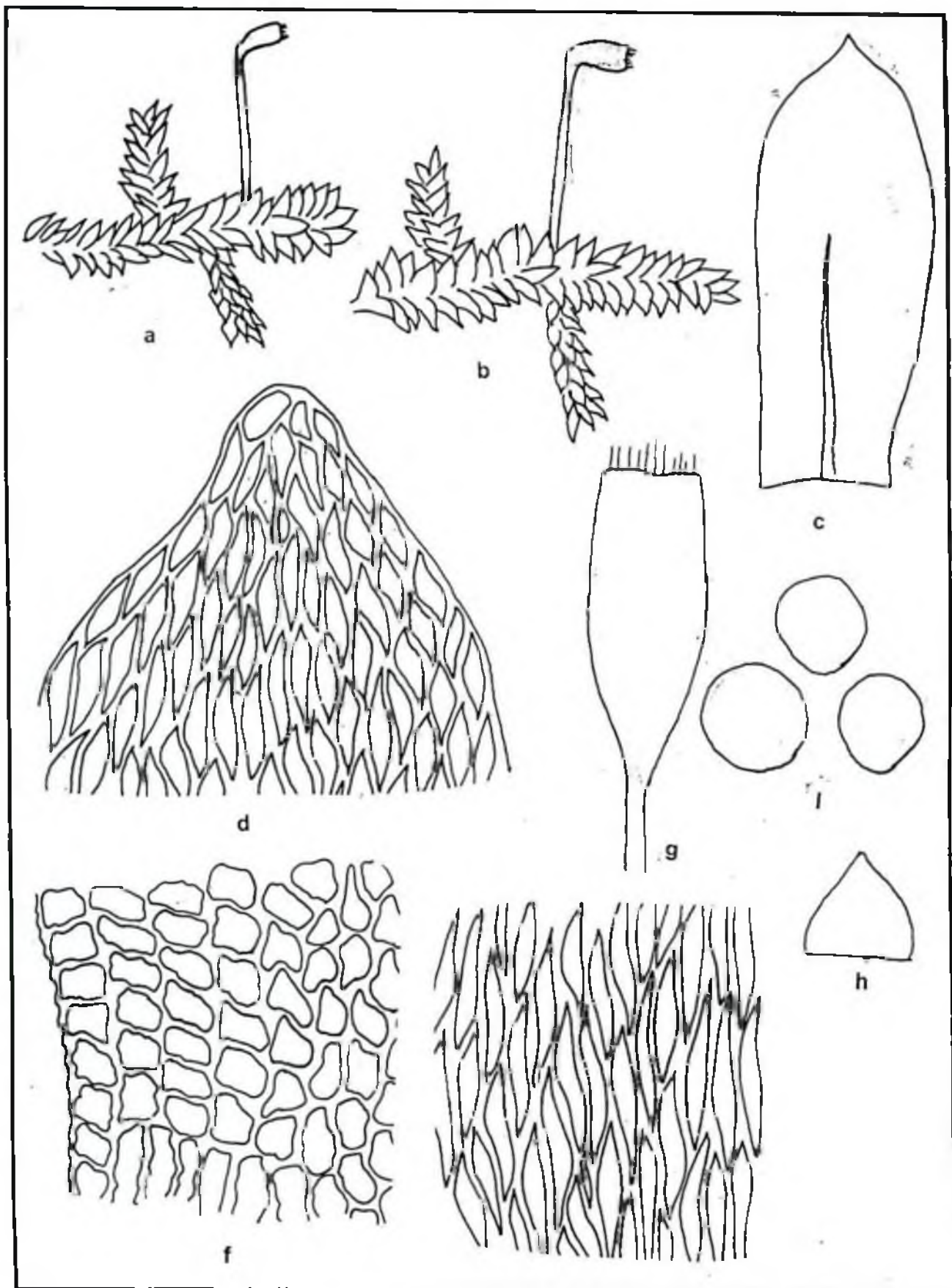
12.10.2009, **644**; Changhat, Rahulbal, on bark of tree, Shirin Akhtar and Mozammel Haque, 23.09.2009, **615**.

Sunamganj: Mollapara, Sunamganj Sadar, on bark of tree, Shirin Akhtar, Jahirul Haque and Mozammel Haque, 12.09.2008, **375**; Rajanagor, Deraï, on bark of tree, Shirin Akhtar, Jahirul Haque and Mozammel Haque, 12.09.2008, **380**.

PLATE 44

Stereophyllum anceps (Bosch & Lac.) Broth

- | | | |
|----|---------------------------|-------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c. | Leaf | × 30 |
| d. | Leaf apex | × 300 |
| e. | Middle laminal cells | × 300 |
| f. | Basal laminal cells | × 300 |
| g. | Capsule without operculum | × 30 |
| h. | Operculum | × 30 |
| i. | Spores | × 450 |



Stereophyllum anceps (Bosch & Lac.) Broth.

FAMILY AMBLYSTEGIACEAE

Plants small to large, slender to robust, loosely or densely tufted, mostly in various habit and habitat. Stem pinnate or irregularly branched. Leaves erect-spreading, symmetrical, ovate-lanceolate or orbicular, long acuminate or acute, nerve single. Leaves cells smooth and flexuose, thin walled, alar cell differentiated, inflated and hyaline, sometimes forming larger auricles or quadrate to rectangular.

GENUS *CAMPYLUM*

Plants small, forming dense carpet, stem creeping to ascending erect, irregularly branched. Leaves erect spreading to spreading, ovate, acuminate, lanceolate, base border ovate, gradually or abruptly narrowed into a long, slender, margin entire. Costa short and double, cells narrowly rectangular-oblong to linear-prosenchymatous, smooth, alar cells often differentiated.

KEY TO THE SPECIES OF *CAMPYLUM*

- | | |
|---|---------------------|
| 1. Leaf apex fine acuminate, not often curved | <i>C. gollanii</i> |
| - Leaf apex slender, often curved | <i>C. stellatum</i> |

1. *Campyllum gollanii* C. Muell. ex Vohra in Bull. Bot. Surv.

India 12 (1-2) : 101, 1910

PLATE 45

Plants small, dioicous, glossy, golden green usually corticolous and loosely tufted. Main stem creeping, branch ascending short arched, pinnate, dense, smooth ± 2.12 cm long and ± 0.45 cm wide with leaves. Branch leaf same as the stem leaves but smaller in size. Leaves erect spreading to spreading, ovate lanceolate, margin slightly involute that makes the leaf little concave, apex narrowed into a long and fine acumen, margin entire, ± 1.34 mm long and 0.34 mm broad. Costa short, double, unequal, sometimes indistinct. Leaves cells smooth not porous. Upper laminal cells rhomboid to linear $\pm 34.32 \times 4.12 \mu\text{m}$, middle cells narrowly linear, fusiform, $\pm 89.32 \times 5.12 \mu\text{m}$, and basal laminal cells quadrate-rhomboidal $\pm 17.32 \times 6.43 \mu\text{m}$. Alar cells quadrate to sub-rectangular, sometimes inflated, incrassate $\pm 26.32 \times 8.43 \mu\text{m}$. Sporophyte grow on main stem. Seta erect, ± 6 mm long. Capsule cup shaped. Spores, smooth, brown in color, $\pm 24.32 \mu\text{m}$ in diameter.

Specimens examined

Sylhet: Lalkhal Tea Estate, Jaunyipur, on sandy soil, Shirin Akhtar and Jahirul Haque, 26.07.2009, **663**.

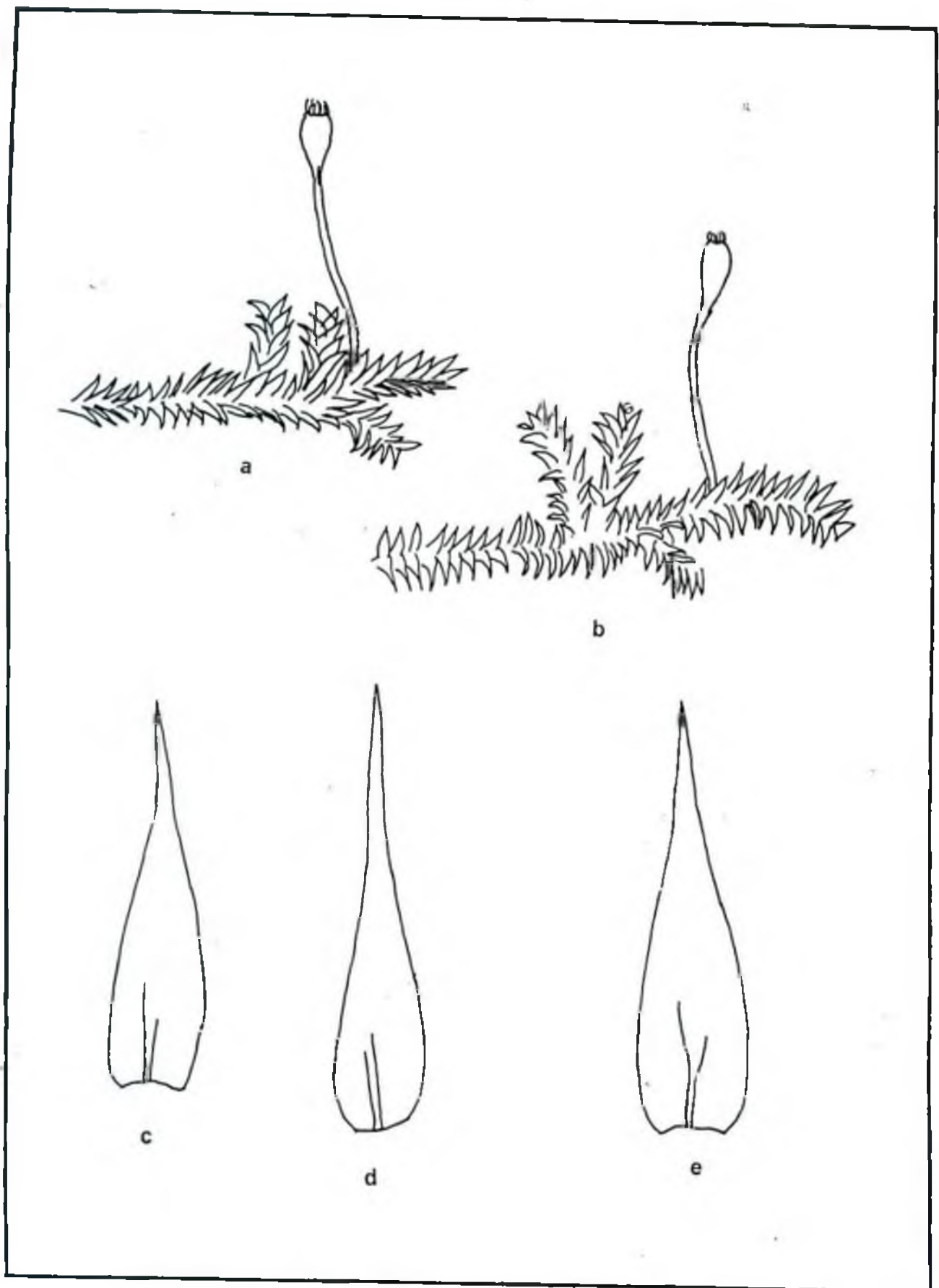
Maulvi Bazar: Chadnighat, Maulvi Bazar sadar, on moist soil, Shirin Akhtar and Jahirul Haque, 26.03.2008, **310**; Najirabad, Maulvi Bazar sadar, on sandy soil, Shirin Akhtar and Jahirul Haque, 26.08.2007, **176**.

Habiganj: Chaumohoni, Madhabpur, on moist soil, Shirin Akhtar, 12.08.2007, **67**; Debpara, Nabiganj, on soil, Shirin Akhtar, 24.08.2007, **116**.

PLATE 45

Campylium gollanii C. Muell. ex Vohra

- | | | |
|-----------|-----------|------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c, d & e. | Leaves | × 30 |

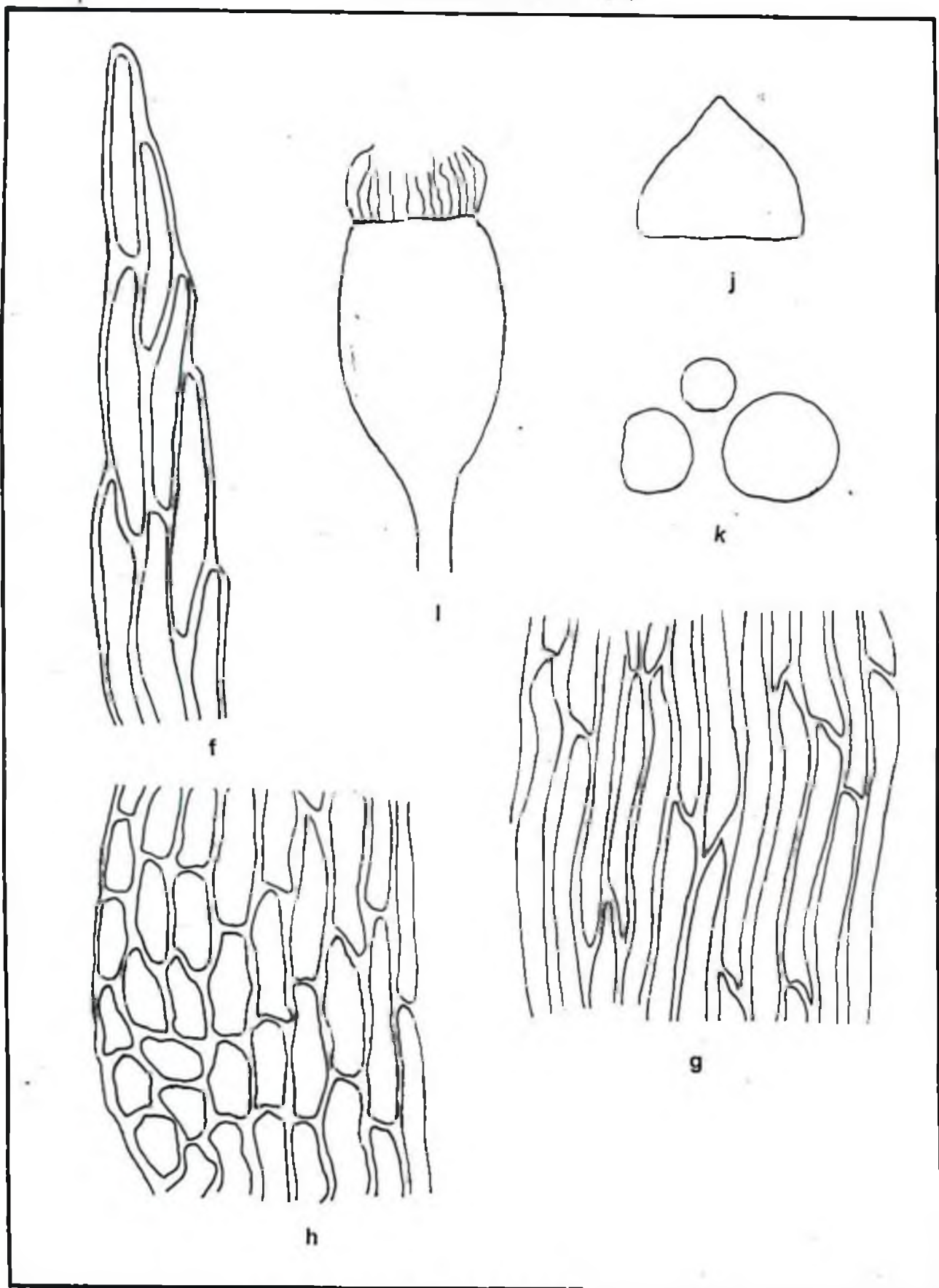


Campyllum gallanii C. Muell.

PLATE 45
(CONT.)

***Calymptum gollanii* C. Muell. ex Vohra**

- | | | |
|----|----------------------|-------|
| f. | Leaf apex | × 450 |
| g. | Middle laminal cells | × 450 |
| h. | Basal laminal cells | × 450 |
| i. | Capsule | × 30 |
| j. | Operculum | × 30 |
| k. | Spores | × 600 |



Campylium gallanii C. Muell.

2. ***Campylium stellatum*** (Hedw) C. Jens.

Campylium stellatum (Hedw) C. Jens. In. Large. Medd.

Gronl. 3: 328, 1887

Hypnum stellatum Hedw., Sp. Musc., P. 280. 1801

Campliodelphus stellatus (Hedw.) Kanda, Jour. Sci. Hiroshima Univ. B2,
15: 269, (1975) 1979.

PLATE 4

Plant forming in loose mats, slender, moderately robust, green or yellowish, more or less glossy when dry. Main stem creeping, irregularly branched, ascending. Leaves crowded, ovate lanceolate gradually narrowed to a long slender, erect to erect spreading from a broad sub-erect base, more or less striolate and curved when dry, ± 1.87 mm long ± 0.45 mm broad, acuminate straight, sometimes recurved, margin entire. Costa double, short, unequal, sometimes absent, in few reaching about $1/3$ or $1/4$ th of the leaf length. Leaves cells fusiform, smooth, Upper laminal cells linear-rhomboidal, $\pm 57 \times 5.1$ μm , middle laminal cell long linear-rhomboidal $\pm 87.21 \times 4.02$ μm , basal laminal cells polygonal and rhomboidal, $\pm 43.12 \times 5.78$ μm , Sporophyte not found.

Specimens examined

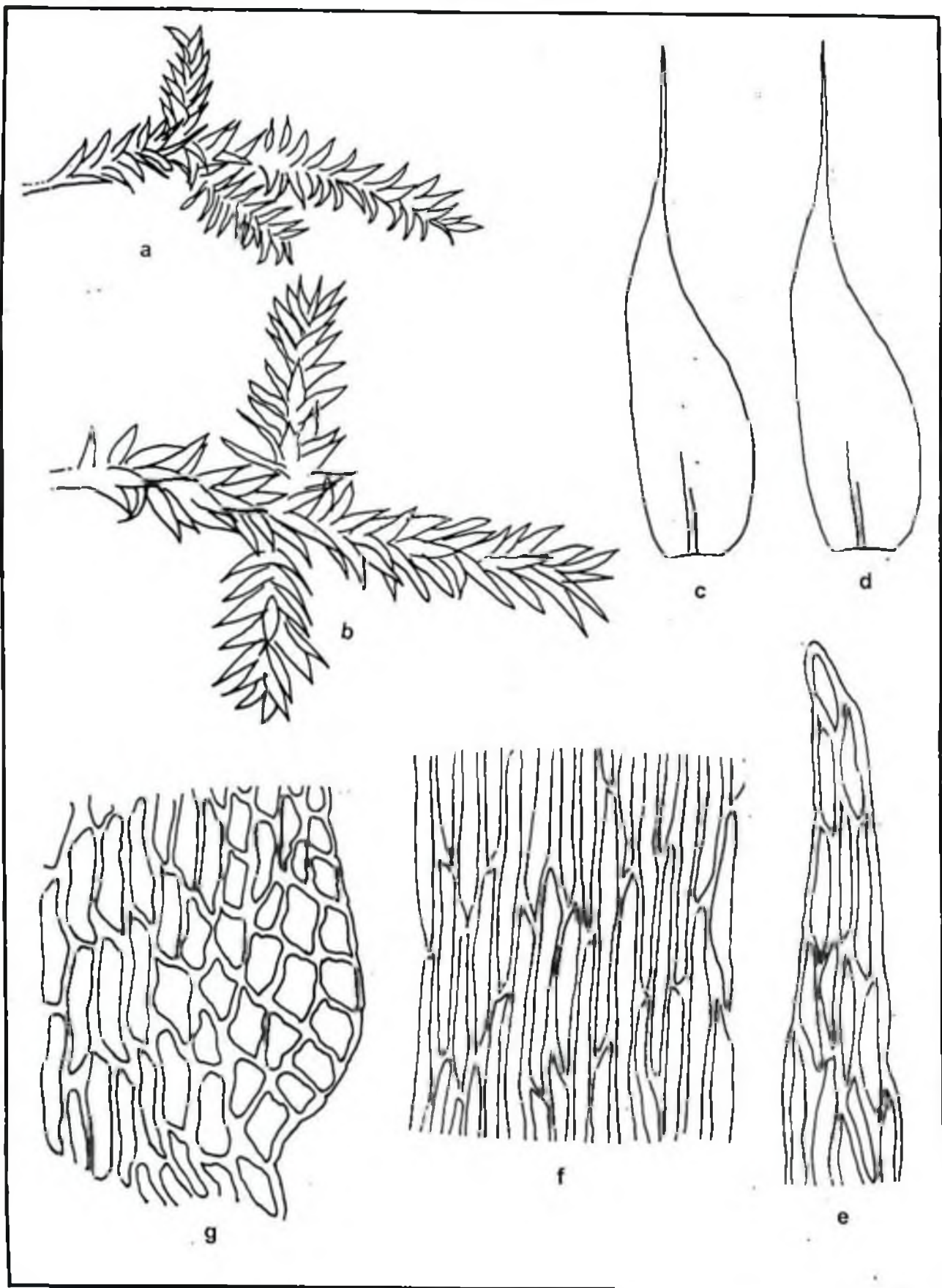
Sylhet: Jaflong Hill Forest, Sylhet Sadar, on soil, Shirin Akhtar, Jahirul Haque and Mozammel Haque, 12.12.2008, **517**; Lalkhal Tea Estate, on moist soil, Shirin Akhtar, Jahirul Haque and Mozammel Haque, 12.12.2008, **535**, Tatli, Sylhet Sadar, on moist soil, Shirin Akhtar, Jahirul Haque and Mozammel Haque, 12.01.2009, **619**.

Moulvi Bazar: Patharia Reserve forest, Juri, on moist soil, Shirin Akhtar, Jahirul Haque and Monirul Haque, 23.12.2007, **200**; Srimongol, on soil, Shirin Akhtar, Jahirul Haque and Mozammel Haque, 23.02.2008, **459**.

PLATE 46

Campylium stellatum (Hedw) C. Jens

- | | | |
|------|----------------------|-------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c, d | Leaves | × 30 |
| e. | Leaf apex | × 450 |
| f. | Middle laminal cells | × 450 |
| g. | Basal laminal cells | × 450 |



Campylium stellatum (Hedw) C. Jens.

FAMILY SEMATOPHYLLACEAE

Plants soft, forming yellow green shiny mats. Main stem creeping or erect ascending, irregularly pinnately branched. Stem leaves and branched leaves are mostly similar, crowded in many rows but often more or less complete, distinctly second, mostly symmetric, various in shaped. Leaves usually ovate or ovate-lanceolate, acuminate. Costa double. Leaves cells linear, rhomboidal, vermicular, alar differentiated at the basal angle.

KEY TO THE GENERA OF SEMATOPHYLLACEAE

- | | |
|---|----------------------|
| 1. Leaf surface rough and cells papillate | <i>Glossadelphus</i> |
| - Leaf surface smooth and cells not papillate | <i>Aptychella</i> |

GENUS *GLOSSADELPHUS*

Plants medium in size, glossy mat forming, usually grow on damp rock. Main stem irregularly or regularly pinnately branched, branches short, complanate, blunt. Leaves oblong to ovate-lingulate or ovate-lanceolate, apex acute or subacute, crenulate to distinctly toothed towards apex, leaves somewhat asymmetric, dorsal and ventral leaves usually narrower than lateral ones. Costa short and double. Leaf cells linear, mostly with papillose extension of tips, thick walled. Alar cells not much differentiated.

Glossadelphus zollingeri (C. Muell.) Fleisch. in Musci Fl. Buitenz,

4 : 1355 (1923)

Hypnum zollingeri C. Muell. In syn., 2 : 241 (1815)

Ectropothecium zollingeri (C. Muell) Jaeg. In Ber. S, Gall.

Naturw. Ges., 1877-78: 272 (1880)

PLATE 47

Plants gloosy in forming mats, yellow green to brown in color, ± 1.34 cm long and 1.23 mm broad with leaves. Main stem creeping, more or less pinnately branched, branches complanate. Stem leaves and branch leaves are more or less similar. Leaves ovate acuminate, ± 1.1 mm long and ± 0.41 mm broad, spreading when wet, margin faintly denticulate at tip, sometimes recurved in both side at middle of the leaves, apex of the leaves more or less acute.. Costa short, double. Leaves cells narrow rhomboid, upper laminal cells $\pm 34.54 \times 7.54 \mu\text{m}$, middle laminal cells $\pm 56.54 \times 7.45 \mu\text{m}$, both cells are papillose at end portion. Basal laminal cells smooth, hyaline, larger sub-rectangular-rhomboidal, $\pm 26.32 \times 8.87 \mu\text{m}$. sporophyte not found.

Specimens examined

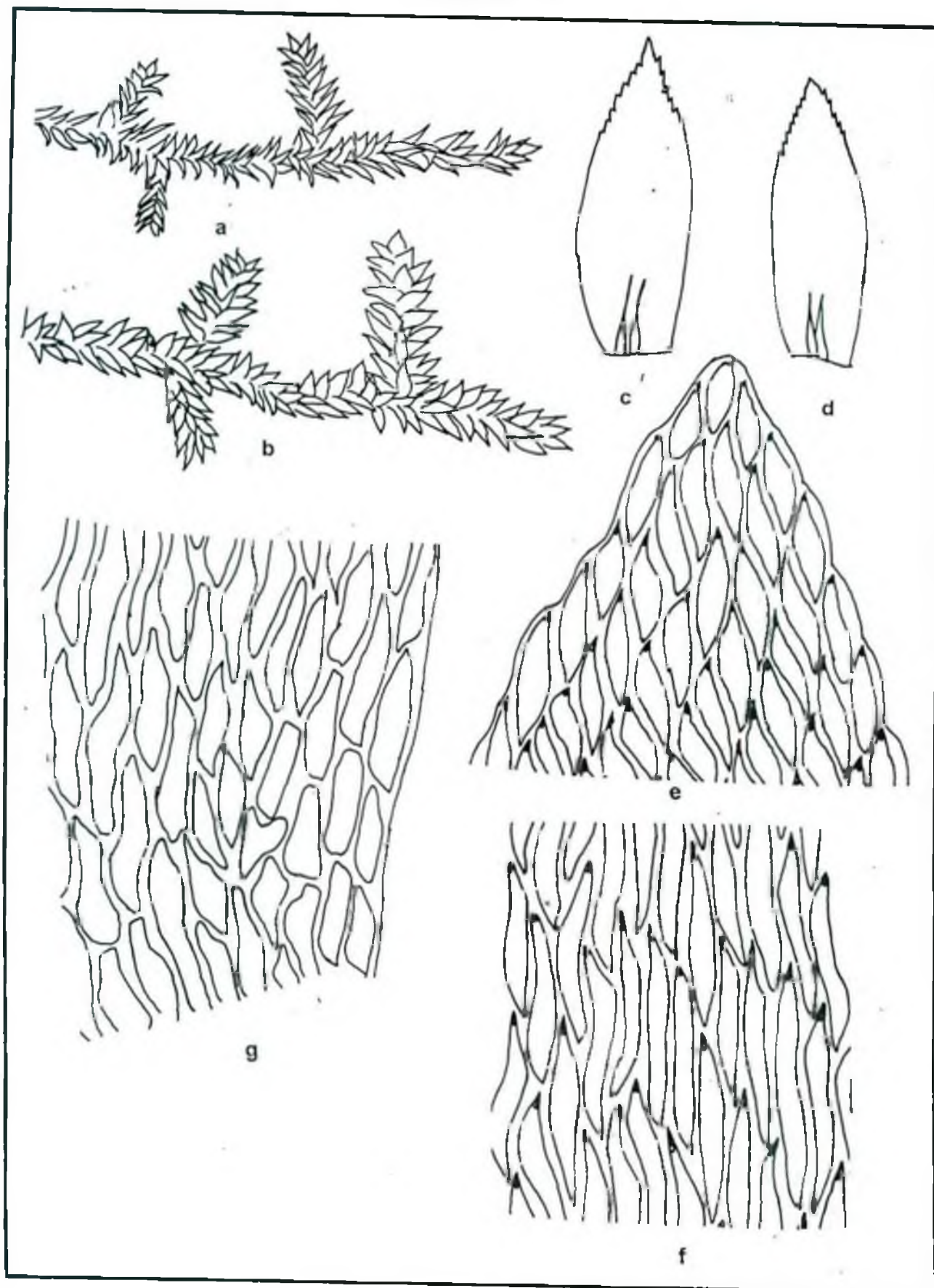
Sylhet: Jaflong Hill Forest, Sylhet sadar, on bark of tree, Shirin Akhtar and Jahirul Haque, 10.10.2007, **82**; Lawacherra Forest, on bark of tree, Shirin Akhtar, Jahirul Haque and Monirul Haque, 13.10.2007, **142**; Monipur Tea Estate, Fenchugonj, on bark of tree, Shirin Akhtar and Jahirul Haque, 18.10.2008, **452**.

Moulvi Bazar: Longla Tea Estate, Kulaura, on soil, Shirin Akhtar and Jahirul Haque, 07.10.2008, **476**; Kolilpur, Moulvi Bazar Sadar, on bark of tree, Shirin Akhtar and Jahirul Haque, 07.11.2009, **618**; Madhabpur, Komolganj, on bark of tree, Shirin Akhtar and Jahirul Haque, 09.10.2008, **475**.

PLATE 47

***Glossadelphus zollingeri* (C. Muell.) Fleisch.**

- | | | |
|--------|----------------------|-------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c & d. | Leaves | × 30 |
| e. | Leaf apex | × 450 |
| f. | Middle laminal cells | × 450 |
| g. | Basal laminal cells | ×450 |



Glossadelphus zollingeri (C. Muell.) Fleisch.

GENUS *APTYCHELLA*

Plants glossy, moderately robust. Main stem creeping or prostrate, brownish in color, irregularly branched. Leaves concave, ovate-lanceolate, usually acuminate, entire. Costa short and double, rarely single. Leaves cells linear, rhomboidal, color above insertion, alar cells differentiated.

Aptychella borii Dix. in J. Bomb. Nat. Soc. 39 : 790 (1937)

PLATE 48

Plants green to light golden green in color, soft, robust ± 1.32 cm long and 0.87 mm broad with leaves. Main stem creeping, irregularly pinnately branched, branches complanate. Leaves appressed to stem and sometimes spreading when dry, usually spreading when wet. Leaves ovate, acute, somewhat concave, ± 1.43 mm long and 0.43 mm broad at base. Leaves margin dentate at apex and rest of the margin is entire. Costa unequal, doubled. Leaves cells elongated, linear. Upper laminal cells $\pm 32 \times 3.76 \mu\text{m}$, middle laminal cells $\pm 68.67 \times 3.23 \mu\text{m}$ and basal cells $\pm 42.76 \times 4.32 \mu\text{m}$. Alar cells distinguished. By hyaline, somewhat decurrent, lax, irregularly elongated rectangular cells lowest row across insertion, $\pm 24.87 \times 6.34 \mu\text{m}$.

Specimens examined

Sylhet: Fatehpur, Gonaighat, on bark of tree, Shirin Akhtar, Jahirul Haque and Mozammel Haque, 12.10.2008, **424**; Fatehpur Tea Estate, on bark of tree, Shirin Akhtar, Jahirul Haque and Md. Rafiqul Haque, 12.03.2008, **373**; Jaflong Hill Forest, on bark of tree, Shirin Akhtar, Jahirul Haque and Mozammel Haque, 12.10.2007, **203**.

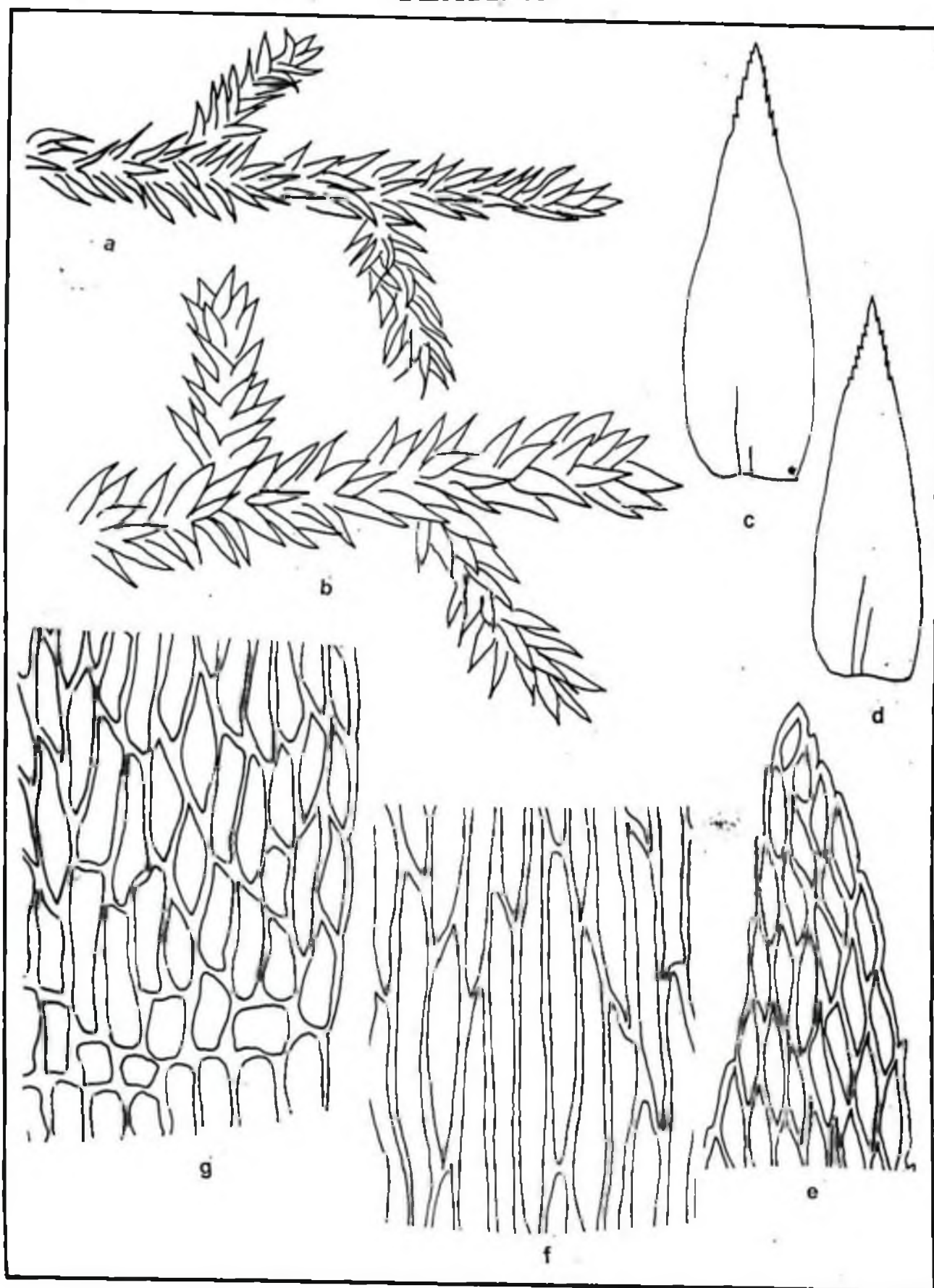
Moulvi Bazar: Kalampur, Srimongol, on bark of tree, Patharia Reserve Forest, Borolekha, on bark of tree, Shirin Akhtar, Jahirul Haque and Mozammel Haque, 12.02.2008, **246**; Akhtar and Jahirul Haque, 24.07.2008, **564**; Kholilpur, Maulvi Bazar sadar, on bark of tree, Shirin Akhtar and Jahirul Haque, 24.07.2009, **612**.

PLATE 48

***Aptychella borii* Dix.**

- | | | |
|--------|----------------------|-------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c & d. | Leaves | × 30 |
| e. | Leaf apex | × 450 |
| f. | Middle laminal cells | × 450 |
| g. | Basal laminal cells | ×450 |

PLATE 48



Aptychella borii Dix.

FAMILY HYPNACEAE

Plants forming in loose or densely mat. Main stem mostly regularly or irregularly pinnately branched, creeping, sometimes ascending,. Leaves ovate or ovate-lanceolate, long acuminate, transversely inserted, often homomallous to second or falcate-secund, occasionally somewhat complanate, rarely plicate or various shaped. Costa short, double. Leaf cells linear, smooth, basal angle mostly differentiated, small and forming a group of limited extent, usually small and quadrate but sometimes moderately enlarged and inflated in rather small usually distinct alar group.

KEY TO THE GENERA OF HYPNACEAE

- | | |
|--|-----------------------|
| 1. Leaf boardly ovate, apex smooth | <i>Vesicularia</i> |
| - Leaf narrowly ovate, apex dentate | 2 |
| 2. Middle laminal cells elongated and linear | <i>Ectropothecium</i> |
| - Middle laminal cells not so | <i>Isopterigium</i> |

GENUS **VESICULARIA**

Plants medium to large sized, pale green to yellowish, forming shiny mats. Stem long creeping, usually pinnately branched, branches short, spreading complanate, sparsely radiculose. Leaves differentiated into dorsal, lateral and ventral. Ventral leaves usually small and more or less appressed. Dorsal and lateral leaves usually larger, spreading to faintly homomallous, normally asymmetric, broadly ovate to oblong-lanceolate, acute to short or sometimes long acuminate, margin entire or serrulate near the apex. Costa short and double or single or lacking. Upper cells usually short and broad, laxly oblong-hexagonal to oblong-rhomboidal or rarely larger and rhomboidal, smooth, sometimes longer and narrower in a marginal row, forming an indistinct border, lower cells more elongated, not much differentiated at the basal angles or alar.

Vesicularia dubyana (C.M.) Broth., E & P. Pflanzenfam. Ed. 1 Musci (1909).

V. splendida Broth., Philip. Journ. Sci. (1913) 89.

Hypnum dubyanum C. M., Syn. 2 (1851) 241.

Ectropothecium campylothecium Broth. Philip. Sci. (1908) 27.

PLATE 49

Plants pale green but shiny, medium in size, ± 2.98 cm long and ± 1.78 mm broad with leaves. Main stem creeping, foliate, freely pinnate branched, sparsely radiculose, branches complanate, horizontal. Ventral leaf usually rather small and appressed. Dorsal and lateral leaves larger than ventral leaves and slightly curved when dry, widely spreading and flattened when moist. Branches and stem leaves similar but stem leaves slightly larger in size. Leaves broadly ovate, short acuminate, asymmetric, ± 1.45 mm long and $\pm$

0.62mm broad at base, margin entire but very faintly serrulate near apex. Costa short, single or double. Leaves cells smooth, non papillose. Upper lamina cells usually short and broad, rhomboidal, $\pm 54.45 \times 12.34 \mu\text{m}$, middle cells narrow, elongated, rhomboidal, $\pm 92.56 \times 13.54 \mu\text{m}$, basal laminal cells rhomboidal and elongated, $\pm 98.13 \times 17.56 \mu\text{m}$. Sporophytes arise from main stem. Seta elongated, $\pm 1.54 \text{ cm}$ long and $\pm 54 \mu\text{m}$ in diameter. Capsule medium sized, brownish, pendulous, 1.86mm long and $\pm 0.34 \text{ mm}$ in diameter. Operculum $\pm 0.45 \text{ mm}$ long. Spore smooth, oval-rounded, light yellow-brown, $\pm 65 \mu\text{m}$ in diameter.

Specimens examined

Sylhet: Jaflong Hill forest, Kolaura, on bark of tree, Shirin Akhtar and Jahirul Haque, 12.10.2007, **148**; Dewoan Bazar, Balagonj, on bark of tree, Shirin Akhtar and Jahirul Haque, 10.09.2008, **553**; Monipur Tea Estate, Fenchugonj, on bark of tree, Shirin Akhtar and Jahirul Haque, 17.09.2008, **468**.

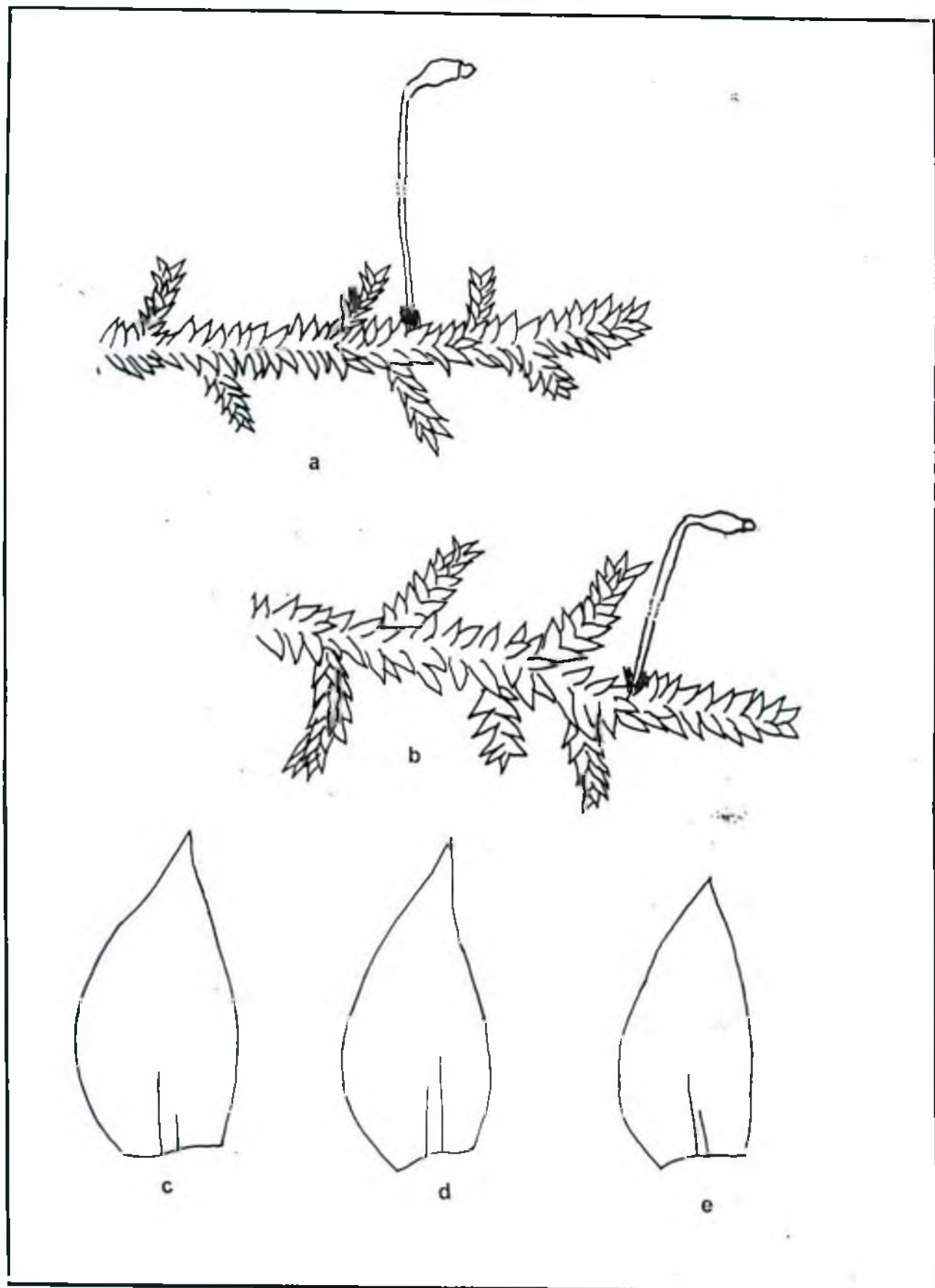
Moulvi Bazar: Atiabagh Tea Estate, Borolekha, on bark of tree, Shirin Akhtar and Jahirul Haque, 14.10.2009, **621**; Patharia Reserve Forest, Borolekha, on bark of tree, Shirin Akhtar and Jahirul Haque, 24.07.2008, **578**; Kholilpur, Maulvi Bazar Sadar, on bark of tree, Shirin Akhtar and Jahirul Haque, 24.07.2009, **660**.

Habiganj: Tarof Hill Reserve Forest, Madhabpur, on bark on a tree, Shirin Akhtar and Jahirul Haque 23.08.2007, **194**; Madhabpur, on bark of a tree, Shirin Akhtar and Jahirul Haque, 23.10.2008, **431**.

PLATE 49

Vesicularia dubyana (C. M.) Broth

- | | | |
|-----------|-----------|------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c, d & e. | Leaves | × 30 |

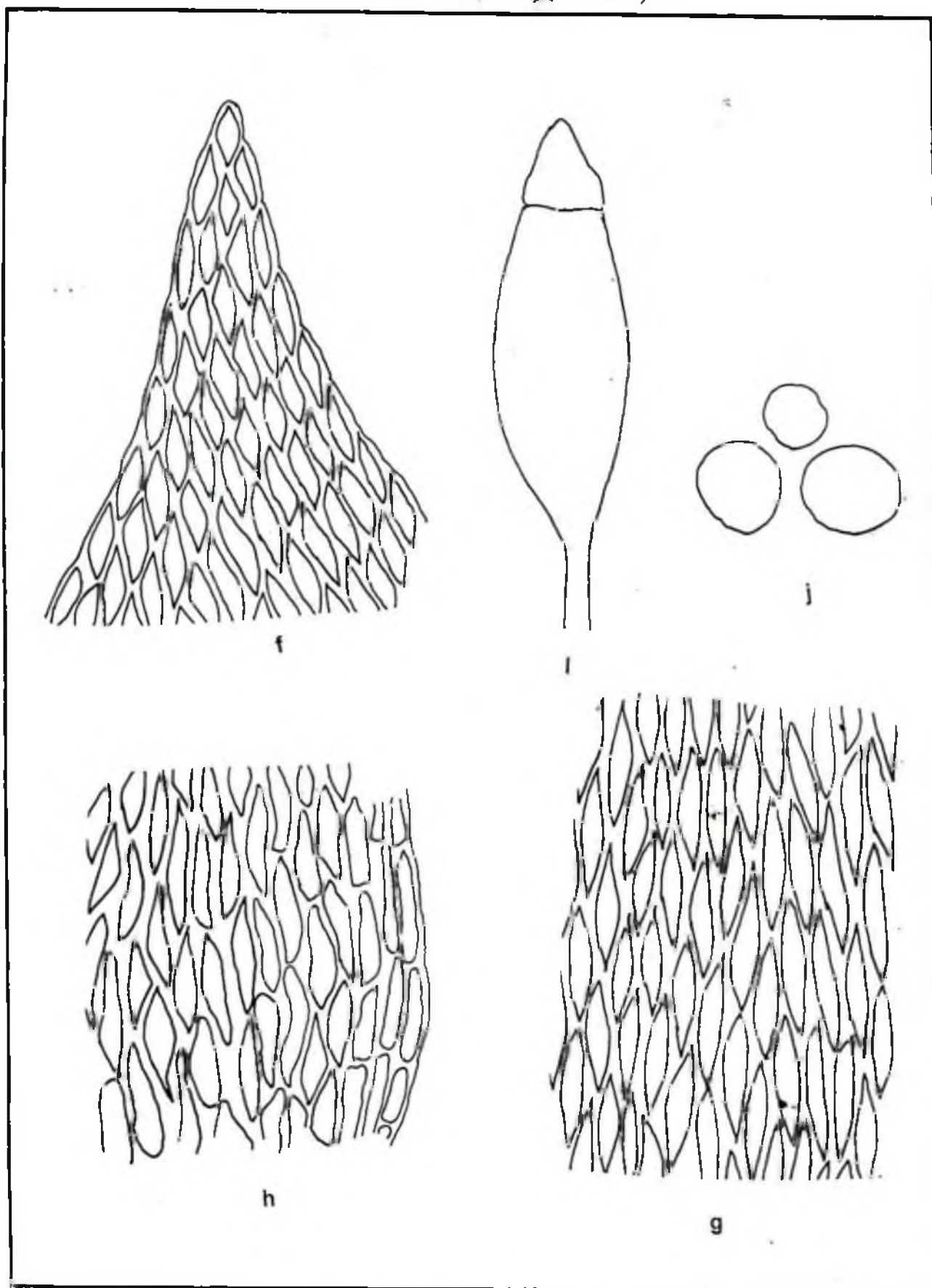


Vesicularia dubyana (C.M.) Broth.

PLATE 49
(CONT.)

***Vesicularia dubyana* (C. M.) Broth**

- | | | |
|----|------------------------|-------|
| f. | Leaf apex | × 300 |
| g. | Middle laminal cells | × 300 |
| h. | Basal laminal cells | × 300 |
| i. | Capsule with operculum | × 30 |
| j. | Spores | ×450 |



Vesicularia dubyana (C.M.) Broth.

GENUS *ECTROPOTHECIUM*

Plants robust, yellow green to green in color, forming in mat. Main stem more or less pinnately branched, creeping,. Leaves concave, ovate lanceolate, apex acute, appressed when dry. Upper portion of leaves dentate and lower portion entire. Costa short, double. Leaves cells elongated rhomboidal.

KEY TO THE SPECIES OF *ECTROPOTHECIUM*

- 1. Leaf and basal laminal cells broader *E. buitenzorgii*
- Leaf and basal laminal cells narrower *E. rostellatum*

1. *Ectropotheclum buitenzorgii* (Bel.) Mitt. In J. Linn. Soc. , 10 : 180 (1868)

Hypnum buitenzorgii Bel. In. Voyag. Ind. Or. Bot., 2 (Crypt.) 2 : 94 (1846)

Stereodon buitenzorgii (Bel.) Mitt. In Musci Ind. Or.: 99 (1959)

PLATE 50

Plants yellow green to green in color, robust, forming in mat ± 1.23 cm long and 1.67 mm broad with leaves. Main stem creeping, more or less pinnately branched. Leaves concave, ovate lanceolate, apex acute, appressed when dry, ± 1.56 mm long and 0.45mm broad at base. Upper portion of leaves dentate and lower portion entire. Costa short, double sometimes indistinct. Upper laminal cells more or less rhomboidal, $\pm 54.23 \times 35.32\mu\text{m}$, middle laminal cells linear rhomboidal, $\pm 61.23 \times 15.56\mu\text{m}$. Alar distinguished by a row of irregular

rectangular tinted cells at extreme base, cells are quadrate, rhomboidal or irregular shaped, $\pm 57.83 \times 21.23 \mu\text{m}$. Sporophyte not found.

Specimens examined

Sylhet: Malnichora Tea Estate, Sylhet sadar, on slope of hill, Shirin Akhtar and Jahirul Haque, 24.10.2007, **149**; Jaflong Hill Forest, Kulaura, on soil, Shirin Akhtar and Mozammel Haque, 26.10.2008, **552**.

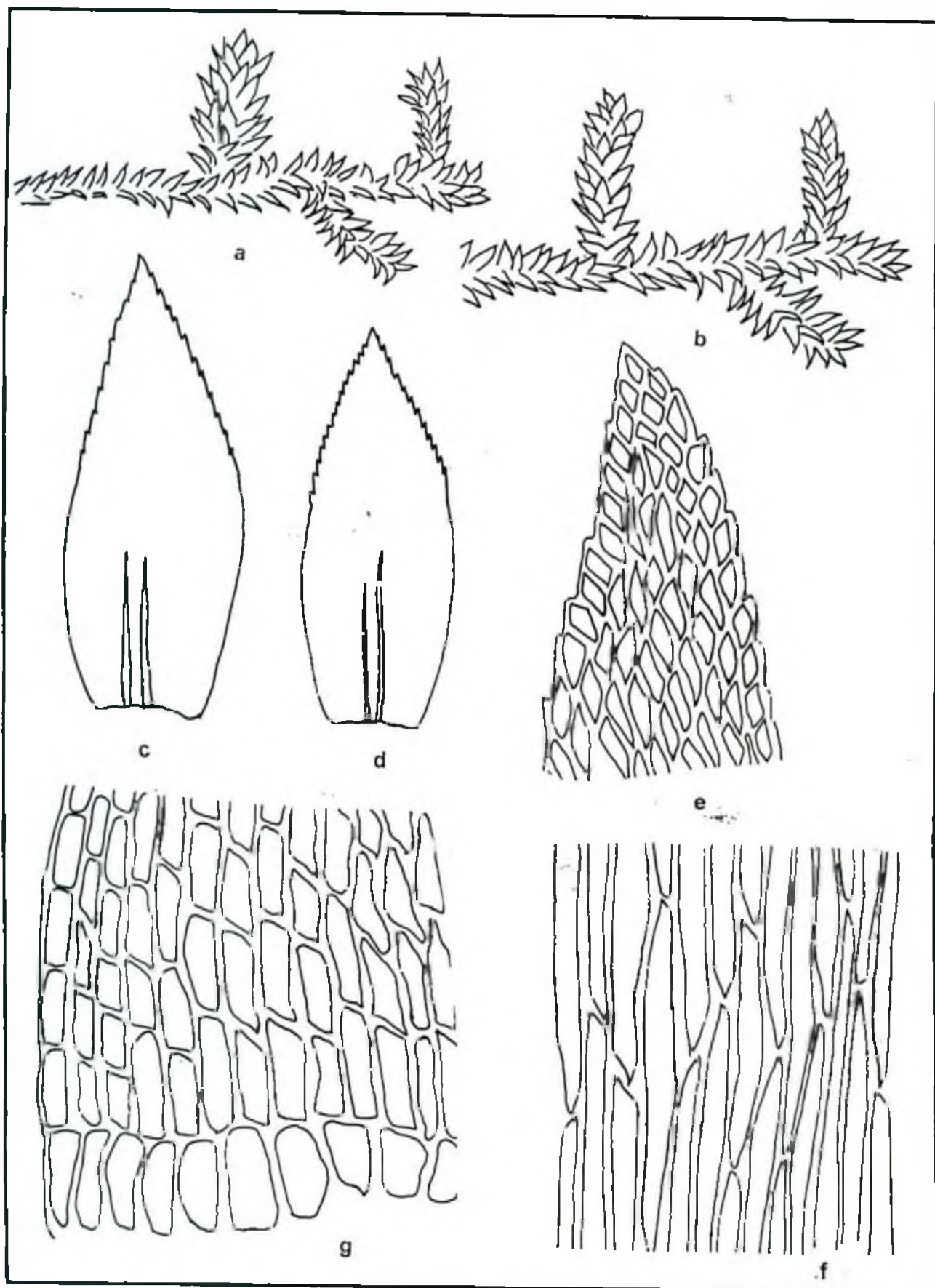
Maulvi Bazar: Patharia Reserve Forest, Borolekha, on soil, Shirin Akhtar and Jahirul Haque, 24.07. 2008, **555**; Kholilpur, Maulvi Bazar sadar, on soil, Shirin Akhtar and Jahirul Haque, 24.07.2009, **614**.

Sunamganj: Durgapasha, Sunamgonj sadar, on soil, Shirin Akhtar and Jahirul Haque, 12.09.2008, **368**; Duhalia, Chatok, on soil, Shirin Akhtar, Jahirul Haque and Mozammel Haque 16.09.2008, **389**.

PLATE 50

***Ectropothecium buitenzorgii* (Bel.) Mitt.**

- | | | |
|--------|----------------------|-------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c & d. | Leaves | × 30 |
| e. | Leaf apex | × 225 |
| f. | Middle laminal cells | × 450 |
| g. | Basal laminal cells | × 300 |



Ectropothecium buitenzorgii (Bel.) Mitt.

2. ***Ectropothecium rostellatum*** (Mitt.) Jaeg. In. Ber. S. Gall. Ges., 1877-78 : 258 (1859)
Stereodon rostellatus Mitt. In Musci Ind. Or. : 100 (1859)

PLATE 51

Plants glossy, corticolous, green in color, forming mats, ± 2.5 cm long and 1.65 mm broad with leaves. Main stem creeping, more or less irregularly branched, complanate. Leaves ovate-lanceolate, falcate, partly appressed to stem when dry, slightly falcate, ± 1.34 mm long and 0.43 mm broad at base. Leaves apex acute and dented margin at upper portion, somewhat assymmetrical. Costa unequal, short, double. Leaf cells smooth, rhoimboidal except extreme basal cells. Upper laminal cell $\pm 46.43 \times 9.34 \mu\text{m}$, middle laminal cells linear rhoimboidal and tip pointed, $\pm 49.54 \times 8.32 \mu\text{m}$, extreme basal laminal cells more or less quadrate, $\pm 42.34 \times 34.23 \mu\text{m}$. sporophyte not found.

Specimens examined

Sylhet: Jaflong Tea Estate, Sylhet sadar, on soil, Shirin Akhtar and Jahirul Haque, 25.10.2007, **154**; Tajpur, balagonj, on soil, Shirin Akhtar and Jahirul Haque, 12.08.2009, **648**.

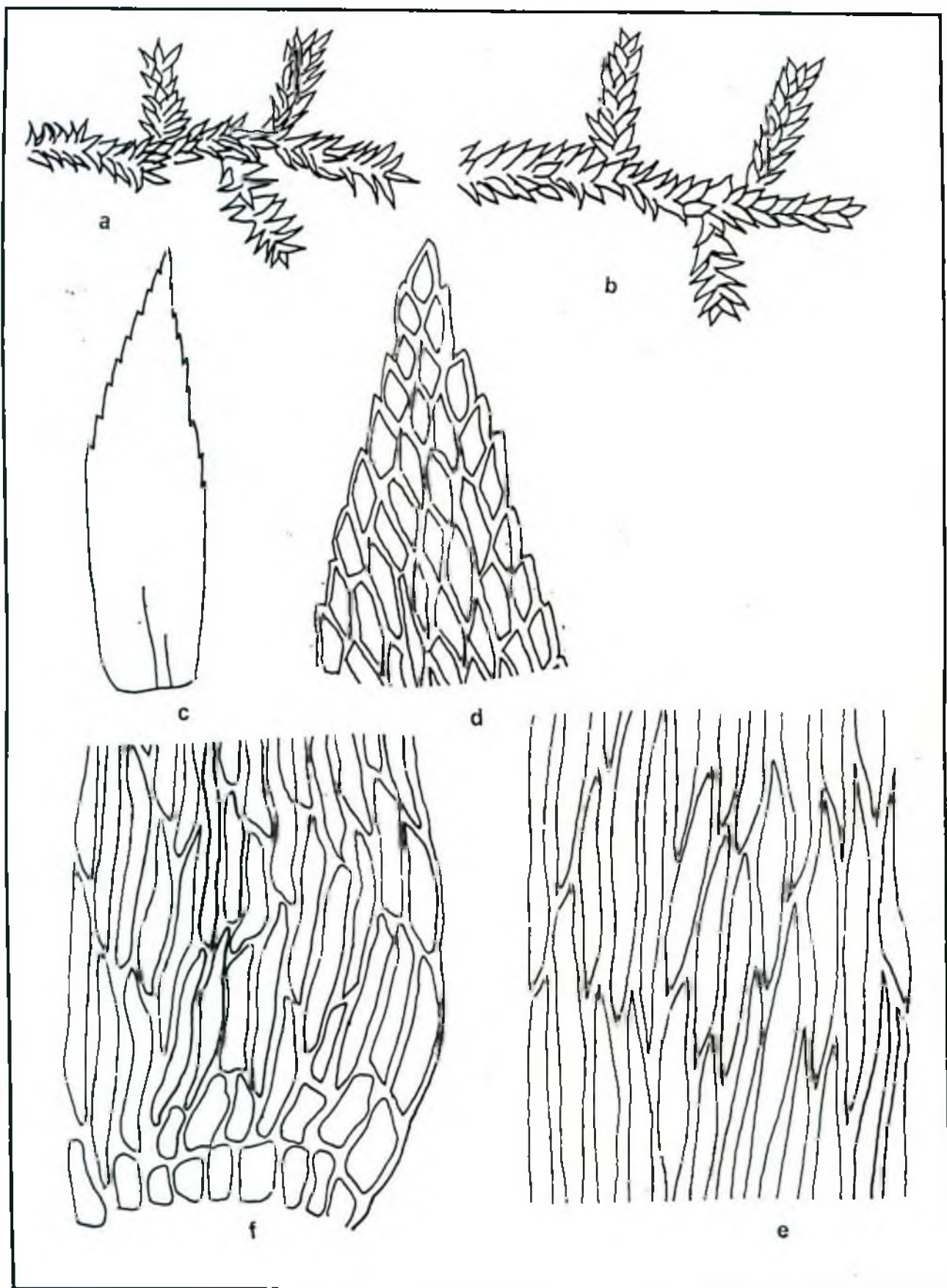
Maulvi Bazar: Jaflong Hill Forest, Kulaura, on bark of tree, Shirin Akhtar and Jahirul Haque, 14.10.2008, 502, Madhabpur, Komolganj, on soil, Shirin Akhtar and Jahirul Haque, 15.09.2007, **198**.

Habiganj: Roghunondon Reserve Forest, Madhabpur, on bark of tree, Shirin Akhtar and Jahirul Haque, 12.02.2008, **394**; Noapara Tea Estate, Madhabpur, on soil, Shirin Akhtar and Jahirul Haque, 12.10.2009, **665**; Changhat, Rahulbal, on soil, Shirin Akhtar and Mozammel Haque, 23.09.2009, **667**.

PLATE 51

***Ectropothecium rostellatum* (Mitt.) Jaeg.**

- | | | |
|----|----------------------|-------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c | Leaf | × 30 |
| d. | Leaf apex | × 225 |
| e. | Middle laminal cells | × 450 |
| f. | Basal laminal cells | × 300 |



Ectropothecium rostellatum (Mitt.)

GENUS *ISOPTERIGIUM*

Plants slender to robust forming mat. Main stem regularly or irregularly pinnately branched. Leaves often falcate, ovate-lanceolate, acute to acuminate, sometimes homomallous,. Costa short, double. Leaf cells short sometimes narrow, alar cells most of them are poorly differentiated.

Isopterigium pallidulum (Mitt.) Jaeg. In Ber. S. Gall. Naturw. Ges. ,

1876-77 : 432(1878)

Stereodon pallidulus Mitt. In Musc Ind. Or. : 105 (1859)

Isopterigium pallidum Jaeg. Ex dix.in j. Bomb. Nat. Hist. Soc. ,

39 : 793 (1937) *nom err.*

PLATE 52

Plants light green in color, forming mats, 0.67 cm long and 0.99mm broad with leaves. Main stem creeping, regularly or irregularly pinnately branched, sometimes simple branched. Paraphyllia or pseudoparaphyllia absent. Leaves spreading, erectopatent to erect near tip or short apiculate, erect spreading when moist, shunken when dry, often falcate, ovate-lanceolate, acute to acuminate, ± 0.75 mm long and 0.4 mm broad at base. Leaves margin crenulate at upper portion. Costa short, double, sometimes indistinct. Leaves cells smooth, slightly vermicular, upper laminal cells $\pm 45 \times 23$ μm , middle laminal cells, $\pm 52 \times 13.43$ μm . extreme basal cells larger rectangular, $\pm 43 \times 26.32$ μm . Sporophyte not found.

Specimens examined

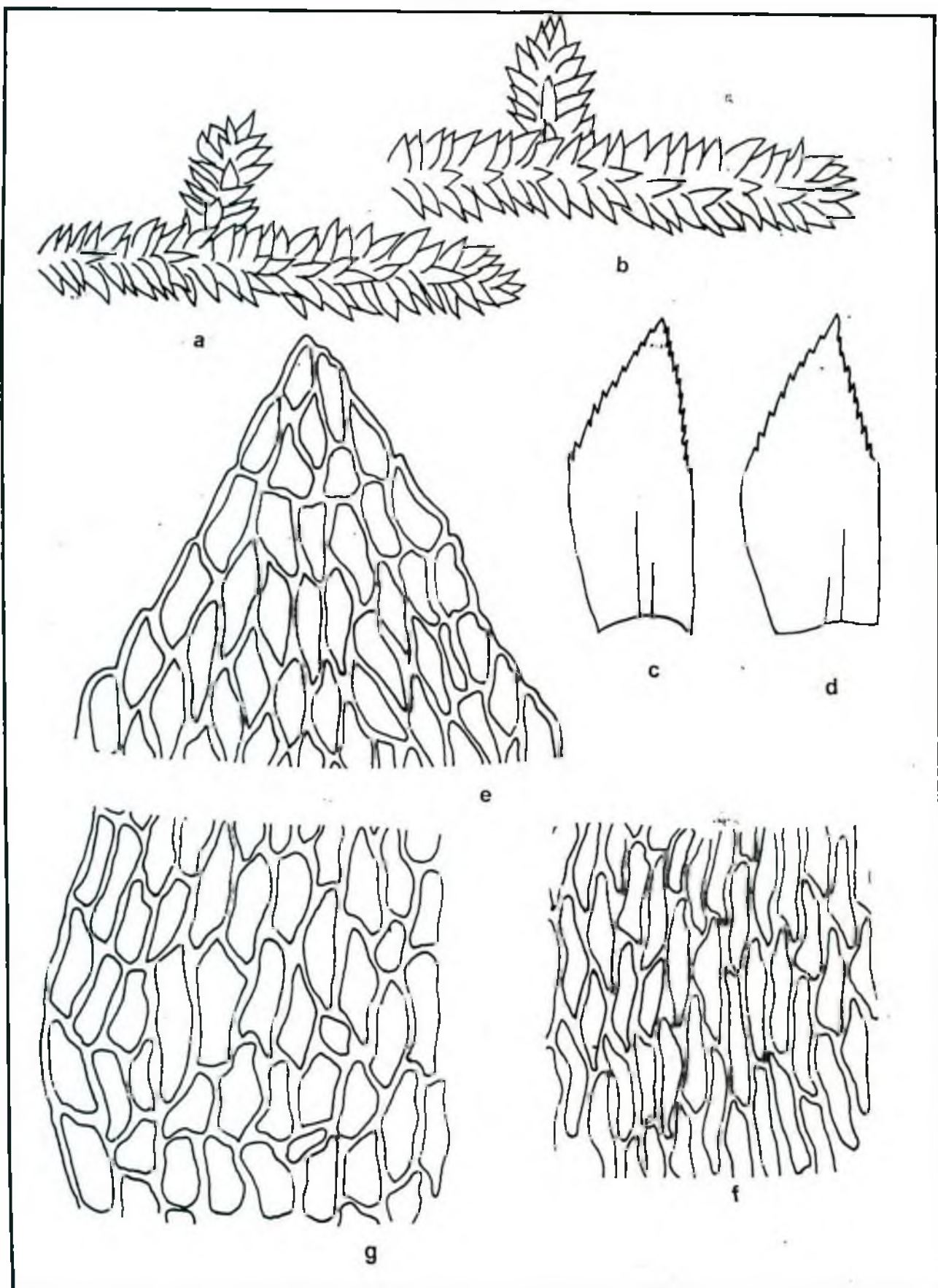
Sylhet: Jaflong Hill Forest, Sylhet Sadar, on bark of tree, Shirin Akhtar, Jahirul Haque and Monirul Haque, 10.12.2008, **462**; Khan Tea Estate, Gonaighat, on bark of tree, Shirin Akhtar, Jahirul Haque and Monirul Haque, 13.12.2008, **479**; Kathimpara, Sylhet Sadar, on bark of tree, Shirin Akhtar, Jahirul Haque and Monirul Haque, 19.10.2007, **457**.

Moulvi Bazar: Kalikabari Tea State, on Atiabagh Tea Estate, on bark of tree, Shirin Akhtar, Jahirul Haque and Monirul Haque, 12.10.2009, **689**; Borolekha, on soil, Shirin Akhtar and Jahorul Haque, 19.09.2008, **466**; Patharia Reserve Forest, Juri, on bark of tree, Shirin Akhtar and Jahorul Haque, 14.09.2009, **666**.

PLATE 52

Isopterigium pallidulum (Mitt.) Jaeg.

- | | | |
|--------|----------------------|-------|
| a. | Dry plant | × 10 |
| b. | Wet Plant | × 10 |
| c & d. | Leaves | × 30 |
| e. | Leaf apex | × 450 |
| f. | Middle laminal cells | × 450 |
| g. | Basal laminal cells | ×450 |



Isopterigium pallidulum (Mitt.) Jaeg

RESULTS AND DISCUSSION

In the present study the authoress and other collectors collected about 700 specimens from different habitat of Sylhet zone and 52 species have been identified and described under 26 genera covering 20 families of 3 classes; Hepaticopsida, Anthoceropsida and Bryopsida. In the class Hepaticopsida 9 species have been described under 3 families; Ricciaceae, Targioniaceae and Marchantiaceae of the order Marchantiales. *Antheceros leavis* of the genus *Anthoceros* and *Nothothylas indica* of the genus *Nothothylas* have been described under the family Anthocerotaceae of the order Anthocerotales of the class Anthoceropsida. A total 40 species have been described under 21 genera covering 15 families; Leucobryaceae, Fissidentaceae, Calymperaceae, Pottiaceae, Funariaceae, Bryaceae, Bartramiaceae, Erpodiaceae, Neckeraceae, Amblystegiaceae, Brachytheciaceae, Entodontaceae, Plagiotheciaceae, Sematophyllaceae and Hylocomiaceae including 8 orders; Dicranales, Fissidentales, Syrrhopodentales, Pottiales, Funariales, Eubryales, Isobryales, and Hypnobryales of the class Bryopsida. Out of which 52 species of Sylhet zone 3 species are new recorded from Bangladesh.

Vegetation analysis shows that 23.08% of the total species are in family Fissidentaceae is the greatest percentage and second largest percentage is in Ricciaceae which is 13.45% (Table 1)

Table 1: Brief analytical data of the bryophyte vegetation of Sylhet Zone

Sl. No.	Orders	Families	No. of genus	No. of species	% of species
1	Marchantiales	Ricciaceae	1	7	13.45
		Targioniaceae	1	1	1.92
		Marchantiaceae	1	2	3.84
2	Anthocerotales	Anthocerotaceae	2	2	3.84
3	Dicranales	Leucobryaceae	1	1	1.92
4	Fissidentales	Fissidentaceae	1	12	23.08

5	Syrrophodontales	Calymperaceae	1	2	3.84
6	Pottiales	Pottiaceae	2	4	7.69
7	Funariales	Funariaceae	1	1	1.92
8	Eubryales	Bryaceae	2	4	7.69
		Bartramiaceae	1	1	1.92
9	Isobryales	Erpodiaceae	1	1	1.92
		Neckeraceae	1	2	3.84
10	Hypnobryales	Amblystegiaceae	1	2	3.84
		Brachytheciaceae	1	1	1.92
		Entodontaceae	1	1	1.92
		Plagiotheciaceae	1	1	1.92
		Sematophyllaceae	2	2	3.84
		Hylocomiaceae	1	1	1.92
		Hypnaceae	3	4	7.67
Total	10	20	26	52	100

Analysis shows that the greatest percentage of species shows in the class Bryopsida which is 76.92%, second largest is 19.33% and the least percentage is 3.84 in the class Hepaticopsida and Anthoceropsida respectively (Table 2).

Table 2: Class-wise Bryophyte vegetation on Sylhet zone

Sl. No.	Class	No. of species	% of species
1	Hepaticopsida	10	19.23
2	Anthoceropsida	2	3.84
3	Bryopsida	40	76.92
Total	3	52	100

District-wise distribution of taxa studied

Sylhet district: *Riccia bengalensis*, *Riccia discolor*, *Riccia sullivantii*, *Riccia billardieri*, *Riccia bogransis*, *Cyathodium tuberosum*, *Marchantia palmata*, *Marchantia nepalensis*, *Anthoceros laevis*, *Octoblepharum albidum*, *Fissidens*

xiphioides, *Fissidens zollingeri*, *Fissidens virens*, *Fissidens semperfalcatus*, *Fissidens nobilis*, *Fissidens orishae*, *Fissidens javanicus*, *Fissidens diversifolius* var. *rubricaulis*, *Fissidens laxitextus*, *Fissidens laxus*, *Calymperes tenerum*, *Hyophila comosa*, *Hyophila involuta*, *Semibarbula ranunii*, *Semibarbula orientalis*, *Phycomitrium pulchellum*, *Pohlia ampullacea*, *Bryum coronatum*, *Bryum cellulare*, *Bryum apiculatum*, *Philonotis hastata*, *Erpodium mangiferae*, *Homaliodendron exiguum*, *Homaliodendron flabellatum*, *Campylium gollanii*, *Campylium stellatum*, *Brachythecium acuminatum*, *Erythrodontium julaceum*, *Stereophyllum anceps*, *Glossadelphus zollingeri*, *Aptychella borii*, *Vesicularia dubyana*, *Ectropothecium buitenzorgii*, *Ectropothecium rostellatum*, *Isopterigium pallidulum*, *Macrothamniella pilosula*.

Moulvi Bazar district: *Riccia bengalensis*, *Riccia discolor*, *Riccia gangetica*, *Riccia billardieri*, *Riccia lithophillii*, *Marchantia palmata*, *Marchantia nepalensis*, *Octoblepharum albidum*, *Fissidens splachnobryoides*, *Fissidens xiphioides*, *Fissidens zollingeri*, *Fissidens virens*, *Fissidens semperfalcatus*, *Fissidens nobilis*, *Fissidens ganguleei*, *Fissidens laxitextus*, *Fissidens laxus*, *Calymperes tenerum*, *Calymperes noakhaliensis*, *Hyophila comosa*, *Hyophila involuta*, *Semibarbula ranunii*, *Semibarbula orientalis*, *Phycomitrium pulchellum*, *Pohlia ampullacea*, *Bryum coronatum*, *Bryum cellulare*, *Bryum apiculatum*, *Philonotis hastata*, *Erpodium mangiferae*, *Homaliodendron exiguum*, *Homaliodendron flabellatum*, *Campylium gollanii*, *Campylium stellatum*, *Erythrodontium julaceum*, *Stereophyllum anceps*, *Glossadelphus zollingeri*, *Aptychella borii*, *Vesicularia dubyana*, *Ectropothecium buitenzorgii*, *Ectropothecium rostellatum*, *Isopterigium pallidulum*, *Macrothamniella pilosula*.

Habiganj District: *Riccia bengalensis*, *Riccia sullivantii*, *Riccia gangetica*, *Riccia billardieri*, *Riccia bogransis*, *Riccia lithophillii*, *Cyathodium tuberosum*, *Anthoceros laevis*, *Notothylas indica*, *Octoblepharum albidum*, *Fissidens splachnobryoides*, *Fissidens xiphioides*, *Fissidens javanicus*, *Calymperes tenerum*, *Hyophila comosa*, *Hyophila involuta*, *Semibarbula orientalis*, *Bryum cellulare*, *Bryum apiculatum*, *Philonotis hastata*, *Erpodium mangiferae*, *Campylium gollanii*, *Brachythecium*

acuminatum, *Erythrodontium julaceum*, *Stereophyllum anceps*, *Vesicularia dubyana*, *Ectropothecium rostellatum*, *Macrothamniella pilosula*.

Sunamganj district: *Riccia discolor*, *Riccia billardieri*, *Fissidens splachnobryoides*, *Fissidens virens*, *Fissidens nobilis*, *Fissidens orishae*, *Fissidens ganguleei*, *Fissidens laxus*, *Calymperes tenerum*, *Hyophila comosa*, *Hyophila involuta*, *Semibarbula orientalis*, *Bryum coronatum*, *Bryum apiculatum*, *Erpodium mangiferae*, *Erythrodontium julaceum*, *Stereophyllum anceps*, *Ectropothecium buitenzorgii*.

The distribution analysis shows that the greatest number of species found in Sylhet district which is 46 and the least number in Sunamganj which is 18 (Table 3)

Table 3: District wise vegetation of Sylhet zone:

Sl.No.	Name of districts	Number of species
1	Sylhet	46
2	Maulvi Bazar	43
3	Habiganj	28
4	Sunamganj	18

The present study indicated that species of *Riccia* and *Fissidens* are found abundantly of 4 districts of Sylhet zone. *Semibarbula orientalis*, *Hyophila involuta* are very common and wide spread species in Sylhet zone. Where as *Anthoceros laevis* and *Notothylas indica* are rare and endangered species in Sylhet zone.

In the present study the authoress documented *Fissidens diversifolius* var. *rubricaulis*, *F. laxitextus* and *Semibarbula. ranuii* as new record for Bangladesh. The authoress collected *Fissidens diversifolius* var. *rubricaulis* from Sylhet district, *F. laxitextus* and *Semibarbula. ranuii* from Sylhet and Maulvi Bazar district.

Most of the species are found in Sylhet, Moulvi Bazar and Habiganj because their humidity, temperature, rainfall and pH of soils are suitable for silent growth of bryophyte. Maulvi Bazar and Habiganj districts were inundated by the high rise of water level in the Manu and the Khowai rivers which engulfed the areas of Barolekha, Kulaura, Rajnagar, Chunarughat, Shaistaganj. This inundation might influence the growth and development of bryophyte flora.

Threat to the Bryophyte Flora:

A number of threats have been identified in the study area based on the observations and group discussion with local people during the field works which might lead to cause bryophyte flora to diminish. Such threats are as appended bellow:

(a) Modern agriculture:

There are many wetland in the study area. The wetland support different types of thalloids bryophytes. In the wetland area Boro cultivation is continued for high yielding varieties. For better production the local people use extensive amount of fertilizer, insecticides, pesticides and also herbicides. Extensive use of these things are responsible for damaging the habit thalloids bryophytes.

(b) Urbanization:

Day by day the population of the area is increasing . To fulfill their basic requirement, they build new houses, new roads and new infrastructure. In this way they destroy various types of bryophytic plants.

(c) Lack of awareness:

As indicator plants knowledge of the groups of plants are limited. As a result they destroy the important group of plants.

Suggested measures for conservation:

Now a days environmental change is a burning issue. People are becoming more conscious about the environmental change of the earth. But presently modern agriculture, urbanization, lack of awareness, road construction etc. are great threat of this important group of indicator plants. A number of suggestion can be made are presented below:

- Both in-situ and ex-situ conservation should be done for this endangered group of plants.
- Stopping all sorts of legal and illegal clear felling.
- Controlling open grazing and forest floor cleaning including collecting of humus.
- Awareness among the local people should be created for the conservation of bryophytic plants.
- Modern agriculture and urbanization should be in proper way.
- Government and local NGOs can work jointly for conservation of this threatened group of plants.

The preliminary study in Sylhet zone 52 species have been identified and described under 26 genera covering 20 families of 3 classes; Hepaticopsida, Anthoceropsida and Bryopsida. From the present preliminary study it be concluded that Sylhet zone is rich in bryophyte flora. To make a complete inventory of Sylhet zone, further long-term study is necessary.

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