CHAPTER 9

The pollens form a fascinating picture under the microscope and
Can but record tales on the stones and rocks.

POLLEN MORPHOLOGY:

9.1. INTRODUCTION

The importance of the pollen grains in the sexually reproducing spermatophytes is immense as it represents the microspore in which the male gametophyte develops. The wall of the pollens in the angiosperms are tough and thick composed of a chemical sporopollenin which is a complex polymer with a chemical formula C_{90} H_{29} $(OH)_5$. This polymer is highly resistant to various forces of nature and plays an important protective role. Morecver, with evolution various types of structures and ornamentation have evolved externally on the pollen wall depending on the mode in which they are carried to the stigma. Thus the shape and size, thickness and construction of different layers of the pollen wall, shape and size and complexity of apertures and pattern of ornamentation show a wide range of variation. As the pollen has certain species specific and stable characteristics earlier workers like Erdtman (1944,1952), Rudenko (1959), and Wodehouse (1928) have stressed the utilisation of pollen morphology in taxonomic studies. Workers including Blackemore 1984, Chanda *et al.* 1988, Manna *et al.* 1988 have used palynology for numerous taxa of variable ranks.

Species of *Acer* do not produce very large quantities of pollen. As the sporopollenin are more perishable as compared to most other trees the microfossil studies for the genus has not been particularly helpful in paleobotany. Studies of the pollen grains of living species of the genus has been made by a number of workers like Biesboer, D.D. (1975), Pozhidaev, A.E. (1993). Typically the pollen grains of *Acer* are 3-colpate or 3-colporate, radially symmetrical, isopolar and prolate to nearly spheroidal.

In most pollen morphological investigations pollen forms deviating from the ones typical to the species are usually regarded as abnormal (teratical) and left unregistered although such forms are present in a number of families belonging to the angiosperms. The wide occurrence of these rare deviate forms throughout the angiosperms and their evident regularity, stability and sufficiently high fertility (Clarke, 1975) does not allow the conclusion that they are random, and irregular, particularly abnormal forms. Pozhidaev (1993) with the help of light and scanning electron microscopy has reported the existence of forms that deviate from the typical pollen

grains in 31 of the 68 spp. of *Acer* that he investigated. He observed the existence of 5 extreme forms of deviations with respect to the number and arrangement of the colpi *viz.*

1. 2-syncolpate (or syncolporate) pollen with borth colpi in one plane and (two ora on opposite sides of the pollen grain): – **Form A**
2. 4-colpate (or 4-colporate) pollen with copli inclined in pairs and arranged diagonally around the grain to form a W shape in plane (and four ora in the middle of each colpus) :– **Form H**.
3. 6-colpate (syncolpate) pollen with colpi arranged on the edges of a tetrahedron : **– Form F**.
4. 2-apeturate pollen with two pairs of colpi joined to form two rings on the opposite sides of the pollen grain – **Form I**.
5. 12-colpate pollen with colpi arranged on the edges of a cube – **Form K.**

All the deviate forms mentioned above occur in *Acer* showing no obvious systematic or geographical regularity with the frequency of these deviate forms rarely exceeding 10%. The rarest forms being H, I and K. Moreover, these deviate forms are not merely restricted to *Acer* but occur in other, completely different systematic angiosperms group (Wooehouse,1935; Candau,1987; Clarke,1975; Polo and Diez,1987; Pozhidaev,1991). Pozidaev (1991) regards these forms as members of the same sequence which he describes as a gradual transformation of 2-syncolpate (or 2-syncolporate) pollen with the colpi arranged in the seams of a tennis ball (and sometimes with two ora in the syncolpus on the opposite sides of the pollen grain). He is of the opinion that the deviate forms of *Acer* pollens are not connected with the ordinary 3-colpate form as opposed to the views of Sladkov,1953; Borzova & Sladkov, 1968 and Borzova 1969.

9.2. SYSTEMATIC ENNUMERATION OF THE POLLEN MORPHOLOGY OF THE DIFFERENT SPECIES OF *Acer* OF THE DARJILING - SIKKIM HIMALAYA

Acer acuminatum Wall. Ex D.Don.
Pollens 3- colporate, spheroidal; PA x ED ± 16.0 x 15.0 μm, colpi ±12.0 x 2.0. μm; exine 2.0 μm thick ; ora lalongate; sexine 1.5 μm thick, reticulate. (Plate 9.1. a)

Acer campbellii Hook., f. & Thomson ex Hiern
Pollen 3- colporate, prolate; PA x ED ± 25.3 x 16.2 μm; colpi ±21.5 x 2.0 μm, exine 2.0 μm thick; ora circular; sexine 1.0 μm thick, striato-reticulate. (Plate 9.1 b)

Acer caudatum Wallich
Pollen 3-colporate, prolate-spheroidal; PA x ED ± 21.0 x 16.5 μm; synecolppate; colpi 20.0 x 2.4 μm; lalongate, medianaly placed, exine 2.0 μm thick, nexine 0.5 μm thick striato-reticulate. (Plate 9.1. c,d)

Acer hookeri Miquel
Pollen 3-colporate, prolate; PA x ED ± 37.4 x 27.0 μm; colpi 33.0 x 2.0 μm; ora circular; exine 2 μm thick, sexine 0.4 μm thick, striato-reticulate.(Plate 9.1. e)

Acer laevigatum Wallich
Pollen 3-colporate; PA x ED ± 37.0 x 30.0 μm; colpi ±35.0 x 3.0 μm; ora lanongate; exine 2.5 μm ; sexine 2.0 μm, striatoreticulate (Plate 9.1. f, g, h)

Acer oblongum Wallich ex DC
Pollen 3-colporate, prolate; PA x ED ± 40.0 x 26.0 μm; colpi ±36.0 x 2.0 mm. Exine 2.0 μm thck; sexine 1.5 μm, striatoreticulate. (Plate 9.1. i)

Acer osmastonii Gamble
Pollen 3-colporate, spheroidal; PA x ED ± 27.5 x 25.5 μm; colpi ±24.0 x 2.0 μm; ora lalongate; exine 2.0 μm thick ; sexine 1.5 μ m thick, striatoreticulate. (Plate 9.1. j, k)

Acer palmatum Thunberg ex Murray
Pollen 3-colpate, prolate; PA x ED ±18.0 x 15.0; colpi ±15.0 x 2.0μm; exine 1.5 μm thick; nexine not differentiaited; Striato-reticulate.(Plate 9.1. l)

Acer pectinatum Wallich ex Nicholson
Pollen 3-colporate or colpate prolate; PAx ED ±25.0 x 14.0 μm; colpi ±21.0 x 2.5 μm; ora constricted; exine 2.0 μm thick; sexine 1.5 μm thick, striato-reticulate.(Plate 9.1. m,n)

Acer sikkimense Miquel

Pollen 3-colporate, subprolate; PA x ED ±40.0 x 30.0 μ m; colpi ± 6.0 x 2.0 μ m; ora circular; exine 2.0 μ m thick; sexine 1.0 μ m thick, striato-reticulate. (Plate 9.1. o, p)

Acer stachyophyllum Hiem

Acer stachyophyllum Hiern

Pollen 3-colporate, prolate-spheroidal; PAxED ±16.0 x 13.5μm; colpi ±13.0x 1.5 μm. Exine 1.5 μm thick; sexine and nexine are not differentiated, striatoreticulate. (Plate 9.1. q, r, s)

Acer sterculiaceum Wallich
Pollen 3-colporate, prolate-spheroidal; PA x ED ± 18.0 x 14.0 μm; colpi 14.0 x 1.8 μm. Exine 2.0 μm thick; nexine 0.5 μm thick; striato-reticulate. (Plate 9.1.t)

Acer thomsonii Miquel
Pollen 3-colporate or ½ colpate; PA x ED ± 38.0 x 26.0μm; colpi ± 33.0 x 2.0μm, ora constricted; exine 2.0 μm ; nexine 0.5 μm . (Plate 9.1. u).

9.3. RESULTS AND DISCUSSIONS:

The different species of this region also exhibit pollen grains that are mainly 3-colporate, and a few 3-colpate, radially symmetrical, isopolar and prolate to nearly spheroidal. The majority of the species however were found to produce 3-colporate grains. All the twelve species of this region showed 3-colporate grains with only the introduced species *Acer palmatum* showing 3-colpate pollens. However, species like *A.pectinatum* and *A.thomsoni* also produce 3-colpate grains in low frequency.The 3-colporate pollens were spheroidal in two species ,*A. thomsonii and A. sterculiaceum* with pollens of two species *A. sikkimense* and *A. pectinatum* being sub-prolate; eight other species showed Prolate pollen grains.

The different species however showed differences with respect to the sizes of their pollens. The smallest pollen grains was found in *A. acuminatum* and *A. stachyohyllum* being ±16 x 15 and 16.0 x 13.5μm respectively; and the largest grains found in by *A. oblongum* and *A. sikkimense*, being ±40.0 x 26.0μm and 40.0 and x 30.0μm respectively. All other species showed sizes intermediate to these two sizes. While species like *A. thomsonii, A. sterculiaceum, A.stachyophyllum, Acer caudatum* showed the sizes of their pollens towards the smaller side those like *A. hookeri, A.laevigatum, A.osmastonii, A. palmatum* showed pollen sizes towards the larger side. The rest of the species showed medium sized grains.

The ora ranged from Circular to the Lalongate types in different species except in *A.sikkimense* where it remains circular and in *A. pectinatum* where it is constricted. The wall thickness is more or less constant being thickest in *A.laevigatum* and the narrowest in *A, caudatum*. Except *Acer acuminatum* where the outer ornamentation of the wall is reticulate in all others it remains

straito-reticulate. The different closely related species show more similarities with respect to both morphology and size of their pollen grains, this being particularly true for species placed under the same sections.

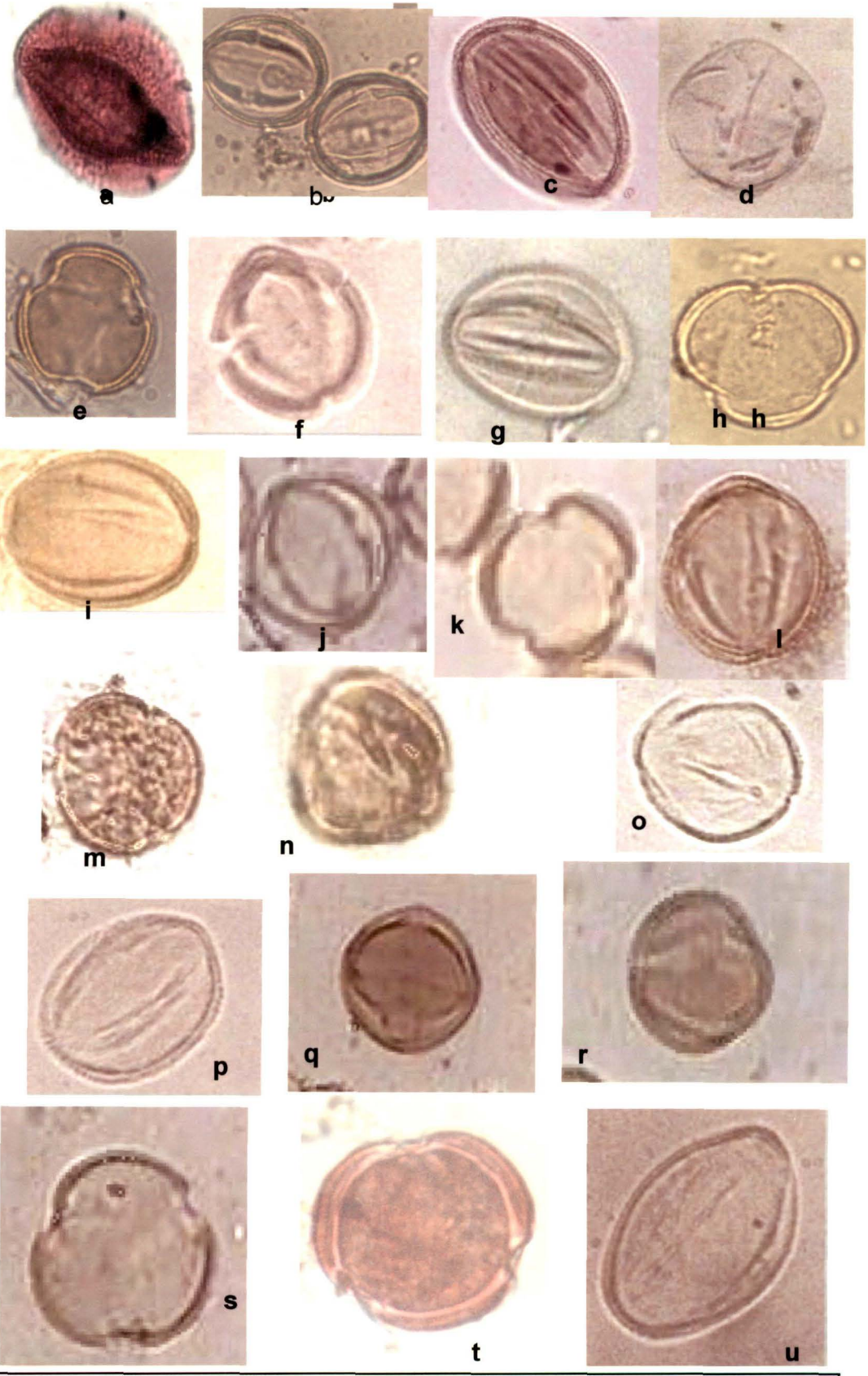
The result of pollen morphological survey detected differences in the different species, also showed a good deal of similarities. Presence of uniformly 3-colporate confirm the dominance f prolate grains. Syncoplae sriato-reticulate surface ornamentation of most of the pollens indicate their close relationship,

TABLE 8.1. MAJOR MORPHOLOGICAL CHARACTERISTICS OF THE DIFFERENT SPECIES OF *Acer L.* OF THE DARJILING SIKKIM-HIMALAYA.

Name of the Species	Type of Pollen grain	PA x ED	Colpi		Type of ora	Thickness of			Ornamentation
			length	Breadth		Exine	Nexine	Sexine	
Acer acuminatum	3-colporate sphaeroidal	± 16.0 x 15.0	± 12.0	±2	Lalongate	2.0		1.5	Reticulate
Acer campbellii	3-colporate Prolate	±25.3 x 16.2	±21.5	2.0	Circular	2.0		1.0	Striato-reticulate
Acer caudatum	3-colporate Prolate	± 18 x 14.0	14.0	1.8		2.0	0.5		Striato-reticulate
Acer hookeri	3-colporate Prolate	± 37.4 x 27.0	33.0	2.0	Circular	2.0		0.8	Striato-reticulate
Acer laevigatum	3-colporate	± 37 x 30.0	35.0	3	Lalongate	2.5		2.0	Striato-reticulate
Acer oblongum	3-colporate Prolate	± 40.0 x 26.0	36.0	2.0		2.0		1.5	Striato-reticulate
Acer osmastonii	3-colporate Spheroidal	± 27.5 x 25.5	36.0	2.0		2.0		1.5	Straito-reticulate
Acer palmatum	3-colpate Prolate	± 27.5 x 25.5	±24.0	2	Lalongate	2.0		1.5	Striato-reticulate
Acer pectinatum	3-colporate Subprolate	±25.0 c 14.0	21.0	2.5	Constricted	2.0		1.5	Striato-reticulate
Acer sikkimense	3-colporate Subprolate	± 40.0 x 30.0	6.0	2	Circular	2.0		1.0	Striato-reticulate
Acer stachyophyllym	3-colporate Prolate Spheroidal	±16.0 x 13.5	13.0	1.5		1.5			Striato-reticulate
A. sterculiaceum	3-colporate Prolate Spheroidal	± 21.0 x 16.5	20.0	2.5		2.0	0.5		Striato-reticulate
A. thomsonii	3-colporate Spheroidal	± 18.0 x 14.0	14.0	1.8		2.0	0.5		Straito-reticulate.

On the other hand, wide differences in their sixes, structure of the ora, reticulate ornamentation in *A.acumnatum*, spheroidal grains in *A,acuminatum an A,thomsonii* are not only helpful in the recognition, but can also be used in phylogeneic analysis,

PLATE 3.1. POLLEN GRAINS OF DIFFERENT SPECIES OF *Acer* L. OF THE DARJILING-SIKKIM HIMALAYA



a. *Acer acuminatum* ; **b**. *Acer caudatum* ; **c & d.** *Acer campbellii* ; **e.** *A.hookeri*
f, g & h . *Acer laevigatum,* **i.** *Acer oblongum* **j.& k**. *Acer osmastonii* **l**. *Acer palmatum*
m & n. *Acer pectinatum* **o.& p.** *Acer sikkiminese* **q, r, s**. *Acer stachyophyllum*
t. *Acer sterculiaceum* **u**. *Acer thomsonii*