4. The Vegetation of Surat and environs

The area covered is mainly Surat city and its outskirts, including the neighbouring coastal regions of the Chorasi taluka. The natural vegetation is seen along the banks of river Tapi and Mindhola. The estuarine tracts, adjoining the coastal-line, support strand vegetation. There are a number of ponds, puddles, roadside ditches, etc. which exhibit aquatic vegetation. The river banks show typical zonations of vegetation on elevated banks. The herbaceous forms are found more or less throughout the area, however, within the city area they have been confined to some extent during monsoon period in well guarded private and public premises of the city. Otherwise most of the land in and around city is either brought under the cultivation or used for the construction of roads, houses etc. The natural vegetation is disturbed by such human activities.

The vegetation shows the seasonal variations. During the dry months of summer, one can find dried remnants of plants or stunted forms of drought resisting species. The soil is devoid of any ground cover, but a marked change is induced by the monsoon. The entire area becomes verdant and covered by a vivid green carpet composed of different grasses and herbaceous forms. The dried hedges, along with climbers and twiners, resume their growths and vegetation again attains a luxuriant monsoon aspect.

Due to permanent irrigation system by the net-work of canals, the weed flora attains a position of prime importance.

A number of Kharif and Rabi weeds are recorded along with different crop plants.

The perennial trees and shrubs form a permanent vegetation. They grow on the upper belt of the river Tapi, planted in gardens, along roadsides and in the hedges or boundaries of fields but they never form a natural vegetation.

To facilitate the systematic floristic study, the vegetation of Surat and environs is divided into following groups :

1. The Coastal vegetation,
2. The Riparian vegetation,
3. The Aquatic vegetation,
4. The Ruderal vegetation,
5. The Vegetation along the roadsides and hedges,
6. The Wall flora,
7. Weed flora of cultivated fields,
8. The Cultural plant communities,
9. Introduced urban flora,
10. Escapes.

4.1. The Coastal Vegetation

The adjoining coastal areas of Dumas, Bhimpor, Abhava, and Hajira, are occupied by coastal vegetation. Dumas and Hajira are about 18 km and 26 km respectively from Surat, situated on the riverine mouth of Tapi, where the river enters the Arabian sea. They are opposite to each other, isolated by a vast belt of

creek, leaving small deltoid islands between the two. Bhimpor is about 4 km in south-west direction of Dumas. There is a place, in between the two villages, known as Chowpatti, from where creek and Arabian sea are visible. The river Mindhola flows in an east-west direction, passing about 4 km south of Abhava. It terminates near Bhimpor in Arabian sea and separates the districts Surat and Valsad.

The northern banks of Mindhola and the creek are occupied by the coastal vegetation. One can visualise a continuous green belt of vegetation, parallel to river Mindhola, right from southwards of Abhava to Bhimpor (Plates 3 A and B). The coastal fringe of about 5 km in length, and has the maritime strand which runs more or less parallel to the coastline. It has a characteristic scenery dominated by a smooth coastline, estuarine tracts, tidal creeks, silted river mouth with alluvial islands, muddy coast, tidal marshes and sand-dunes, stretching well into the interior.The entire belt lying in between the prevailing high tide limit and the upper limits of the back shore sandy relief. Near the coastline two distinct zones can be recognised. They are (a) submersible and (b) non-submersible.

4.1. (a) Submersible zone : It supports very poor vegetation of few individuals of Scirpus maritimus, Aeluropus lagopoides, and Sporobolus virginicus. They are visible during low ebb.

4.1. (b) Non-submersible zone : It is a maritime region adjoining the coastal line and supports strand vegetation. The

A

B

maritime climate on the coastal biosphere has direct effect on the vegetation and is influenced by tides, wave action, salt spray, saline water and the nature of substratum. Under the influence of all these factors, the strand flora represented by distinct plants of ecological interest. The vegetation of this zone can be categorised into following types :

(1) Open herbaceous zone,

(2) Middle mixed zone, and

(3) Inner wood-land zone.

4.1.(b). 1. Open Herbaceous Zone : It is characterised by dense and gregarious growth of succulent herbs in varying proportions dispersed on a relief lying under constant influence of tidal waters. The pioneer plant is Spinifex littoreus (Plate 4 A), which dominates on a large tract and mixed occasionally with Aeluropus lagopoides and Urochondra setulosa. Further interior, towards the landward fringe, the soil is somewhat hard and more or less sandy-saline. The vegetal cover is replaced by a few salt tolerant species. Arthrocnemum indicum occupies saline mud flats (Plate 4 B) while Suaeda fruticosa and S. nudiflora (Plates 5 A - B) growing on hard saline soils, bordering the herbaceous and middle mixed zones. The other important plants are Salicornia brachiata, Sesuvium portulacastrum and Perotis indica.

The distribution pattern of various taxa on coastal region of Hajira, is somewhat different. The absence of Spinifex

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B

A

B

littoreus and Arthrocnemum indicum is noticeable. They are replaced by the gregarious growth of Sesuvium portulacastrum and often interrupted by a few individuals of Avicennia alba (Plates 6 A - B). On the drier soils, one can visualise, the patchy growth of Suaeda fruticosa and S. nudiflora along with few individuals of Aeluropus lagopoides. The overall vegetation is scanty as compared to that of Abhava-Bhimpor tract.

4.1.(b). 2. Middle Mixed Zone : The distribution pattern of this zone can be sorted out under two types : (i) plants showing complete fedelity to salinity and (ii) plants under the maritime influence but spread from strand to inland.

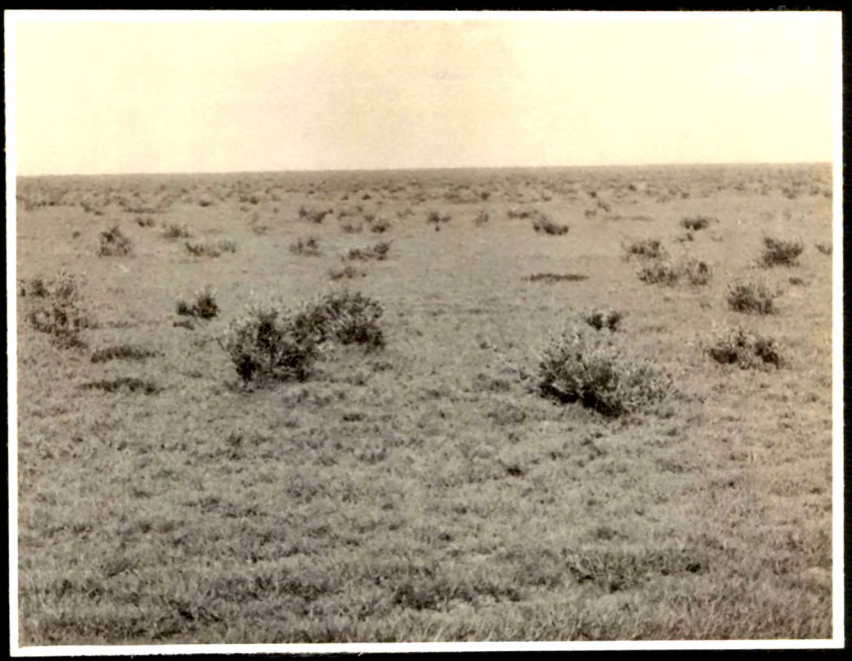
Under the first category, one can find strand shrubs and undershrubs. Towards the sea-side, the soil is more saline and muddy due to continuous action of tide waves. It is often flooded during high-tides but when the water recedes, the loose soil particles are eroded, leaving the small gullies. During the high-tide, they fill with tidal waters and cut their banks. Some of the gullies are connected with sea and they form small islets. This is the ideal situation for the growth of bushy mangroves like Acanthus ilicifolius (Plates 7 A - B). As the estuarine water is available in plenty, Sesuvium portulacastrum and Spinifex littoreus gradually migrate with their diffusely spreading branches. In the interior sheltered muddy areas, Avicennia alba dominates (Plates 8 A - B) along with Acanthus ilicifolius and their thicket forming feature is seldom observed.

A

B

A

B



A

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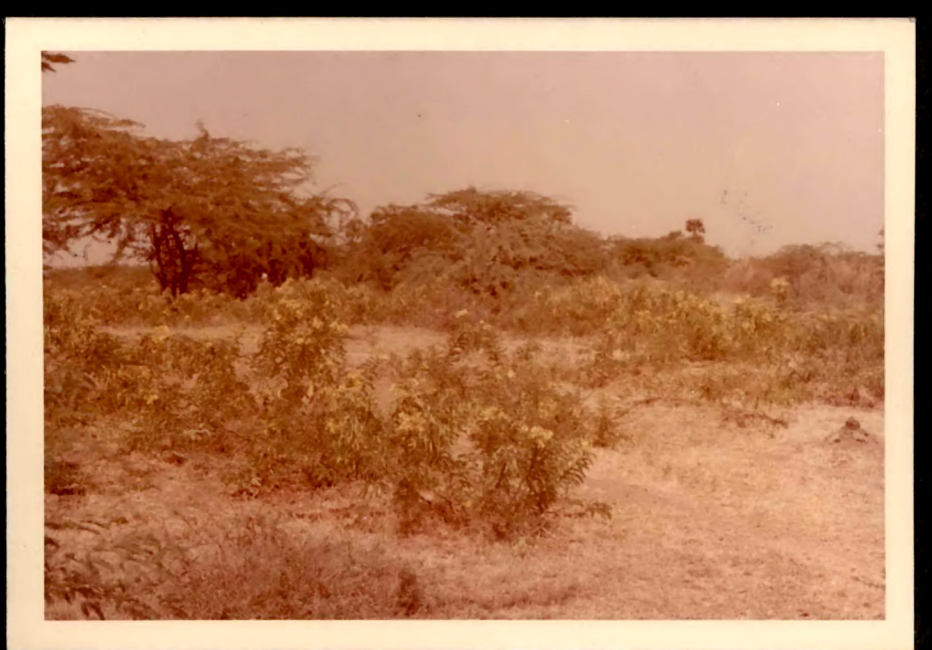
At a time stunted forms of Salvadora persica and Prosopis chilensis are visible. Along the sea-coast of Hajira, Acanthus ilicifolius being totally absent and Avicennia alba does not form a continuous belt. During summer, the hard substrate of soils support a characteristic vegetation of their own. The plants like Alhagi pseudalhagi, Cressa cretica, Eragrostis ciliaris and Alternanthera sessilis are observed on dried soils. Blumea obliqua and Opuntia elatior are seldom observed gregariously (Plate 9).

Under the second category, the sandy coastal strip is composed of the herbaceous forms like Cyperus arenarius, Cyperus difformis, Euphorbia microphylla, Euphorbia hirta and Cressa cretica. They thrive on the soil where little moisture is available. They are not true halophytes or psammophytes but they are the inland plants adapted to xeric conditions. They are always under the influence of shore-winds and thus they show xeric features. They help in binding sand-particles to some extent. To check wind velocity and blowing sand particles, the State Forest Department has introduced plant like Ipomoea pes-caprae (Plate 10 A) along the sea-coast of Hajira. They cover large areas and stabilize the sand particles. The salt tolerant, fast growing species of Casuarina equisetifolia and Prosopis chilensis, show their luxuriant growth and entire belt looks like a thick forest. Other plants noted here are Polycarpaea corymbosa, Borreria pusilla, Evolvulus alsinoides, Launaea procumbens, Heliotropium marifolium, Boerhavia diffusa, Indigofera cordifolia and Indigofera linnaei.

A

B

A



B

4.1. (b). 3. Inner Woodland Zone : It is man-made zone, where most of the perennial species are planted in hedges, along the boundary of fields or around residential premises. The woodland zone of Bhimpor and Dumas is more thick and composed of a variety of tree species than that of Hajira. Some notable trees are Ailanthus excelsa, Albizia lebbeck, Derries indica, Sapindus emarginatus, Thespesia populnea and Ficus benghalensis. Near human habitation one can find Moringa oleifera, Ficus religiosa, Delonix elata and Azadirachta indica. Along the boundary of fields Annona squamosa and Maytenus emarginata are invariably seen along with Prosopis chilensis, Salvadora persica. Occasionally Cassia auriculata, Prosopis chilensis and Acacia nilotica ssp. indica occupy the large tract in between the shore land and arable land. (Plate 10 B). A noticeable community of Acacia nilotica ssp. indica near Hajira is more attractive even during hot summer months (Plate 11 A). Another community of tall Borassus flabellifer is significant among the coastal woodland zone, occupies very large tract and frequently shows strangling growth of Ficus amplissima (Plate 11 B).

There are number of fruit orchards at Dumas, Bhimpor and Hajira. A variety of fruit trees is being planted in the premises of bunglows, sanatoria and in fields. The thick green canopy of these plants interrupted with the luxuriant growth of tall Cocos nucifera enhances the beauty of these holiday resorts and make them pleasant to the eyes.

A

B

4.2. The Riparian Vegetation

The vegetation along the banks of the river Tapi has been studied along with the seasonal changes. The river Tapi flows through the area in an east-west direction in a zig-zag fashion and terminates into the Arabian sea. The vegetation along the banks of the river Tapi has seasonal and permanent aspect in addition to an ephemeral aspect.

The lowlying riverine tracts get flooded during monsoon. The ephemeral vegetation is totally destroyed by the rising water level. Occasionally, however, the floods are very severe, accompanied by heavy rain, being strong enough to blow down large tree (Plate 12). After the monsoon, the water level goes down, exposing the banks throughout. In the month of October, the banks are muddy, showing a sparse vegetation, but during November to April, ephemeral and the permanent vegetation of the banks could be studied simultaneously. During these months one can find three belts of vegetation, parallel to the river. These are

(1) the lower-most belt,

(2) the middle belt, and

(3) the upper-most belt.

4.2.1 The Lower-Most Belt : It comprises the area between the water current and the base of sloping banks. The width of this belt differs from place to place. The vast river bed can be seen at Variav, Ved, Singanpor and opposite to Rander. The vegetation can be studied under two different aspects (a) Post-monsoon flora

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B

and (b) the Summer flora.

4.2.1 (a) The Post-monsoon Flora : The vegetation of the lower-most storey is ephemeral in the sense that it is totally destroyed by the rising water level during the monsoon. The river is usually in spate and the banks are flooded. Only in the month of October, when the water level goes down, exposing the banks throughout, a sparse vegetation in the form of seedlings can be noted. As the months advanced, one can find the plants like Bacopa monnieri, Caesulia axillaris, Eclipta alba and Phyla nodiflora. The river bed near Singanpor and Ved, is being dug for the sand which is used for construction purposes. The small ditches are left in the river beds. They contain shallow water and more moisture. They support the growth of Ammannia baccifera, Ammannia solicifolia, Bergia ammannioides, Dentella repens, Glinus oppositifolius, Grangea maderaspatana, Cyperus exaltatus, Fimbristylis dichotoma and Lindernia crustacea. Some rare plants recorded from this area are Bistella dicyna, Sutera dissecta, Torenia cordifolia and Veronica anagallis-aquatica.

At some places, during pre-summer, the following associations can be recognised :

(i) Polygonum association : which comprises mainly Polygonum glabrum and Polygonum barbatum var. gracile along with few individuals of Cyperus exaltatus, Fimbristylis dichotoma and Bacopa monnieri (Plates 13 A - B). It is comparatively short zone extended to few meters. (ii) Blumea lacera and Sphaeranthus indicus association;in addition to some scattered plants like Argemone mexicana (Plate 14), Alternanthera paronychioides,

A

B

Amaranthus spinosus and Solanum surattense occupy a huge tract from Fulpada to Ashwanikumar and often extends upto the railway bridge. Gradually it merges into more xerophytic species towards the eastern direction.

The rare sedges, Lipocarpha chinensis and Rhynchospora glauca were collected from the muddy wet soils of river bed near Variav.

4.2.1.(b) The Summer Flora : As the water in the river decreases on the advent of dry months after the winter, mud flats are left exposed, which support the vegetation consisting the plants like Ageratum conyzoides, Alternanthera sessilis, Cenchrus ciliaris, Cyathocline purpurea, Digitaria adscendens, Eragrostis viscosa, Erigeron asteroides and Gnaphalium indicum. Some rare plants noted during summer months are Mollugo cerviana, Rumex dentatus and Spilanthes paniculata.

4.2.2. The Middle Belt : It corresponds to the sloping banks of river and covers a width of few meters. Under the central Government Flood Control Scheme, the huge embankments are constructed to prevent the entry of flood waters and erosion. These embankments have affected the natural vegetation but some areas still remain exposed, where pattern of vegetation can be studied under the following aspects.

4.2.2.(a) The Monsoon and Post-monsoon Flora : With a few heavy showers in the month of July, the herbaceous species come in to their own. As the rains commence, the middle belt is gradually

covered with green vegetation by the seedlings of different plants. Although, at the time of high flood, the part of vegetation is completely submerged by the raging waters. During the monsoon, there is fluctuation in the water level and the plants present these are subjected to periodic flooding. Except the monsoon months, most of the time the tract is left exposed. The vegetation attains both in its luxuriance and diversity between September and December. During this tenure, the middle-belt is covered by Post-monsoon plants like Bidens biternata, Blainvillea acmella, Indigofera linifolia, Sida acuta, Tephrosia senticosa and Setaria verticillata. The shady wet places are occupied by Canscora diffusa, Cyathocline purpurea, Grangea maderaspatana, Indigofera cordifolia, Leucas urticaefolia and Salvia plebeia. The drier slopes have been occupied by the scattered plants like Acanthospermum hispidum, Achyranthes aspera var. porphyristachya, Triumfetta pentandra and Xanthium strumarium.

Some rare taxa have been reported from this belt are Canscora concanensis, Cleome simplicifolia, Flaveria trinervia, Leucas biflora and Hackelochloa granularis.

4.2.2.(b) The Summer Flora : In between March and first week of June, most of the herbaceous plants disappear but moist and shady places support the plants like Canscora diffusa, Cyathocline purpurea, Exacum bicolor and Leucas longifolia. The drought resistant species make their way and flourish as the summer advances. They are Amaranthus spinosus, Argemone mexicana, Blepharis maderaspatensis, Oligochaeta ramosa and Xanthium

strumarium. At Singanpor and Dabholi the large sandy river bed gradually elevated without forming an elevated slope. At this junction Sida cordifolia along with few individuals of Datura inoxia and Solanum surattense were noted (Plate 15 A). The dry sandy river bed towards western side of Singanpor, the patchy growth of Calotropis procera is seen which acted as a sand-stabilizer (Plate 15 B).

4.2.3. The Upper-Most Belt : It is occupied by the ephemeral and permanent types of vegetation.

4.2.3.(a) Ephemeral Vegetation : It is composed of herbaceous plants which appear during monsoon, persist upto the beginning of summer and then gradually vanish. The vegetation is edaphically controlled and the water current has no effect on it whatsoever as it is beyond the reach of water except in the years of excessive rainfall. The important components of ephemeral vegetation are Alysicarpus vaginalis, Alysicarpus longifolius, Cassia tora, Cassia occidentalis, Corchorus olitorius, Sida acuta, Sida alba, Triumfetta pentandra. The important grasses noted on the wet banks are Cenchrus pennisetiformis, Eragrostis ciliaris, Iseilema laxum and Themeda quadrivalvis.

4.2.3. (b) Permanent Vegetation : The permanent vegetation of the elevated banks is dominated by trees like Azadirachta indica, Acacia nilotica ssp. indica, Cordia dichotoma, Derris indica, Ficus hispida, Limonia acidissima, Prosopis cineraria, Salvadora

A

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persica, Tamarindus indica, Thespesia populnea and Zizyphus mauritiana. Moringa concanensis and Moringa oleifera are extensively planted near habitation for their edible fruits.

The huge tract near Variav is occupied by the most popular palms of this area - Borassus flabellifer and Phoenix sylvestris (Plates 16 A - B). They have been planted for 'toddy' and 'nira'.

Some shrubs and low trees noted from this belt are Annona squamosa, Aegle marmelos, Clerodendrum phlomidis, Balanites aegyptiaca, Lantana camara var. aculeata and Tamarix troupii.

A few plants such as Clerodendrum phlomidis, Kirganelia reticulata, Salvadora persica and Woodfordia fruticosa were found growing lithophytically in the crevices of the walls of the temples near Ashwanikumar.

4.3. The Aquatic Vegetation

The aquatic plants are the denizens of ponds, puddles, ditches and other lowlying areas which exhibit fluctuations in water level. These fluctuations determine the succession of vegetation occupying the sloping banks, water fringes and also water surface. However, the floristic composition of the aquatic vegetation is subject to change due to various biotic and edaphic factors.

There are numerous such habitats in and around Surat. The area has no natural lake but is well supplied with reservoirs in

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B

the form of ponds, puddles and tanks. Almost every village has a small pond. Most of the area has a net-work of canals. The ditches and puddles along the sides of canals remain water-logged and support number of aquatic forms. Even the coastal regions of Dumas, Bhimpor and Hajira where the main canals terminate into the permanent reservoirs, exhibit a wide variety of aquatic flora. Most of the roadside ditches and ponds hold water during rains and show the seasonal changes in the floristic composition as the summer advances. Some of the ponds, due to excessive biotic interference, do not support any vegetation but show the wetland species occupying the banks. The aquatic habitats which have comparatively less of biotic interference show interesting zonation of vegetation.

For the study of aquatic communities, the following ponds have been investigated. The number given in the bracket indicates the number of ponds included in each area : Bhimpor (2), Dumas (3), Piplod (1), Althan (1), Abhava (1), Katargam (2), Ved (1), Rander (2), Variav (1), Adajan (2), Bhatha (1), Ichhapor (1), Bhestan (1), Hajira (2). The Gopi talav of Surat does not support good aquatic vegetation.

The aquatic habitats so far studied are grouped into the following communities :

4.3.1. Free floating communities :

(a) Plankton : Abundantly found in steady or slowly flowing waters. Eg.

(b) Higher plants : Occur in still waters of ponds,

puddles or ditches. These are Lemna gibba, Spirodela polyrhiza, Ceratophyllum demersum and Utricularia stellaris.

4.3.2. Submerged rooted communities : They occur in fairly deep or sometimes in shallow waters, on soft, muddy substrata. Common plant species observed are Hydrilla verticillata, Najas minor, Nechamandra alternifolia, Ottelia alismoides, Potamogeton pectinatus, Potamogeton perfoliatus, Vallisneria spiralis. Species of Chara and Nitella are fairly common. Some of these plants can also be seen in small ditches along the roadsides.

4.3.3. Submerged and rooted communities with floating leaves (Plate 17 A)

They are usually found in shallow waters. During post-monsoon period Nymphaea nouchali and Nymphaea pubescens are associated with Eichhornia crassipes but as the water goes down, Nymphaea is replaced by Eichhornia, which is so aggressive that within a few days they cover most of the water surface (Plate 17 B). It has become a nuisance in the ditches within the limits of the city. The Municipal Corporation has a hard time to remove from the water bodies very frequently. Nelumbo nucifera and Trapa natans var. bispinosa are cultivated at Dumas, Bhimpor and Katargam (Plate 18 A). Other important plants are Aponogeton natans, Nymphoides cristatum, Nymphoides indicum, Limnophyton obtusifolium, Sagittaria sagittifolia, Pistia stratiotes, Potamogeton nodosus and Ipomoea aquatica. Marsilea

A

B

A

B

quadrifolia and Marsilea minuta are also found in shallow waters near margins.

4.3.4. Marsh communities :

These plants are always rooted in water or water-logged soils. They occupy the fringes of ponds, puddles and are commonly known as amphibious hydrophytes. Some important plants are Typha angustata (Plate 18 B), Scirpus articulatus, Coix lacryma-jobi, Hygrophila auriculata, Ammannia baccifera, Eleocharis atropurpurea and Fimbristylis dichotoma. At Rander and Dumas, the ditches along the sides of canals, remain filled with the discharged waters of canals, and support the growth of ground orchid Zeuxine strateumatica. The damp water-logged soils of canals in and around Udhana are occupied by the important plants like Ludwigia perennis, Ludwigia octovalvis and Bergia ammannioides.

The various aquatic communities listed above are present on the surface of water or near the banks especially when the ponds are flooded. When the water level recedes, the wet banks are exposed which then exhibit plants like Bacopa monnieri, Cassia mimosoides, Dentella repens, Eclipta prostrata, Glinus oppositifolius, Neptunia triquetra, Phyla nodiflora and Echinochloa colonum.

Some aquatics are cultivated in the artificial ponds in the Science College for ornamentation and study purposes. They

are Cyperus alternifolius, Equisetum debile, species of Salvinia sp. and Azolla sp.

The following table indicates the relative range of distribution of aquatic species. On close study of the table it could be concluded that the aquatic plants are at their best at Dumas, Ichhapor, Ved and Udhana in quality and quantity as compared to the rest of the areas.

4.3.5. Distribution of the aquatic plants in and around Surat.

Sr. No.	Species	I	II	III	IV	V	VI
1.	Aeschynomene indica L.	O	C	F	O	C	F
2.	Alternanthera sessilis DC.	O	O	O	C	F	C
3.	Ammannia baccifera L.	C	C	F	C	F	C
4.	Ammannia multiflora Roxb.	O	O	-	R	R	R
5.	Ammannia salicifolia Monti.	R	-	-	-	-	R
6.	Aponogeton natans (L.) Engl.	-	F	-	-	-	F
7.	Bacopa monnieri (L.) Wettsl.	C	F	C	F	F	F
8.	Bergia ammannioides Roxb.ex R.	F	F	-	-	R	C
9.	Caesulia axillaris Roxb.	F	O	F	F	F	F
10.	Ceratophyllum demersum L.	O	F	F	O	R	F
11.	Coix lacryma-jobi L.	F	O	F	R	F	F
12.	Cyperus difformis L.	O	F	O	O	R	F
13.	Cyperus exaltatus Retz.	-	O	F	F	O	F
14.	Cyperus laevigatus L.	O	F	F	O	-	F
15.	Dopatrium junceum (Roxb.) Buch.-Ham.	-	-	-	R	-	-
16.	Eclipta alba (L.) Hassk.	O	F	O	F	O	O
17.	Eichhornia crassipes (Mart.) Solms.	A	C	A	O	F	F
18.	Eleocharis atropurpurea Kunth.	-	F	O	F	F	O
19.	Eriocaulon cinereum R. Br.	-	-	-	R	-	-
20.	Fimbristylis dichotoma (L.) var. dichotoma	O	O	F	-	-	O

Sr. No.	Species	I	II	III	IV	V	VI
21.	Fimbristylis ovata (Burm.f.)Kern.	F	-	-	-	-	R
22.	Hydrilla verticillata (L.f.)Royle	F	F	O	F	O	O
23.	Hygrophila auriculata (Sch.)Heine	O	F	C	-	O	F
24.	Ipomoea aquatica Forsk.	O	O	F	F	F	O
25.	Lemna gibba L.	O	F	-	O	F	F
26.	Limnophila indica (L.) Druce	-	-	-	O	R	-
27.	Limnophyton obtusifolium (L.) Miq.	-	R	-	-	R	-
28.	Ludwigia octovalvis (Jacq.)Enum.	-	-	-	O	O	O
29.	Ludwigia perennis L.	F	-	-	R	R	F
30.	Najas minor All.	-	R	-	F	F	F
31.	Nechamandra alternifolia (Roxb.) Thw.	-	R	-	-	-	R
32.	Nelumbo nucifera Gaertn.	-	A	R	R	R	-
33.	Nymphaea nouchali Burm. f.	O	F	F	O	O	F
34.	Nymphaea pubescens Willd.	O	F	O	O	F	F
35.	Nymphoides cristatum (Roxb.) O.K.	-	O	F	-	-	-
36.	Nymphoides indicum (L.) O.K.	-	-	-	O	R	-
37.	Oryza nivara Sharma & Shas.	-	R	-	-	-	F
38.	Ottelia alismoides (L.) Pers.	-	F	F	-	-	-
39.	Phyla nodiflora (L.) Green.	O	F	F	O	O	O
40.	Pistia stratiotes L.	R	-	-	O	-	F
41.	Polygonum barbatum L. var.gracile	St. O	R	-	-	-	-
42.	Polygonum glabrum Willd.	F	O	O	-	-	O
43.	Potamogeton nodosus Poir.	-	O	R	-	-	-
44.	Potamogeton pectinatus L.	-	R	R	-	-	-
45.	Potamogeton perfoliatus L.	-	-	-	-	O	-

4

Sr. No.	Species	I	II	III	IV	V	VI
46.	Rotala serpyllifolia (Roth)Bremek.	O	-	-	-	R	-
47.	Rumex dentatus L.	-	-	-	O	-	-
48.	Sagittaria sagittifolia L.	-	O	-	O	-	-
49.	Scirpus affinis Roth.	F	F	R	-	-	O
50.	Scirpus articulatus L.	O	F	F	-	O	-
51.	Scirpus littoralis auct. var. subulatus (Vahl) Chi.	-	O	F	-	O	F
52.	Spirodela polyrhiza (L.) Schl.	R	R	-	-	R	-
53.	Trapa natans L. var. bispinosa (Roxb.) Makino	R	F	-	-	-	-
54.	Typha angustata Bory & Chaub.	F	A	C	A	C	C
55.	Utricularia stellaris L. f.	-	-	R	-	-	-
56.	Vallisneria spiralis L.	F	F	O	O	F	F
57.	Veronica anagalis-aquatica L.	-	-	R	-	-	-
58.	Zeuxine strateumatica (L.)Schltr.	-	O	-	O	-	-

Localities symbolised :

I = City area - including Nana Varachha, Ashwanikumar, Piplod.

II = Dumas, Bhimpor, Magdalla and Abhava.

III = Adajan, Ichhapor, Bhatha and Hajira.

IV = Rander, Variav.

V = Ved, Katargam,

VI = Udhana, Bhestan, Althan etc.

Explaination of abbreviations :

- = absent, R = Rare, F = Frequent, O = Occasional,

C = Common, A = Abundant.

4.3.6. Key to the Aquatic Plants :

Plants free floating ..... Key I

Plants submerged and rooted ..... Key II

Plants submerged, rooted with floating leaves and flowers ..... Key III

Plants growing on marshy soils ..... Key IV

Key I

1. Plants thalloid :

   2. Thalloid with single root .....*Lemna gibba*

   2. Thalloid with several roots .....*Spirodela polyrhiza*

1. Plants not thalloid :

   3. Plants always with bladders .....*Utricularia stellaris*

   3. Plants without bladders .....*Ceratophyllum demersum*

Key II

1. Leaves entire :

   2. Leaves radical :

      3. Leaves broadly ovate-oblong or sub-orbicular and petiolate.....*Ottelia alismoides*

      3. Leaves linear, sessile .....*Vallisneria spiralis*

   2. Leaves cauline :

4. Leaves whorled .....*Hydrilla verticillata*

4. Leaves not whorled :

5. Leaves ovate.....*Potamogeton perfoliatus*

5. Leaves elliptic-lanceolate.*Potamogeton nodosus*

1. Leaves filiform, not entire :

6. Stems dichotomously branched.....*Najas minor*

6. Stems not as above :

7. Flowers solitary .....*Nechamandra alternifolia*

7. Flowers in spike .....*Potamogeton pectinatus*

Key III

1. Flowers large, more than 5 cm. in diam., Perianth lobes many :

2. Leaves floating :

3. Leaves glabrous on both the surfaces .....*Nymphaea nouchali*

3. Leaves pubescent on the lower surface .....*Nymphaea pubescens*

2. Leaves raised above the water surface .....*Nelumbo nucifera*

1. Flowers small, less than 3 cm. in diam., Perianth lobes definite :

4. Petioles swollen :

5. Leaves dimorphic (submerged leaves filiform and segmented).....*Trapa natans* var. *bispinosa*

5. Leaves broadly ovate, rhomboid, but not dimorphic .....*Eichhornia crassipes*

4. Petioles not swollen :

6. Leaves elliptic or ovate, deeply cordate :

7. Corolla lobes entire .....*Nymphoides cristatum*

7. Corolla lobes fimbriate.....*Nymphoides indicum*

6. Leaves not as above :

8. Plants with heterophyllous leaves .....*Limnophila indica*

8. Plants with uniform leaves :

9. Flowers large, corolla funnel-shaped .....*Ipomoea aquatica*

9. Flowers smaller than above; corolla not funnel-shaped :

10. Leaves sessile, rosette..*Pistia stratiotes*

10. Leaves petiolate, not rosette :

11. Leaves sagittate :

12. Carpels crowded on a minute receptacle,

achenes swollen .....*Limnophyton obtusifolium*

12. Carpels inserted on a large globular or oblong receptacle, achenes compressed .....*Sagittaria sagittifolia*

11. Leaves not sagittate .....*Aponogeton natans*

Key IV

1. Flowers in heads or head-like spikes :

2. Flowers in heads :

3. Leaves linear, grass-like..*Eriocaulon cinereum*

3. Leaves not as above :

4. Heads axillary, sessile..*Caesulia axillaris*

4. Heads pedunculate .....*Eclipta alba*

2. Flowers in head-like spikes :

5. Leaves obovate, coarsely serrate toward apex .....*Phyla nodiflora*

5. Leaves lanceolate or linear oblong not serrate .....*Alternanthera sessilis*

1. Flowers other than heads or head-like spikes :

6. Perianth of 2 whorls :

7. Flowers regular :

8. Ovary superior :

9. Flowers in axillary, solitary or fascicled cymes :

10. Erect herbs :

11. Leaves sharply serrulate, capsule septicidal .....*Bergia ammannioides*

11. Leaves entire, capsule circumscissile :

12. Calyx striate with 8 vertical lines .....*Ammannia multiflora*

12. Calyx not striate with vertical lines :

13. Leaves rounded or cordate at base...*Ammannia salicifolia*

13. Leaves narrowed at the base .....*Ammannia baccifera*

10. Prostrate or sub-erect herb...*Bacopa monnieri*

9. Flowers in dense terminal spikes..*Rotala serpyllifolia*

8. Ovary inferior :

14. Capsule glabrous, ribbed .....*Ludwigia octovalvis*

14. Capsule hairy, not ribbed .....*Ludwigia perennis*

7. Flowers irregular :

15. Plants spiny .....*Hygrophila auriculata*

15. Plants not spiny :

16. Ovary superior :

17. Flowers in lax slender racemes .....*Veronica anagallis-aquatica*

17. Flowers not as above :

18. Corolla papilionaceous, leaves compound .....*Aeschynomene indica*

18. Corolla bilabiate; leaves simple .....*Dopatrium junceum*

16. Ovary inferior .....*Zeuxine strateumatica*

6. Perianth of 1 whorl or none or rudimentary or of scales or bristles :

19. Perianth of 1 whorl :

20. Flowers in axillary clusters..*Rumex dentatus*

20. Flowers in spiciform racemes :

21. Stipules ciliate on the margins .....*Polygonum barbatum* var. *gracile*

21. Stipules glabrous .....*Polygonum glabrum*

19. Perianth rudimentary or of scales or bristles or none :

22. Flowers in dense terminal cylindrical spikes .....*Typha angustata*

22. Flowers not as above :

23. Leaves without ligules; fruits trigonous nuts :

    24. Glumes distichously arranged :

        25. Spikelets in heads :

            26. Stigmas 2 ..... *Cyperus laevigatus*

            26. Stigmas 3 ..... *Cyperus difformis*

        25. Spikelets in umbels ..... *Cyperus exaltatus*

    24. Glumes spirally arranged :

        27. Hypogynous bristles absent :

            28. Spikelet solitary ..... *Fimbristylis ovata*

            28. Spikelets many :

                29. Spikelets terminal umbellate ..... *Fimbristylis dichotoma*

                29. Spikelets in the lower half; in clusters ... *Scirpus articulatus*

        27. Hypogynous bristles present :

            30. Inflorescence terminal umbels :

                31. Bristles more or less scabrid ..... *Scirpus affinis*

                31. Bristles plumose..... *Scirpus littoralis* var. *subulatus*

30. Inflorescence always solitary..Eleocharis atropurpurea

23. Leaves with ligules, fruits caryopsis :

32. Fruit case spherical bead-like.Coix lacryma-jobi

32. Fruit case compressed chaffy...Oryza nivara

4.4. The Ruderal Vegetation

A characteristic type of vegetation seen in places which are subjected to change from time to time and always under the influence of biotic factors - is referred to as ruderal vegetation. The ruderal flora occurs in open places or waste areas along roadsides, railway tracks, waste places around habitation, old garden sites, fallow fields and waste dumps.

4.4.1. Roadside weeds : Along roadsides a number of weeds are found. The most common weeds are Amaranthus spinosus, Solanum surattense and Xanthium strumarium. Near human habitation, one can find Cassia tora and Cassia occidentalis in patches along with scattered individuals of Vernonia cinerea, Acalypha ciliata, Peristrophe bicalyculata and Ocimum canum. At Dumas, Bhimpor and Hajira the roadside weeds include Pedalium murex, Achyranthes aspera var. porphyristachya, Tephrosia hamiltonii and Crotalaria medicaginea. Aristolochia bracteolata and Tribulus terrestris are occasionally seen along the road leading to Magdalla port. Sarcostemma secamone twines upon the spiny plants of Prosopis

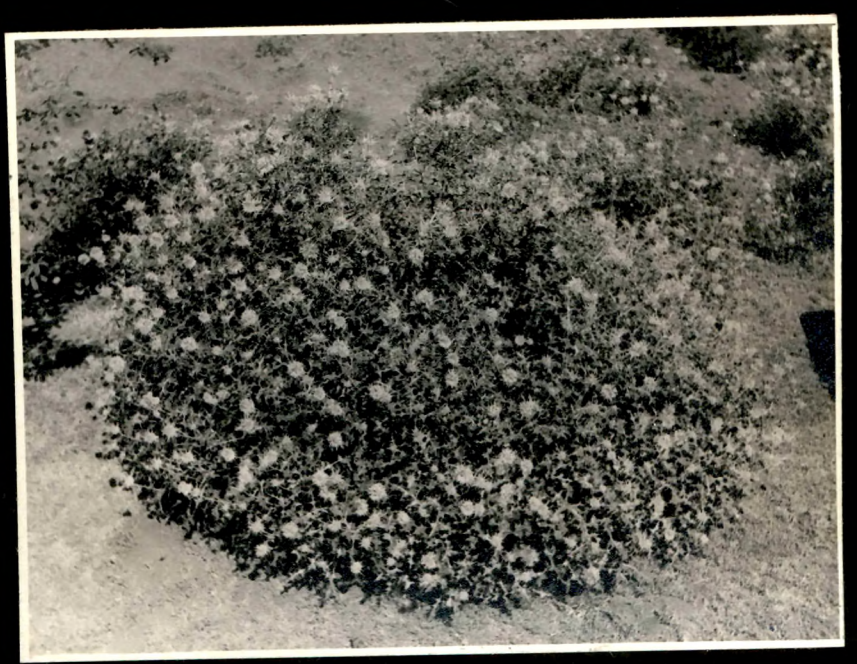
chilensis and Mimosa hamata. Along the roadsides of Surat-Ved and Surat-Katargam, noteworthy weeds are Croton bonplandianum and Rauvolfia tetraphylla, frequently found with Triumfetta pentandra and Martynia annua. Along Surat-Althan and Udhana-Magdalla road Malachra capitata and Psoralea corylifolia were seen on the wet soils. Acacia farnesiana is confined to this area. Near Hajira, the road is elevated from the surrounding plain. The slope and the areas slightly away from the actual road are occupied by the scattered individuals of Cassia auriculata (Plate 19 A). During summer Echinops echinatus (Plate 19 B) is the main occupant along with Argemone mexicana, Solanum surattense, Chrozophora rottleri and Sphaeranthus indicus.

4.4.2. Plants along the Railway-track : The railway track between Surat and Bhestan is rich in vegetation as compared to northern track. On set of monsoon, the barren rail track gradually greening up and between August and December, it supports a fairly good vegetation. This luxuriance of vegetation is probably due to the near absence of biotic interferences and the protection, that is provided to the rail tracks.

The ephemeral, prostrate or sub-erect herbaceous taxa growing along the sides of rails through the gravel pieces and in between the rails are Goniogyna hirta, Indigofera cordifolia, Zornia gibbosa, Corchorus aestuans, Borreria articularis, Cassia pumila, Portulaca oleracea and Hybanthus enneaspermus.

A slope of railway track is occupied by Anisomeles indica, Hibiscus vitifolius, Alysicarpus longifolius, Crotalaria albida

A



B

and Indigofera glandulosa. At some places Xanthium strumarium covered the entire slope along with stunted forms of Ficus hispida.(Plate 20). Some of the grasses are Chionachne koenigii, Cymbopogon martinii, Chloris virgata and Desmostachya bipinnata. Few stunted perennial shrubs are often seen on the slope. To mention a few of them, they are Balanites aegyptiaca, Maytenus emarginata, Zizyphus nummularia, Kirganelia reticulata, Mimosa hamata, Calotropis procera and Securinega virosa.

A fallow land parallel to railway track has crooked or mutilated forms of many trees which are due to indiscriminate cutting of plants by hut-dwellers for fuel. A few of them are Salvadora persica, Adansonia digitata, Azadirachta indica, Ailanthus excelsa, Cordia dichotoma and Limonia acidissima.

Some noteworthy plants observed in this area are Lagascea mollis, Hyptis suaveolens, Orthosiphon pallidus, Operculina turpethum, Taverniera cuneifolia, Tephrosia jamnagarensis, Indigofera astragallina, Tephrosia hirta, Smithia conferta, Atylosia scarabaeoides and Tragia cannabina.

4.4.3. Plants on waste dumps : There are number of small nullahs and Khadis, located in and around Surat. Municipal Corporation has started a massive programme to close all the nullahs and Khadis by the dumping of solid waste along with soil. Such newly formed soil supports a very poor vegetation. Some common plants are Boerhavia diffusa, Citrullus colocynthis, Centella asiatica, Eclipta alba [illegible], Trianthema portulacastrum,

Tridax procumbens and Vigna trilobata represent the pioneer stage, then followed by sparsely scattered plants like Martynia annua, Amaranthus spinosus, Alternanthera paronychioides, Datura metel, Solanum surattense and Calotropis procera.

4.4.4. Plants on playgrounds : The playgrounds are constantly used for variety of games. On such playgrounds, prostrate plants like Evolvulus alsinoides, Tephrosia senticosa, Indigofera cordifolia, Indigofera linnaei are of common occurrence. Cyperus compressus, Cynodon dactylon and Echinochloa colonum are the main sedges and grasses, seen on the playgrounds.

4.4.5. Weeds of Gardens : Beside number of cultivated plants, gardens support the growth of some weeds. On moist soils, the occurrence of different taxa like Portulaca quadrifida, Alysicarpus vaginalis, Trianthema portulacastrum, Lindernia crustacea are noted. During the monsoon Striga densiflora, Ammannia baccifera, Glinus lotoides, Phyla nodiflora and Commelina diffusa make their growth with some garden escapes like Zephyranthes rosea, Tagetes patula and Zinnia elegans. The occurrence of Parthenium hysterophorus from the corner of the Nehru Garden - as a garden weed is interesting.

4.5. The Vegetation along the roadsides and hedges :

The growth of population along with industrialization is a common phenomenon of Surat like other cities of Gujarat. Most of the land in and around city has been brought under the

construction of houses, roads, factories etc. Therefore, the arable land used for cultivation of crops, has been reduced. As a result, natural vegetation is confined outside the city in the form of roadside trees and hedges.

4.5.1. Roadside trees : The connecting roads of Surat with different villages, support a number of trees, both wild and cultivated. The common wayside - avenue trees are Albizia lebbeck, Azadirachta indica, Derris pinnata, Caesalpinia pulcherrima, Polyalthia longifolia, Ficus benghalensis and Tamarindus indica. The Municipal Corporation has recently introduced the plantation of Sesbania grandiflora, Spathodea campanulata, Erythrina variegata var. orientalis and Kigelia pinnata as roadside trees. The state Forest Department has planted Eucalyptus sp., Casuarina equisetifolia, Dalbergia sissoo, Acacia auriculiformis and Prosopis chilensis - along the roads connecting to Udhana-Magdalla, Surat-Dumas and Surat-Hajira. One can find the luxiriant growth of Prosopis chilensis along the road connecting Surat and Hajira (Plate 21 A). The huge belt occupied by Phoenix sylvestris, along the roadsides connecting Surat-Adajan and Rander, making room for housing settlements (Plate 21 B). Some plants are frequently found within the city limits. They are Morinda tomentosa, Guazuma ulmifolia, Melia azedarach, Ailanthus excelsa, Adansonia digitata, Salmalia malabarica, Mitragyna parvifolia, Holoptelea integrifolia and Millingtonia hortensis.

A

B

4.5.2. Roadside hedges : The hedges are planted either for the protection of fields or for demarcating the boundaries of fields or residential areas. A number of perennial shrubs or even small trees have been used for this purpose and one can find a net-work of hedges near human habitation, while the fields away from population or around the fields in which paddy is cultivated, exhibit poor hedge flora. The commonest components of hedges are Euphorbia neriifolia, Euphorbia tirucalli, Lawsonia inermis, Clerodendrum inerme and Caesalpinia crista. Pedilanthus tithymaloides can be also used as a hedge plant in gardens and in residential premises. The hedge plants of the coastal regions are Prosopis chilensis, Agave americana, Sansevieria zeylanica, Aloe barbadensis and Jatropha curcas. At Rander, Variav and Ichhapor, Ipomoea fistulosa (Plate 22 A) is the most popular hedge plant. Lantana camara var. aculeata, Capparis sepiaria, Zizyphus nummularia and Caesalpinia crista are also planted in hedges. In the city areas, the plants with attractive flowers, can be used for hedging purposes. The common ones are Bougainvillea spectabilis, Clerodendrum inerme, Duranta repens, Casuarina equisetifolia, Adhatoda zeylanica, Lawsonia inermis. Even though some garden plants like Galphinia gracilis, Nerium indicum, Thevetia peruviana, Murraya paniculata have been cultivated for this purpose in many private premises and gardens.

Some notable trees are found growing along hedge plants. They are Prosopis cineraria, Limonia acidissima, Crataeva adansonii ssp. odora, Cordia gharaf and Morinda tomentosa.

A rare tree Diospyros chloroxylon occurs along the hedges near Ichhapor, Delonix elata is planted along with other hedge plants (Plate 22 B).

Sometimes an attractive combination of different hedge plants like Delonix elata, Borassus flabellifer, Azadirachta indica along with shrubby Ipomoea fistulosa can be seen in one of the hedges on the way to Bhatha (Plate 23 A). The important shrubs found in the hedges are Annona squamosa, Maytenus emarginata, Opuntia elatior, Jatropha gossypifolia and Carissa carandas.

The most important components of hedge flora are the climbers, twiners, undershrubs and herbs. They form a close association along with hedge plants. They can be listed as Cissampelos pareira, var. hirsuta, Tinospora cordifolia, Celastrus paniculatus, Cayratia carnosa, Abrus precatorius, Coccinia grandis, Teramnus labialis, Leptadenia reticulata, Antigonon leptopus and Dioscorea bulbifera. The hedge flora of Ved, Singanpor, Dabholi, Dumas and Katargam composed a number of plants, because it has less human disturbance and constant vigilance over the browsing animals. The noteworthy plants of these areas are Dioscorea pentaphylla, Merremia hederacea, Merremia quinquefolia. One can see the beautiful blooming of Derris timoriensis during monsoon period near Nana-Bahucharaji - a place on the way to Ved. The hedges around Udhana, Bhestan and Althan support interesting plants like Ipomoea triloba, Operculina turpethum, Rivea hypocrateriformis, Celastrus

A

B

A

B

49

paniculata, Telosma pallida, Ampelocissus latifolia and Combretum ovalifolium.

Some cultivated plants like Basella rubra, Vallaris solanacea, Ipomoea pescaprae, Ipomoea cairica and Ipomoea quamoclit certainly add the beauty of hedges. One can see the charming scarlet flowers of Ipomoea hederifolia (Plate 23 B) on the hedges near Nana-Varachha.

The important herbaceous forms are Achyranthes aspera var. porphyristachya, Barleria prionitis, Pupalia lappacea, Anisomeles indica, Gloriosa superba, Basilicum polystachyon and Commelina benghalensis. At times plants of Plumbago zeylanica (Plate 24) beautify the hedges. Other important plants are Waltheria americana, Boerhavia chinensis and Indigofera trita.

4.6. The Wall Flora

There are number of sites like dilapidated or abandoned buildings, deserted wells and even newly constructed buildings which support a characteristic flora in the cracks and crevices. The development of the wall flora is controlled by the nature of the exposed surface which generally consists of disintegrated bricks and mortar, decayed remnants of plant material and also all kinds of debris. Water is an important factor, which has great influence on the wall flora. The seasonal rainfall during monsoon or dew during the winter are the real sources of water. it is always the water retention capacity of the substratum

which influences the vegetation of such places. Temperature has an important role to play while the biotic factors are much less important, although the renovation of old houses or changes in construction do affect the vegetal set-up of the walls.

In this work, the wall flora is studied by visiting the various localities round the year and their floristic composition has been recorded. The floristic composition of the old walls displays remarkable change with the change in the season. During the dry summer days excepting the hardy, woody perennials, the vegetation on the exposed walls perished. The surviving perennials also present unhealthy, depauperate appearance. The common woody perennials are Ficus benghalensis, Ficus religiosa, Kirganelia reticulata, Capparis sepiaria, Cadaba fruticosa, Azadirachta indica and Lantana camara var. aculeata. Seedlings of Tamarindus indica, Clerodendrum phlomidis and Woodfordia fruticosa are also occasionally seen. At a number of places, especially in shade, Tridax procumbens, Launaea procumbens, Peristrophe bicalyculata and Vernonia cinerea are observed in a dry, fruiting stage.

With the onset of monsoon, the woody perennials start fresh vegetative activity. A number of herbaceous annuals make their appearance. They are Glinus oppositifolius, Ageratum conyzoides, Lindenbergia muraria, Kickxia ramosissima, Acalypha ciliata, Goniogyna hirta, Indigofera cordifolia and Alysicarpus vaginalis. Very old buildings at Dumas support the growth of Ocimum canum, Laportea interrupta (Plate 25), Phyllanthus

virgatus, Euphorbia microphylla and Peperomia pellucida. Some escape from cultivation like Sesamum indicum, Turnera ulmifolia, Impatiens balsamina and Vigna aconitifolia are also seen at some places. Some notable climbers are Coccinia grandis, Luffa acutangula, Passiflora foetida, Cayratia carnosa, Cissus quadrangularis, Antigonon leptopus, Cryptostegia grandiflora and Telosma pallida. Few sedges and grasses are Cyperus compressus, Cyperus difformis, Cynodon dactylon, Chloris virgata, Eragrostis ciliaris, Dactyloctenium aegyptium, Setaria tomentosa and Chionachne koenigii.

4.7. Weed Flora of Cultivated Fields

In the floristic composition of Surat and environs, the weed flora attains a position of prime importance. Except residential and industrial land, most of the land has been brought under cultivation and is permanently irrigated by the net-work of canals. Most of the land is fertile. To get maximum crop-yields, the farmers give very high dose of fertilizers. All these conditions lead to the luxuriant growth of a variety of weeds.

4.7.1. Kharif and Rabi Weeds :

Depending upon the season in which they grow along with crop-plants, the weeds are classified into i) Kharif and ii) Rabi weeds. Most prominent annual Kharif weeds are Aeschynomene indica, Caesulia axillaris, Cyperus iria, Cyperus difformis, C. rotundus, Eclipta alba [illegible], Oryza nivara and

Sesbania bispinosa. Some weeds like Euphorbia geniculata, Mollugo pentaphylla, Crotalaria albida, Malachra capitata and Digera muricata are prefer irrigated soils, while Alysicarpus longifolius, Euphorbia hirta, Euphorbia dracunculoides (Plate 26 A), Celosia argentea (Plate 26 B) and Vernonia cinerea are grown on dry localities. The few important rabi weeds are Cichorium intybus, Goniocaulon indicum, Oligochaeta ramosa, Polygala erioptera, Sonchus asper, Sonchus oleraceus and Vaccaria pyramidata.

For complete list of Kharif and Rabi weeds and their identification, please refer to the following keys which are based on simple macroscopic characters. Members of the Cyperaceae and the Poaceae have not been included in the keys, because the identification of the members of these groups is not possible with the help of macroscopic characters only.

4.7.2. An artificial key to the identification of 'Kharif' and 'Rabi' Weeds :

Plants with yellow flowers ..... Key I

Plants with white flowers ..... Key II

Plants with pink, rose or red flowers. Key III

Plants with blue, purple or violet flowers ..... Key IV

Plants with green or greenish-white flowers ..... Key V

A

B

Plants, which could not be placed
in any one of the above groups ..... Key VI

Key I

1. Flowers in heads or in umbels or
in clusters :

2. Flowers in heads :

3. Plants erect :

4. Plants with milky juice :

5. Leaves sharply toothed;
auricles appressed to stem ...Sonchus asper

5. Leaves minutely toothed;
auricles spreading .....Sonchus oleraceus

4. Plants without juice .....Vicoa indica

3. Plants prostrate or ascending :

6. Leaves simple :

7. Leaves radical; heads sub-
racemosely arranged on the
peduncle .....Launaea procumbens

7. Leaves mainly cauline,
alternate or opposite :

8. Leaves alternate; heads
usually solitary;
peduncles short .....Grangea maderaspatana

8. Leaves opposite; heads
on long peduncles .....*Tridax procumbens*

6. Leaves compound .....*Neptunia triquetra*

2. Flowers in umbels or in clusters :

9. Flowers in umbels .....*Biophytum sensitivum*

9. Flowers in clusters .....*Malachra capitata*

1. Flowers other than heads; umbels
or clusters :

10. Flowers in racemes :

11. Flowers regular or almost regular :

12. Leaves simple :

13. Flowers bisexual :

14. Petals free :

15. Flowers large,
1-2 cm. in diam.

16. Calyx spathaceous :

17. Involucral
bracts 4-6...
.....*Abelmoschus manihot*

17. Involucral bracts
more than 6 ..
.....*Abelmoschus moschatus*

16. Calyx not spathaceous..
.....*Hibiscus panduraeformis*

15. Flowers small, less than

5 mm. in diam...*Triumfetta rotundifolia*

14. Petals united .....*Verbascum chinensis*

13. Flowers unisexual :

18. Plants erect .....*Chrozophora rottleri*

18. Plants prostrate....*Chrozophora prostrata*

12. Leaves palmately compound...*Cleome viscosa*

11. Flowers irregular :

19. Leaves simple :

20. Pods glabrous :

21. Corolla exserted....*Crotalaria retusa*

21. Corolla not exserted.*Crotalaria albida*

19. Leaves compound :

22. Leaves pinnately
3-foliolate .....*Melilotus indica*

22. Leaves more than 3-foliolate :

23. Plants glabrous;
pods jointed.....*Aeschynomene indica*

23. Plants prickly; pods
not jointed .....*Sesbania bispinosa*

10. Flowers solitary or few :

24. Flowers bisexual :

25. Flowers irregular .....*Goniogyna hirta*

25. Flowers regular :

26. Stamens definite :

27. Plants prostrate, rooting or not rooting at nodes :

28. Plants succulent; leaves obovate or spathulate :

29. Nodal hairy appendages present ..... Portulaca quadrifida

29. Nodal hairy appendages absent ..... Portulaca oleracea

28. Plants not succulent; leaves reniform ..... Merremia gangetica

27. Plants usually erect :

30. Corolla free; petals with purple veins ..... Eruca vesicaria

30. Corolla united; petals without purple veins ..... Physalis minima

26. Stamens indefinite :

31. Stamens free :

32. Plants prickly or spiny .....Argemone mexicana

32. Plants not prickly or spiny :

33. Capsule globose, without beak ..... Corchorus capsularis

33. Capsule longer than broad; angular or cylindrical; beaked :

34. Capsule angular :

35. Capsule winged, beak trifid..Corchorus aestuans

35. Capsule not winged,
beak entire .....Corchorus trilocularis

34. Capsule cylindrical :

36. Capsule 10-ribbed .....Corchorus olitorius

36. Capsule not ribbed .....Corchorus fascicularis

31. Stamens monadelphous :

37. Carpels less than 10 :

38. Petioles spiny at the base..Sida alba

38. Petioles not as above .....Sida acuta

37. Carpels more than 10 .....Abutilon indicum

24. Flowers unisexual :

39. Stipules peltate :

40. Leaves oblong-rounded, closely
set on the branches .....Phyllanthus virgatus

40. Leaves obovate, scattered
on the branches .....Phyllanthus
maderaspatensis

39. Stipules not peltate .....Phyllanthus fraternus

Key II

1. Plants parasitic .....Orobanche cernua
var. nepalensis

1. Plants not parasitic :

2. Leaves compound :

3. Plants tendrilar climber.....Cardiospermum halicacabum

4. Leaves 3-foliolate;

flowers irregular .....Melilotus alba

4. Leaves 5-foliolate;

flowers regular .....Cleome gynandra

2. Leaves simple :

5. Corolla bilabiate .....Leucas aspera

5. Corolla not bilabiate :

6. Leaves opposite or in whorls :

7. Leaves usually opposite :

8. Flowers in capitula :

9. Heads axillary :

10. Heads sessile ....Caesulia axillaris

10. Heads pedunculate.Eclipta alba

9. Heads in corymbs or

panicles .....Ageratum conyzoides

8. Flowers not in capitula :

11. Flowers in condensed spikes :

12. Plants rooting

at the nodes :

13. Condensed spikes

sessile .....Alternanthera sessilis

13. Condensed spikes on

a long axillary

peduncle.....Phyla nodiflora

12. Plants not rooting at the nodes..*Gomphrena celosioides*

11. Flowers not in condensed spikes :

14. Flowers usually solitary :

15. Flowers sessile, deeply sunken .....*Trianthema portulacastrum*

15. Flowers pedunculate, not sunken .....*Bergia suffruticosa*

14. Flowers in cymes .....*Polycarpaea corymbosa*

6. Leaves in whorls :

16. Leaves more than 2 mm broad; erect herb .....*Mollugo pentaphylla*

16. Leaves less than 2 mm broad; wiry herb .....*Mollugo cerviana*

6. Leaves alternate :

17. Leaves cauline :

18. Flowers with epicalyx .....*Abelmoschus ficulneus*

18. Flowers without epicalyx :

19. Plants erect :

20. Flowers white woolly.....*Aerva lanata*

20. Flowers not woolly .....*Cressa cretica*

19. Plants prostrate or ascending :

21. Leaves hastate .....*Convolvulus arvensis*

21. Leaves not hastate ....*Convolvulus microphyllus*

17. Leaves radical, cylindrical and fistular .....*Asphodelus tenuifolius*

Key III

1. Leaves pinnately compound.....*Indigofera linnaei*

1. Leaves simple :

2. Leaves dissected .....*Sopubia delphinifolia*

2. Leaves not as above :

3. Leaves alternate :

4. Flowers in capitula or heads :

5. Plants armed .....*Oligochaeta ramosa*

5. Plants unarmed .....*Goniocaulon indicum*

4. Flowers not in capitula or heads :

6. Flowers in spikes :

7. Spike loose, cylindric..*Celosia argentea*

7. Spike lax .....*Digera muricata*

6. Flowers solitary or few, axillary or in clusters :

8. Flowers irregular :

9. Corolla papilionaceous; leaves broadly ovate to obovate .....*Indigofera cordifolia*

9. Corolla not papilionaceous;
leaves narrowly-linear..... Polygala erioptera

8. Flowers regular :

10. Leaves hastate at the base....Convolvulus arvensis

10. Leaves not hastate :

11. Flowers in clusters in the
upper axils .....Cressa cretica

11. Flowers solitary or few,
axillary; stems flower-bearing
from near the base .....Convolvulus microphyllus

3. Leaves opposite :

12. Flowers irregular, in globose or
elongate condensed spikes .....Phyla nodiflora

12. Flowers regular :

13. Flowers solitary or few,
axillary; or dichotomous cymes :

14. Flowers solitary or few,
axillary :

15. Flowers pedunculate....Bergia suffruticosa

15. Flowers sessile,
almost sunken .....Trianthema portulacastrum

14. Flowers in dichotomous
cymes .....Vaccaria pyramidata

13. Flowers in umbels arranged in
corymbose panicles .....Boerhavia diffusa

Key IV

1. Flowers regular :

   2. Flowers in head or capitula :

      3. Leaves opposite .....Ageratum conyzoides

      3. Leaves alternate :

         4. Heads many :

            5. Heads in terminal corymbs .....Vernonia cinerea

            5. Heads in terminal spiciform cymes .....Blumea mollis

         4. Heads 1 or 2, axillary.....Cichorium intybus (Plate 27 A)

   2. Flowers other than head or capitula :

      6. Leaves opposite .....Anagallis arvensis

      6. Leaves alternate :

         7. Plants prostrate; diffuse or creeping :

            8. Flowers 1 or 2, not enclosed in a spathaceous bracts .....Evolvulus alsinoides

            8. Flowers enclosed in a spathaceous bracts :

               9. Perfect stamens 3 ....Commelina diffusa

               9. Perfect stamens 6.....Cyanotis cristata

A

B

7. Plants erect :

10. Prickly herb .....*Solanum surattense*

10. Plants not prickly :

11. Calyx rounded at the base..*Trichodesma zeylanicum*

11. Calyx cordate or hastate...*Trichodesma indicum* var. *amplexicaule*

1. Flowers irregular :

12. Pods moniliform; veinless .....*Alysicarpus monilifer*

12. Pods not moniliform; veined.....*Alysicarpus longifolius*

Key V

1. Leaves opposite; flowers in spikes....*Achyranthes aspera* var. *porphyristachya*

1. Leaves alternate :

2. Flowers in racemosely arranged whorls; stipules ochreate .....*Rumex dentatus*

2. Flowers in axillary and terminal spikes :

3. Plants spiny .....*Amaranthus spinosus*

3. Plants not spiny :

4. Flowers bisexual; leaves thick and fleshy :

5. Plants with foetid smell; seeds rugose .....*Chenopodium murale*

5. Plants odourless;seeds smooth..*Chenopodium album*

4. Flowers unisexual or polygamous;
leaves not thick or fleshy .....*Amaranthus viridus*

Key VI

1. Flowers in cyathia :

2. Stems zig-zag; leaves broadly
elliptic or obovate .....*Euphorbia geniculata* (Plate 27 B)

2. Stems and leaves not as above :

3. Leaves opposite :

4. Leaves more than 1 cm long ....*Euphorbia hirta*

4. Leaves less than 1 cm long :

5. Stems and capsules hairy :

6. Capsules hairy all over..*Euphorbia thymifolia*

6. Capsules hairy on
angles only .....*Euphorbia prostrata*

5. Stems and capsules glabrous.*Euphorbia heyneana*

3. Leaves alternate .....*Euphorbia dracunculoides*

1. Flowers not in cyathia :

7. Bracts fimbriate;capsule glabrous.....*Acalypha ciliata*

7. Bracts toothed; capsule hairy .....*Acalypha indica*

4.8. The Cultural Plant Communities : The plants cultivated in the fields or orchards for various purposes, are included under this heading. The cultural plants are of two types : (1) Crop Plants, (2) Fruit Plants.

4.8.1. Crop Plants : They are cultivated during Kharif, Rabi or Hot weather seasons.

4.8.1. a. Kharif season crops : The crops cultivated during Kharif (June to October) season are Oryza sativa, Gossypium herbaceum, Sorghum vulgare, Cajanus cajan and Zea mays. They are extensively cultivated throughout the area. The crops cultivated in a very few hectares are Arachis hypogea, Pennisetum typhoides, Vigna aconitifolia, Vigna mungo and Vigna radiata.

4.8.1. b. Rabi season crops : The crops cultivated during Rabi (November to March) season are Triticum aestivum, Lablab purpurea and Sorghum vulgare. Amaranthus hybridus ssp.cruentus is often cultivated along with wheat (Plate 28 A). Ricinus communis and Nicotiana tabacum (Plate 28 B) are cultivated in a small area during the Kharif season but the crops are harvested by the last week of March. Cicer arietinum is cultivated for its unripe seeds, which are used as vegetable.

A short season between rabi and kharif, which commences from the last week of March and ends before the arrival of the monsoon, is known as hot weather season. During this short spell, vegetables and fodder jowar are sown in the irrigated fields.

A

B

Cotton is the chief non-food crop of the area. Other non-food crops are Saccharum officinarum, Musa paradisiaca (Plate 29), Arachis hypogea and Sesamum indicum.

The following vegetables are grown during various seasons : Brassica oleracea var. botrytis, Brassica oleracea var. capitata, Raphanus caudatus, Abelmoschus esculentus, Cyamopsis tetragonoloba, Daucus carota, Lycopersicon esculentum, Solanum melongena, Amorphophallus campanulatus, Dioscorea alata, Ipomoea batatas, Allium cepa, Colocasia esculenta and Spinacia oleracea.

The following cucurbits are grown on a large scale : Coccinia grandis, Cucumis melo var. momordica, Cucumis melo var. utilissimus, Cucumis sativus, Cucurbita maxima, Lagenaria siceraria, Luffa acutangula, Luffa cylindrica, Momordica charantia, Momordica dioica and Trichosanthes dioica.

The following condiments and spices are cultivated : Capsicum annum, Zingiber officinale, Curcuma domestica, Curcuma amada, Allium sativum, Coriandrum sativum, Trigonella foenum-graecum, Anethum graveolens, Foeniculum vulgare, Brassica juncea and Brassica nigra.

4.8.2. Fruit Plants : Dumas, Bhimpor, Ved, Katargam and Rander are famous for their orchards. The various fruits are cultivated on a large scale, especially in the fields or on a small scale around houses. The following fruits may be mentioned.

Mangifera indica (the principal commercial local varieties like Alphanso, Rajapuri, Jamadar, Karanj, Totapuri, Dadamiyo, Vanaraj, Sardar, Payri are cultivated. Recently well known variety 'kesar' has been introduced by some growers), Musa paradisiaca, Manilkara achras, Manilkara hexandra, Psidium guajava, Annona squamosa, Annona reticulata, Cocos nucifera, Grewia asiatica, Syzygium cumini, Punica granatum, Artocarpus heterophyllus, Artocarpus lakoocha, Morus alba, Ficus carica, Anacardium occidentale, Terminalia catappa, Syzygium malaccensis.

Among the winter season fruits, may be mentioned : Carica papaya, Averrhoa carambola, Cicca acida, Emblica officinalis, Citrus limon, Citrus maxima, Pithecellobium dulce and Tamarindus indica.

Zizyphus mauritiana is planted throughout the area. The local variety Randeri Bor is famous in the district (Plate 30).

4.9. Introduced Urban Flora

The present study has revealed a number of plants, which are introduced from different places. They are cultivated in private and public gardens. Some noteworthy plants are mentioned under the following headings :

4.9.1. Gardens and Parks

Besides two major gardens - Gandhi Baag and Nehru Baag - Surat has several small gardens and parks. They are Lala Lajpatrai, Kasturba, Lokmanya Tilak, Sardar Patel and Dayalji Baag . A century-old Gandhi Baag has many noteworthy plants. In addition

to these there are number of small gardens attached to public and private organisations. Some worth to mention are, Baroda Rayon Corporation (BRC), Adarsh Fertilizer - at Udhana, Sumal dairy, the gardens of some colleges like M.T.B., Medical, P.T.Science, Navyug and South Gujarat University. The botanical garden of P.T. Science College has many interesting plants. The Hari Nursery and Swami Atmanand Saraswati Pharmacy has many rare plants. Some precious garden wealth is as follows :

4.9.1. a. Trees and Shrubs : Adenanthera pavonia, Alstonia scholaris, Bauhinia acuminata, Butea monosperma, Callophyllum inophyllum, Couroupita guianensis (Plate 31 A), Santalum album, Hardwickia binata, Jacaranda mimosifolia, Drypetes roxburghii, Terminalia arjuna, Terminalia bellirica, Terminalia chebula, Parkinsonia aculeata, Sterculia foetida and Guaiacum officinale Plate 31 B).

4.9.1. b. Climbers and Creepers : They are either grown as screens or along walls and pergolas or as twiners around pillars. Some of the wild climbers can be also introduced in the gardens. Some important climbers and creepers are :
Agnosma caryophyllata, Aristolochia elegans, Asparagus racemosus, Basella rubra, Bougainvillea spectabilis, Clerodendrum splendens, Jasminum officinale, Ipomoea quamoclit, Ipomoea cairica, Petrea volubilis and Vallaris solanacea. Recently Thunbergia grandiflora, Bignonia magnifica and Argyreia nervosa are cultivated at many gardens.

A

B

The following wild climbers noted from this area can be introduced : Cryptostegia grandiflora, Ipomoea hederifolia, Operculina turpethum, Derris timoriensis, Abrus precatorius, Clitoria ternatea, Ipomoea nil, Ipomoea hederifolia, Rivea hypocrateriformis and Antigonon leptopus.

4.9.2. The Botanical Gardens

The Botanical gardens of P. T. Science College has a good collection of curious and rare plants of academic utility. To mention few interesting plants are : Clematis gouriana, Michelia champaka, Helicteres isora, Ochna squarrosa, Swietenia mahagoni, Lannea coromandelica, Caesalpinia decapetala, Mimosa pudica, Mussaenda frondosa, Madhuca longifolia, Ardisia solanacea, Chrysophyllum cainito, Gymnema sylvestre, Tabebuia pentaphylla, Holmskioldia sanguinea, Tectona grandis, Ficus elastica, Ruscus aculeatus and Smilax zeylanica.

4.9.3. Recently Introduced Plants

Among recent introduction on the public landscape, the following deserve mention: Cleome spinosa, Cassia alata, Calliandra tweedii, Vitis vinifera, Begonia picta, Turnera ulmifolia, Solanum seaforthianum (Plate 32 A), Polianthes tuberosa (Plate 32 B), Dahlia variabilis and Eschscholtzia californica. Manihot esculenta, Anacardium occidentalae and Ficus carica are also cultivated at few places. Recently, Hari Nursery has started the cultivation of orchids and succeeded

A

B

to grow Vanilla planifolia and Cypripedium sps. upto the fruiting stage (Plates 33 A and B).

Surat is rich in palm flora. The different palms are cultivated in gardens and at the front of buildings. Some worth to mention are : Areca catechu, Caryota urens, Thrinax parviflora, Roystonea regia, Trachycarpus martiana, Livistona chinensis, Washingtonia filifera (Plate 34) and Pritchardia filifera. Hyphaene indica, locally known as Ravan Tad, was planted at many places in Surat as could be inferred from Ravan Tad Falia; now has completely disappeared from the landscape of Surat except few saplings grown in Gandhi Baag.

4.10. Escapes

There are number of plants, originally under cultivation for various purposes, found in ruderal areas. They are Brassica juncea, Brassica nigra, Abelmoschus esculentus, Impatiens balsamina, Cyamopsis tetragonoloba, Medicago sativa, Vigna aconitifolia, Trigonella foenum-graecum, Turnera ulmifolia, Momordica charantia, Anethum graveolens, Tagetes erecta, Lycopersicon esculentum, Sesamum indicum, Ocimum sanctum, Gomphrena globosa and Zephyranthes rosea.

*****

A

B

Key to the Families of Angiospermic plants of Surat and environs. The numbers given in brackets refer to the relevant figures in plates....35 A, B, C, D.

KEY TO GROUPS

1. Seeds with two cotyledons; leaves usually with reticulate-veined; flowers tetra or pentamerous .....Group A (Dicotyledons) (1 to 4)

2. Perianth biseriate or multiseriate: (5, 6)

3. Petals free; sepals free or united : (7,8,9)

4. Ovary superior : (13)

5. Stamens more than twice as many as petals .....Group A I (10,11)

5. Stamens twice as many as petals or fewer .....Group A II (12)

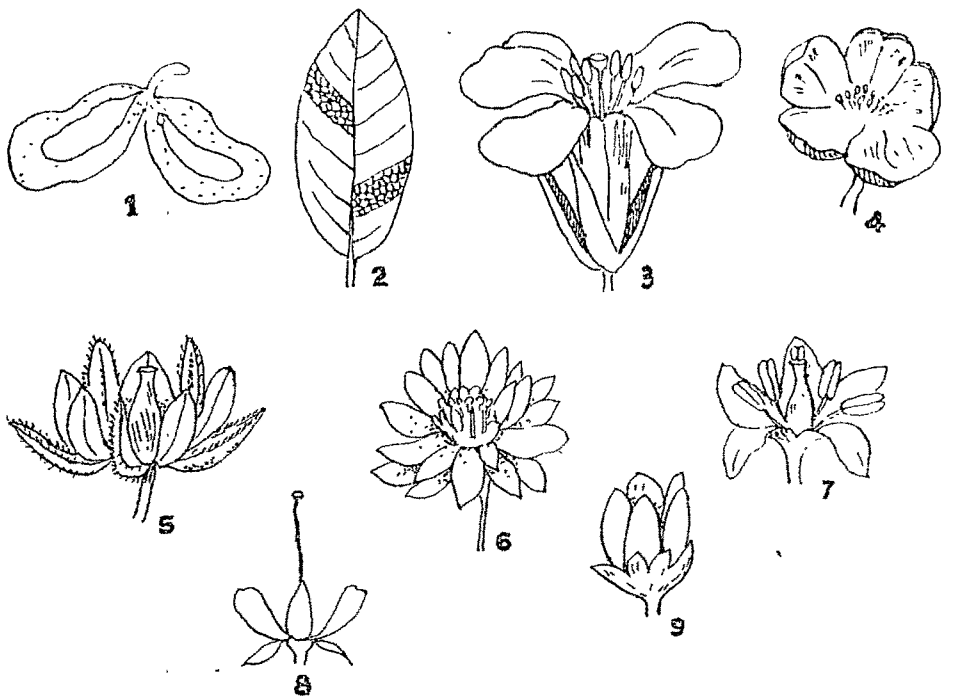
4. Ovary inferior or half inferior .....Group A III(14,15)

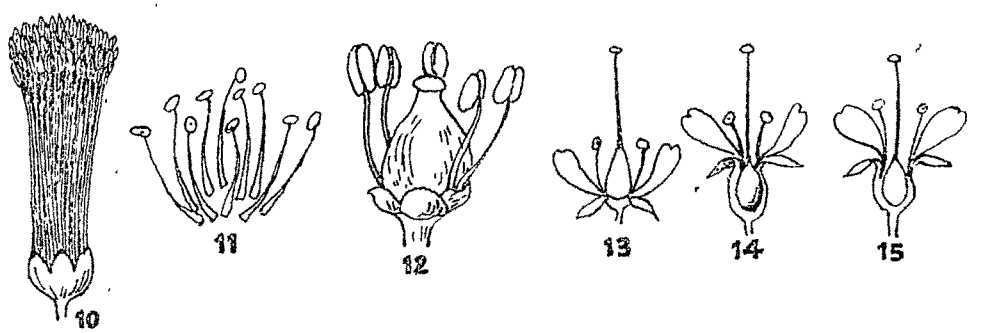
3. Petals united at least at base, sepals united .....Group A IV

2. Perianth uni-seriate or absent .....Group A V (16)

1. Seeds with one cotyledons; leaves mostly parallel veined; flowers predominantly tri-merous .....Group B (Monocotyledones) (17 - 20)

ILLUSTRATIONS OF MORPHOLOGICAL TERMS





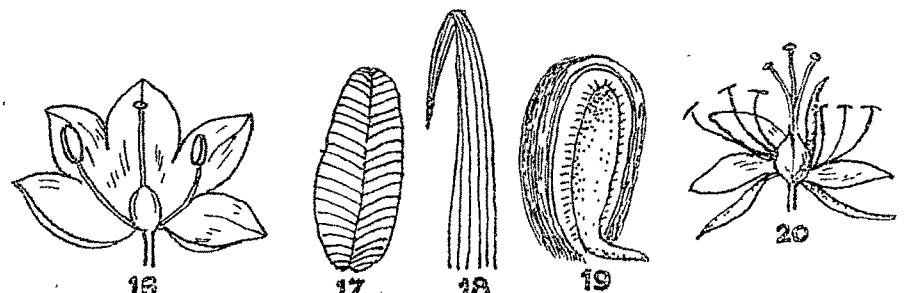


PLATE - 35 A

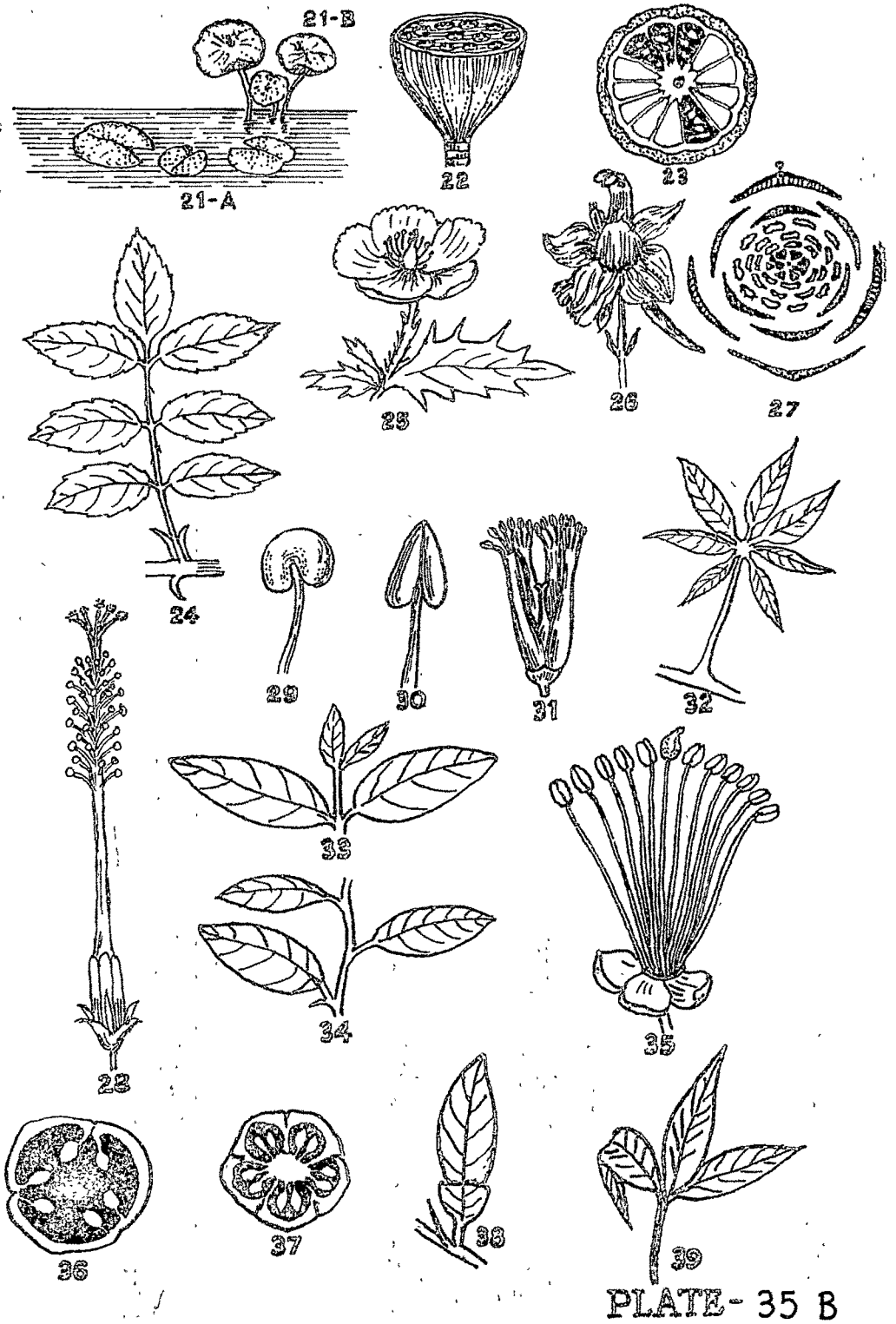


PLATE - 35 B

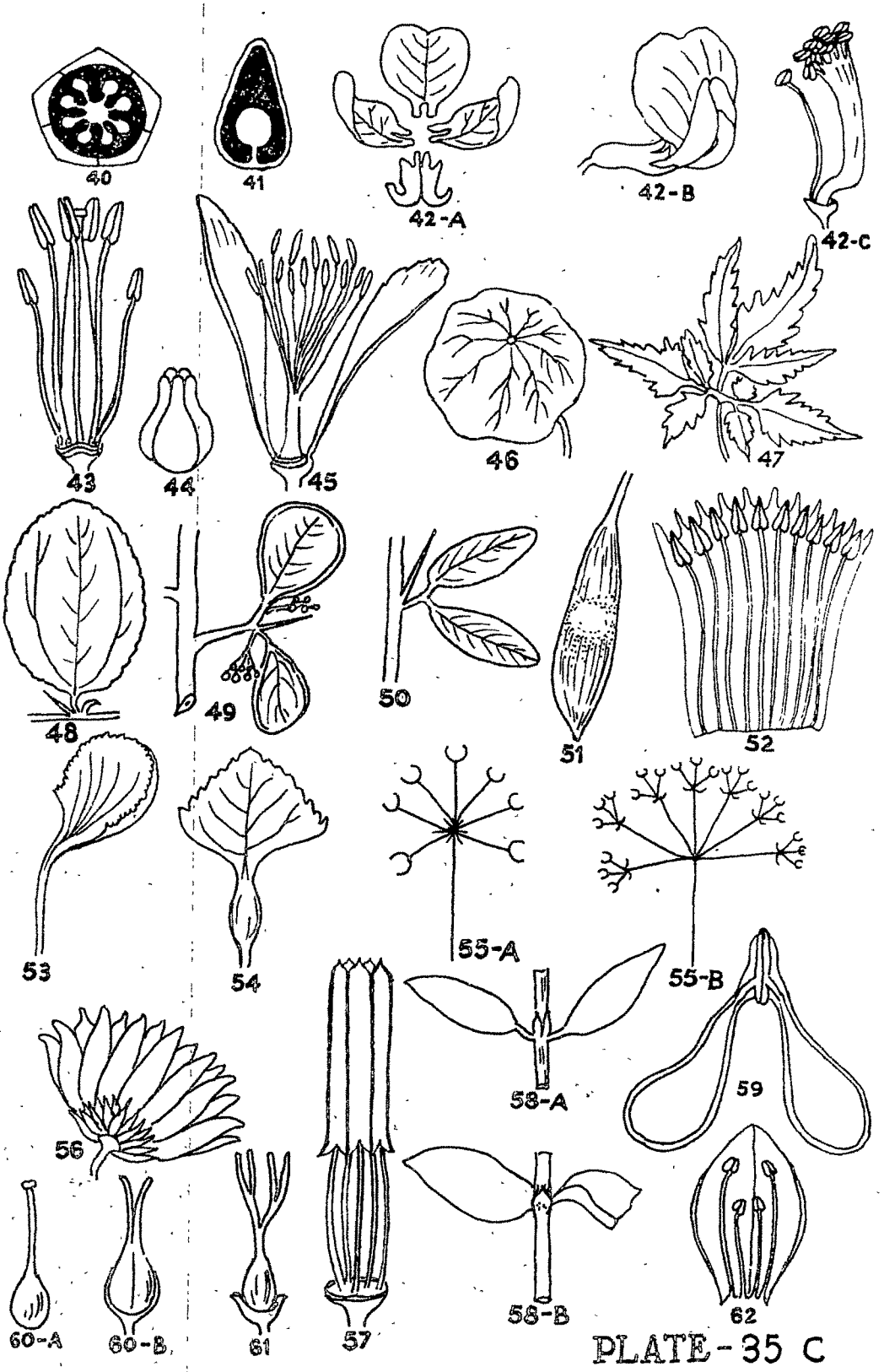

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PLATE - 35 C

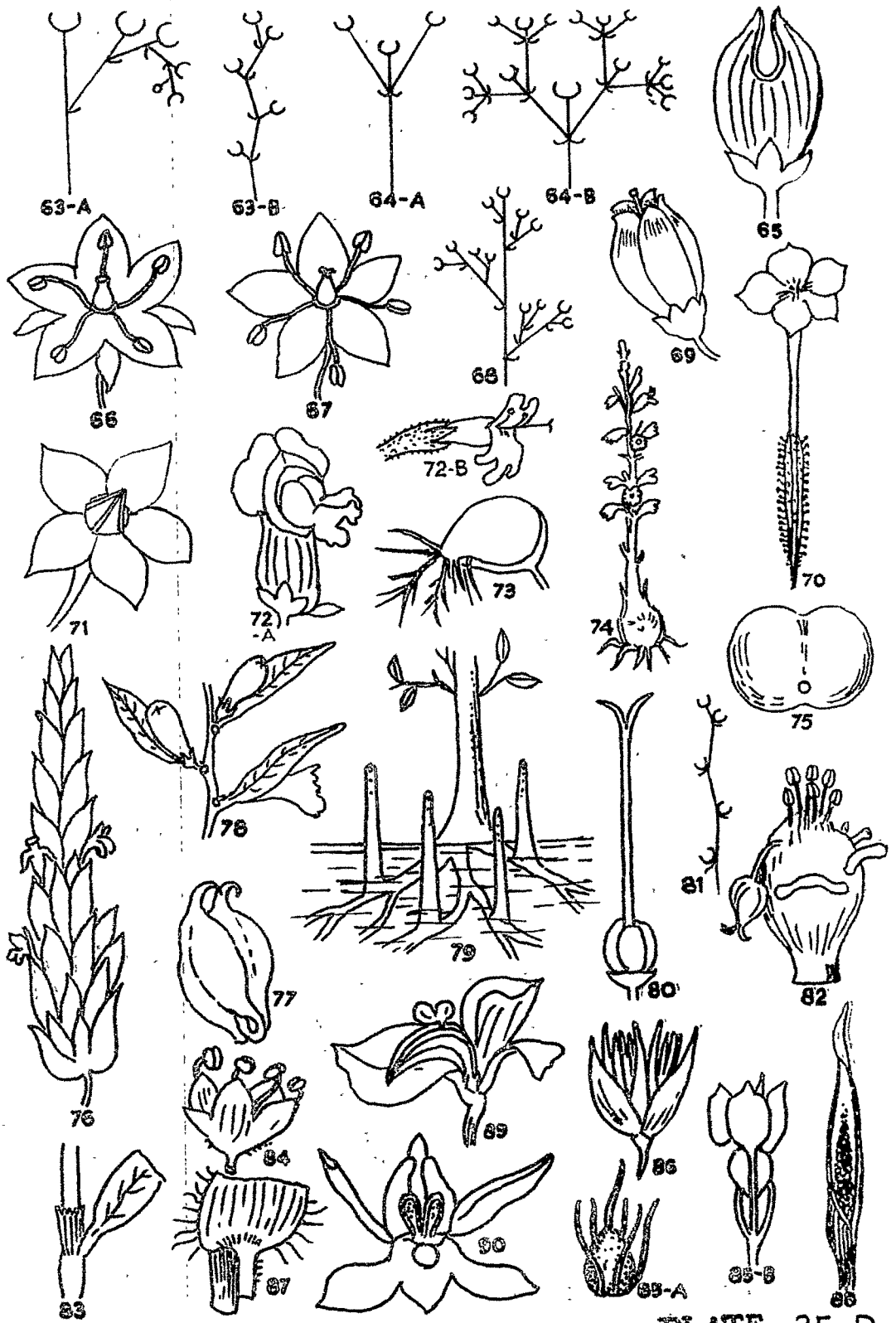
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PLATE- 35 D

GROUP A (DICOTYLEDONES)

GROUP A I

1. Perianth multiseriate :

   2. Aquatics; placentation superficial : (23)

      3. Leaves floating; carpels connate in to a many celled ovary .....5. NYMPHAEACEAE (21 a)

      3. Leaves raised above the surface of water; carpels sunk in to the torus .....6. NELUMBONACEAE (21 b & 22)

   2. Terrestrials; placentation not as above :

      4. Plants herbaceous; prickly 42.ROSACEAE (24)

      4. Plants woody; not prickly 2.MAGNOLIACEAE

1. Perianth 2-3-seriate :

   5. Herbs or undershrubs :

      6. Flowers regular :

         7. Sepals 2; plants succulent .....14. PORTULACACEAE

         7. Sepals more than 2; plants not succulent :

            8. Sepals 2-3; plants with prickles.7. PAPAVERACEAE (25)

            8. Sepals 5; plants not as above ...21.TILIACEAE

      6. Flowers irregular .....1. RANUNCULACEAE (26)

5. Shrubs or trees :

9. Perianth 3-seriate .....3. ANNONACEAE (27)

9. Perianth 2-seriate : (5)

10. Stamens united : (28, 31)

11. Stamens monadelphous : (28)

12. Anthers 1-celled .....18. MALVACEAE (29)

12. Anthers 2-celled .....20. STERCULIACEAE (30)

11. Stamens polyadelphous : (31)

13. Leaves compound .....19. BOMBACACEAE (32)

13. Leaves simple .....17. GUTTIFERAE

10. Stamens free : (10, 11, 35)

14. Leaves simple : (33, 34)

15. Leaves opposite (33);
fruits capsule .....48. LYTHRACEAE

15. Leaves alternate : (34)

16. Ovary on gynophore,
placentation parietal..10.CAPPARACEAE (35,36)

16. Ovary sessile;
placentation axile 31.OCHNACEAE (37)

14. Leaves compound : (38, 39)

17. Plants armed 28.RUTACEAE (38)

17. Plants unarmed 10.CAPPARACEAE (39)

GROUP A II

1. Ovary unilocular :

2. Leaves simple :

3. Flowers 3-merous .....4. MENISPERMACEAE

3. Flowers 4-5-merous :.....

4. Placentation free-central : (40)

5. Sepals 2; stems and leaves succulent .....14. PORTULACACEAE

5. Sepals 5; stems and leaves not succulent .....13. CARYOPHYLLACEAE

4. Placentation other than free-central :

6. Placentation marginal .....39. FABACEAE (41)

6. Placentation parietal : (36)

7. Plants with tendrils .....53. PASSIFLORACEAE

7. Plants without tendrils :

8. Ovary on a gynophore : (35)

9. Shrubs .....10. CAPPARACEAE

9. Herbs ..... 9. CLEOMACEAE

8. Ovary sub-sessile :

10. Flowers irregular ...11. VIOLACEAE

10. Flowers regular :

11. Herbs; flowers yellow .....52. TURNERACEAE

11. Trees; flowers not yellow :

12. Soft wooded; leaves large .....54. CARICACEAE

12. Wooded; leaves scaly .....15. TAMARICACEAE

2. Leaves compound :

13. Ovary on a gyhophore .....9. CLEOMACEAE (35)

13. Ovary sessile :

14. Flowers regular; unisexual or polygamous 37.ANACARDIACEAE

14. Flowers irregular; bisexual :

15. Corolla papilionaceous; stamens diadelphous .....39. FABACEAE (42)

15. Corolla not as above; stamens free 40.CAESALPINIACEAE (11)

1. Ovary 2-more-locular :

16. Herbs :

17. Flowers regular :

18. Stamens tetradynamous 8.BRASSICACEAE (43)

18. Stamens not as above :

19. Leaves simple :

20. Leaves opposite :

21. Style 1;ovules axile.48.LYTHRACEAE (37)

21. Styles 5; ovules not axile 16.ELATINACEAE (44)

20. Leaves alternate :

22. Flowers unisexual :

23. Pistil 1 ..... 108. EUPHORBIACEAE

23. Pistils 3-6 ..... 4. MENISPERMACEAE

22. Flowers bisexual :

24. Stamens basally connate..... 20. STERCULIACEAE (45)

24. Stamens free ..... 21. TILIACEAE

19. Leaves compound :

25. Tendrilar climbers ..... 35. VITACEAE

25. Plants without tendrils :

26. Fruit spiny ..... 23. ZYGOPHYLLACEAE

26. Fruit not spiny ..... 26. OXALIDACEAE

17. Flowers irregular :

27. Leaves simple :

28. Leaves peltate ..... 27. TROPAEOLACEAE (46)

28. Leaves not peltate :

29. Small herbs; ovary 2-locular; ovule 1 per locule ..... 12. POLYGALACEAE

29. Herbs or undershrubs; ovary 5-locular, with many ovules per locule ..... 24. BALSAMINACEAE

27. Leaves biternate ..... 36. SAPINDACEAE (47)

16. Woody plants :

30. Leaves simple :

31. Plants armed :

32. Armed with spines; fruits drupes..34. RHAMNACEAE (48)

32. Armed with thorns;fruits capsules.33. CELASTRACEAE (49)

31. Plants unarmed :

33. Twining shrubs or shrubs :

34. Petals clawed 22.MALPIGHIACEAE (53)

34. Petals sessile 33.CELASTRACEAE

33. Trees or shrubs :

35. Stamens united below 20.STERCULIACEAE (45)

35. Stamens free 21.TILIACEAE (11)

30. Leaves compound :

36. Leaves gladular-punctate 28.RUTACEAE

36. Leaves not glandular :

37. Leaves 2-foliolate 30.BALANITACEAE (50)

37. Leaves pinnate :

38. Stamens free :

39. Fruits berry :

40. Leaflets 4-8,large;

flowers dull white...36. SAPINDACEAE

40. Leaflets more than 8, small;
flowers pink-purple .....25. AVERRHOACEAE

39. Fruits other than berry :

41. Fruits capsule :

42. Capsule much elongated .....38. MORINGACEAE

42. Capsule short .....23. ZYGOPHYLLACEAE

41. Fruits samara .....29. SIMAROUBACEAE (51)

38. Stamens united .....32. MELIACEAE (52)

GROUP A III

1. Aquatic herbs :

2. Leaves floating, petiole spongy,
fruit with lateral horns .....51. TRAPACEAE (54)

2. Leaves and petioles not as above;
fruit without horns .....50. ONAGRACEAE

1. Terrestrials :

3. Stamens few :

4. Plants always tendril bearing.....55. CUCURBITACEAE

4. Plants devoid of tendril :

5. Herbs or undershrubs :

6. Herbs with sticky glands;
flowers in pair .....43. VAHLIACEAE

6. Plants without sticky glands;
flowers in umbels .....60. APIACEAE (55 A - 55 B)

5. Twining shrubs .....45. COMBRETACEAE

3. Stamens many :

7. Succulent plants .....56. BEGONIACEAE

7. Non-succulent plants :

8. Leaves opposite, glandular-punctate; ovary many-celled .....46. MYRTACEAE

8. Leaves not opposite and glandular-punctate; ovary 1-5-celled :

9. Ovary 1-celled; flowers creamy-white .....61. ALANGIACEAE

9. Ovary 5-celled :

10. Flowers regular, red-orange; fruits berry .....49. PUNICACEAE

10. Flowers irregular, reddish-white; fruits fibrous drupes.47. LECYTHIDACEAE

GROUP A IV

1. Flowers regular :

2. Ovary inferior :

3. Stamens many .....57. CACTACEAE

3. Stamens as many as the corolla lobes or fewer :

4. Plants tendril bearing .....55. CUCURBITACEAE

4. Plants without tendril :

5. Flowers in involucrate heads; anthers syngenesious; ovary 1-celled .....64. ASTERACEAE (56-57)

5. Flowers other than heads; anthers not syngenesious; ovary more than 1-celled:

6. Leaves stipulate .....63. RUBIACEAE (58A-58B)

6. Leaves exstipulate .....62. CAPRIFOLIACEAE

2. Ovary superior :

7. Ovary with 1 carpel .....41. MIMOSACEAE

7. Ovary with 2-more carpels :

8. Ovary with 2 carpels :

9. Plants aquatic .....78. MENYANTHACEAE

9. Plants terrestrial :

10. Plants with latex or greenish-yellow sap :

11. Pollens free; style 1..72. APOCYNACEAE

11. Pollens aggregated; styles 2 :

12. Pollens aggregated in pollinia; filaments united...73. ASCLEPIADACEAE (59)

12. Pollens in tetrads; filaments free.....74. PERIPLOCACEAE

10. Plants without latex or sap :

13. Stamens 2 :

14. Fruit a berry or woody pyriform capsule ..... 70. OLEACEAE

14. Fruit a compressed capsule ..... 75. NYCTANTHACEAE

13. Stamens 4 or 5 :

15. Plants leaf-less, stem parasites... 83. CUSCUTACEAE

15. Plants leafy-green, not parasites :

16. Leaves alternate :

17. Flowers in one or two sided cymes : (63 A - 63 B)

18. Trees or shrubs; style once forked or styles 2..80. EHRETIACEAE (61)

18. Herbs or undershrubs; style entire or shortly 2-lobed .....81. BORAGINACEAE (60 A - 60 B)

17. Flowers not as above :

19. Twining or trailing herbs; flowers bracteate.....82. CONVOLVULACEAE

19. Herbs or shrubs, often trailing; flowers ebracteate .....84. SOLANACEAE

16. Leaves opposite :

20. Herbs; flowers in dichotomous or axillary, solitary cymes;rarely in clusters; fruits capsule :

21. Corolla greenish-white; capsule wedge-shaped .....76. SPIGELIACEAE (65)

21. Corolla white, or capsules oblong-ellipsoidal or globose, never wedge-shaped :

22. Ovary 1-celled; placentation free central or parietal :

23. Placentation free central; stamens opposite the petals..66.PRIMULACEAE (66)

23. Placentation parietal; stamens alternate the petals 77.GENTIANACEAE (67)

22. Ovary 2-celled; placentation axile 85.SCROPHULARIACEAE

20. Trees; flowers in panicle; fruit drupe 71.SALVADORACEAE (68)

8. Ovary usually more than 2 carpels :

24. Flowers unisexual; corolla urceolate.....69.EBENACEAE (69)

24. Flowers bisexual; corolla hypocrateriform (70) or rotate (71) but not urceolate :

25. Plants with milky-latex; corolla lobes in 2 or 3 series .....68. SAPOTACEAE

25. Plants without latex; corolla lobes unlike the above :

26. Calyx with stalked glands .....65. PLUMBAGINACEAE (70)

26. Calyx without glands :

27. Stamens opposite the corolla lobes; flowers in racemes....67. MYRSINACEAE (65)

27. Stamens alternate the corolla lobes; flowers in paniculate cymose clusters .....79. POLEMONIACEAE (67)

11. Flowers irregular : (i.e. corolla personate bilabiate or dissimilar) (72 A - 72 B)

28. Plants aquatics :

29. Plants with bladders.....87.LENTIBULARIACEAE (73)

29. Plants without bladders.....85.SCROPHULARIACEAE

28. Plants terrestrials :

30. Plants root-parasites :

31. Leaf-less, scapigerous...86.OROBANCHACEAE (74)

31. Leafy-green, not scapigerous 85.SCROPHULARIACEAE

30. Plants not parasitic :

32. Leaves compound; fruits elongated capsules; seeds winged 88.BIGNONIACEAE (75)

32. Leaves simple; fruits and seeds not as above :

33. Bracts conspicuous: (76)

34. Twining shrubs; calyx minute .....91. THUMBERGIACEAE

34. Herbs, shrubs or undershrubs;
never twining .....92. ACANTHACEAE

33. Bracts inconspicuous, minute or absent :

35. Flowers with extra-floral glands at
the base of pedicels (78) :

36. Fruits with 2 large hooks.....90. MARTYNIACEAE (77)

36. Fruits without hooks .....89. PEDALIACEAE (78)

35. Flowers without extra floral glands :

37. Plants with pneumatophores....94. AVICENNIACEAE (79)

37. Plants not as above :

38. Ovules 1 or 2 in each cell :

39. Ovary entire;
style terminal .....93.VERBENACEAE (60 A)

39. Ovary deeply 4-lobed;
style gynobasic 95.LAMIACEAE (80)

38. Ovules many in each cell :

40. Corolla tubular;
placentation parietal..77.GENTIANACEAE

40. Corolla 2-lipped or
personate,placentation
axile 85.SCROPHULARIACEAE
(72 - 73).

GROUP A V

1. Perianth absent :

   2. Flowers in spike .....103. PIPERACEAE (81)

   2. Flowers in cyathia .....108. EUPHORBIACEAE (82)

1. Perianth present :

   3. Ovary superior :

      4. Perianth sepaloid, scarious or rudimentary :

         5. Aquatics .....113. CERATOPHYLLACEAE

         5. Terrestrials :

            6. Stem parasite 106.LAURACEAE

            6. Plants not parasite :

               7. Ovary 1-locular :

                  8. Plants twining 4.MENISPERMACEAE

                  8. Plants not twining :

                     9. Herbs or undershrubs :

                        10. Stipules ochreate.101.POLYGONACEAE (83)

                        10. Stipules absent or present but never ochreate :

                        11.Perianth and bracts scarious;stamens connate below..98. AMARANTHACEAE

11. Perianth and bracts not as above;
stamens free :

12. Styles undivided; flowers
unisexual .....110. URTICACEAE

12. Styles divided; flowers
bisexual ..... 99. CHENOPODIACEAE

9. Woody plants :

13. Leaves simple :

14. Leaves reduced to scales..112.CASUARINACEAE

14. Leaves not reduced :

15. Styles branched :

16. Anthers inflexed
in bud 111.MORACEAE (84)

16. Anthers erect in
bud 109.ULMACEAE

15. Styles unbranched.....111.MORACEAE

13. Leaves compound 40.CAESALPINIACEAE

7. Ovary 2-5 locular :

17. Ovules many per locule 59.MOLLUGINACEAE

17. Ovules 1-3 per locule :

18. Ovules axile 108.EUPHORBIACEAE

18. Ovules basal 58.AIZOACEAE

4. Perianth petaloid :

19. Herbs, shrubs or twiners :

20. Climbing or twining :

    21. Tendrilar climbers :

        22. Stipules absent ..... 1. RANUNCULACEAE

        22. Stipules sheathing .....101. POLYGONACEAE (83)

    21. Twiners, not tendrilar :

        23. Woody twiners, bracts petaloid, not succulent ..... 97. NYCTAGINACEAE

        23. Herbaceous twiners, bracts none, succulent .....100. BASELLACEAE

20. Herbs or undershrubs, not climbing or twining :

    24. Ovary 1-locular :

        25. Stipules present :

            26. Stipules ochreate, persistent..101. POLYGONACEAE (83)

            26. Stipules minute, caducous ..... 96. PHYTOLACACEAE

        25. Stipules absent :

            27. Bracts and bracteoles scarious; flowers in spike or head ..... 98. AMARANTHACEAE

            27. Bracts and bracteoles not scarious; flowers in cyme, umbel or head..97. NYCTAGINACEAE

    24. Ovary 2-5-locular :

        28. Ovules many per locule .....59. MOLLUGINACEAE

        28. Ovules 2-3 per locule :

            29. Ovules axile .....108. EUPHORBIACEAE

29. Ovules basal ..... 58. AIZOACEAE

19. Trees :

30. Leaves digitate .....20. STERCULIACEAE

30. Leaves pinnate :

31. Leaves deeply pinnatifid....104. PROTEACEAE

31. Leaflets entire ..... 40. CAESALPINIACEAE

3. Ovary inferior :

32. Ovary inferior or apparently so :

33. Herbs :

34. Leaves alternate; flowers unisexual ..... 56. BEGONIACEAE

34. Leaves opposite; flowers bisexual ..... 48. LYTHRACEAE

33. Woody :

35. Stem parasite .....105. LORANTHACEAE

35. Plants not parasite :

36. Small tree; flowers regular .....107. SANTALACEAE

36. Shrub; flowers irregular.48.LYTHRACEAE

32. Ovary truly inferior :

37. Plants herbaceous 102.ARISTOLOCHIACEAE

37. Plants woody 45.COMBRETACEAE

GROUP B (MONOCOTYLEDONES)

1. Plants very small, thalloid .....131. LEMNACEAE

1. Plants neither very small nor thalloid :

2. Carpels 1 or more, usually distinct :

3. Inflorescence a true spadix :

4. Leaves plicate in bud;
spadix compound .....127. ARECACEAE

4. Leaves not plicate in bud;
spadix simple .....130. ARACEAE (88)

3. Inflorescence not a true spadix :

5. Perianth none, or when present,
bristle-like or scale-like,
endosperm present :

6. Rhizomatous herbs; flowers in
dense, terminal spikes .....129. TYPHACEAE

6. Woody plants; flowers often
crowded on the axis .....128. PANDANACEAE

5. Perianth sepaloid or petaloid
or none; endosperm absent or
very little :

7. Ovary superior :

8. Pistils 1-ovuled :

9. Perianth composed of
calyx and corolla ....132. ALISMATACEAE

9. Perianth inconspicuous or none :

10. Flowers crowded in spikes ....134. POTAMOGETONACEAE

10. Flowers solitary or few together .....135. NAJADACEAE

8. Pistils 2-many-ovuled .....133. APONOGETONACEAE

7. Ovary inferior .....114. HYDROCHARITACEAE

2. Carpels united into a syncarpous ovary :

11. Leaves pinnately or palmately divided..127. ARECACEAE

11. Leaves entire :

12. Inflorescence of heads or spikelets of florets in the axils of glumaceous bracts :

13. Perianth of 2 whorls; inflorescence a solitary head .....136. ERIOCAULACEAE

13. Perianth non- or much reduced :

14. Stem solid, triangular; fruit an achene; ligules absent (present in Fuirena).137. CYPERACEAE (85 A - 85 B)

14. Stem hollow, cylindrical; fruit a caryopsis; leaves ligulate .....138. POACEAE (86-87)

12. Inflorescence other than heads or spikelets of florets, not in the axil of dry chaffy scales :

15. Ovary superior :

16. Outer segments of perianth sepaloid and inner petaloid; flowers enclosed in spathe-like bracts .....126. COMMELINACEAE (89)

16. Outer and inner segments of perianth essentially alike, either all sepaloid or petaloid :

17. Plants aquatic .....125. PONTEDERIACEAE

17. Plants terrestrial :

18. Plants herbaceous; leaves succulent or membranous.....123. LILIACEAE

18. Plants woody; leaves coriaceous:

19. Plants climbing .....124. SMILACACEAE

19. Plants not climbing .....121. AGAVACEAE

15. Ovary inferior :

20. Flowers more or less regular :

21. Leaves large, fan-shaped with long petioles .....119. STRELITZIACEAE

21. Leaves not as above :

22. Twining herbs .....122. DIOSCOREACEAE

22. Plants not twiner :

23. Flowers umbellate .....120. AMARYLLIDACEAE

23. Flowers not umbellate, but in panicles or racemes...121. AGAVACEAE

20. Flowers very irregular :

    24. Gynostemium present; one of the inner perianths, forming the labellum 115.ORCHIDACEAE (90)

    24. Gynostemium absent :

        25. Fertile stamens 1-2, the rest often becoming petaloid staminodes or forming the labellum :

            26. Anthers 2-celled 116.ZINGIBERACEAE

            26. Anthers 1-celled 117.CANNACEAE

        25. Fertile stamens 5 .....118.MUSACEAE