INTRODUCTION

1. The need for a modern and comprehensive flora of the Gujarat State.
2. The authors work presented in the thesis and its place in the general scheme of the proposed flora of the Gujarat State.
3. Description of the area:
   (a) Geographical location
   (b) Climate and soils
4. Previous work done.
5. Present work - Methodology and results.

The work on the systematic Botany of the Indian sub-continent appears to be a never-ending task. This is one of those fascinating aspects of botanical research in India, which has commanded the attention of a number of European and a few Indian botanists. We have the Hooker's Flora of British India which, with all its shortcomings, has been accepted as a national flora. Moreover there are a number of state or regional floras. Inspite of all this, there remains a lot to be done in this field. In

recent years we hear about the demand for a thorough revision of Hooker's Flora of British India and the other provincial floras including Cooke's Flora of the Presidency of Bombay. With the revival of the Botanical survey of India there has been a great spurt in the activity of reprinting and thereby preserving the old floras and exploring new and hitherto unexplored regions of this great country with a view to compiling floras on the most modern lines. The most exacting part of the job is to find out the correct identity of the Indian plants and to work out the nomenclature so as to bring it up-to-date. The essential prerequisite for this work is a library equipped with old classical works on the floras as well as recent floras and monographs. Secondly, most of the type material of Indian plants is not available in India. This makes the task of finding the correct identity very difficult.

Gujarat formed a part of the Bombay Presidency, the Flora of which was written by Cooke (1901-1908). There are a number of very good works available on the Flora of the Western Ghats but only a few ones worth the name for the whole state of Gujarat. Here mention may be made of the excellent service rendered by Dr. H. Santapau, Director of the Botanical Survey of India. His contributions to the Botany of Dangs (1956) and Saurashtra (1962) are a guide to any

worker in the field of floristic studies in this part of the country. Fr. E. Blatter (1908) wrote on the flora of Cutch, which was further explored by Puri, Jain and their associates. Jayakrishna Indraji Thakar (1910) has the honour of publishing the Flora of Barda Hills in Kathiawar (Saurashtra) in Gujarati, one of the regional languages of India. Saxton, W.T. and Sedgwick L.J. surveyed some parts of Northern Gujarat. Their work has been presented in 'The plants of Northern Gujarat' (1918). Inspite of the availability of the above mentioned works, there certainly exists a big lacuna in our knowledge of the plants of the mainland of Gujarat (present state of Gujarat, excluding Cutch and Saurashtra).

With a view to compiling a comprehensive Flora of Gujarat state on the most modern lines, the Department of Botany of the M.S. University of Baroda under the able leadership of late Prof. A.R. Chavan, has launched a programme of floristic studies on the different areas, both hilly as well as plain, of Gujarat. This study of the vegetation and Flora of Baroda and environs including an account of the Cyperaceae of Gujarat presented in the thesis is one amongst a series of works, which are either completed or are nearing completion. The author was encouraged to do the work on the vegetation and Flora of Baroda and environs by Dr. Santapau's comments (1958)

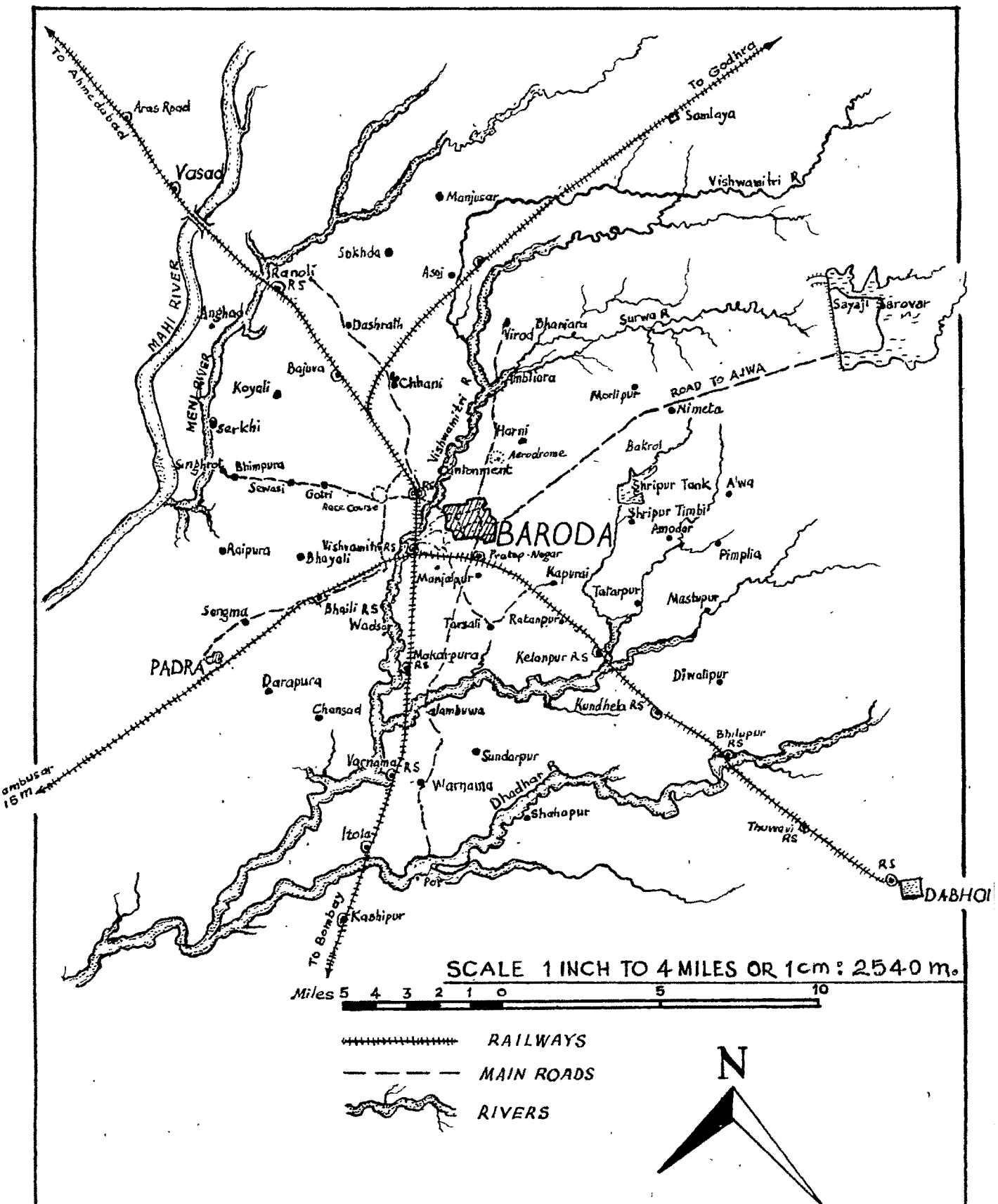
in an article on the floristic studies in India published in memoir no. 1 of the Indian Botanical Society. Dr. Santapau remarked - "Our universities can do excellent work in selected areas in the neighbourhood of their headquarters. In a relatively small area it is possible to keep costs down to a minimum, since travelling expenses usually eat up much of the funds assigned to botanical exploration. In all such areas it is possible to intensify exploration so that full details about the occurrence and distribution of plants, their ecological associations, phenological notes, local names and uses, etc. can easily be gathered in the course of the various seasons of the year". The present thesis is a result of 6 years of intensive work in the field. It is fully informative and should aptly serve as a handbook to all the undergraduate and postgraduate students of this University in years to come. The work on the Cyperaceae, on the other hand, was undertaken with a view to knowing more about this difficult and hence neglected group of plants. The work on the Cyperaceae is a compilation of the available data and the data gathered by the author during his various field trips to places in South, Central and North Gujarat. It is hoped that the first part of the thesis (A study of the Flora and vegetation of Baroda and environs) should satisfy a long felt need of the

students of Botany in this university while the second part (An account of the Cyperaceae of Gujarat) can conveniently be incorporated in a comprehensive Flora of the state.

We are fully aware of the shortcomings of the present work. But we simply hope that it will satisfy, to a great extent, the need of the student community in particular and the botanists in general.

Description of the Area

The area under study lies between 22° - 0' and 22° - 30' N. latitude and 73° - 0' and 73° - 30' E. longitude. It is more or less a plain area comprising approx. 650 Sq. Km. with the M.S. University of Baroda campus in the centre (Plate I). Baroda city is a junction on the Western Railway lying 390 Km. to the north of Bombay. It is a beautiful and well-planned city, a district place in the Gujarat State. It was the capital of the former Baroda state, which merged with the Indian union after Independence. It is the main seat of learning and culture of the state of Gujarat. It boasts of numerous educational and research institutes, which now form a part of the M.S. University of Baroda. Now it is gaining importance also as a business centre



A MAP OF BARODA & ENVIRONS

PLATE NO. - 1

because of the pharmaceutical industry, O.N.G.C. establishments, Gujarat refinery and also many other small scale private industries.

Most of the land area has been used either for the construction of factories and townships or for agriculture with the result that natural vegetation is present only in some of the remotest and inaccessible corners. The area is traversed by a number of rivers and their tributaries, which all flow in the same direction because of a gentle slope towards the southwest.

Vishwamitri takes its rise from the hills of Pavagadh, which is about 45 Km. north east of Baroda. Vishwamitri is joined by another stream called 'Surya', which also originates from Pavagadh a little to the south of Vishwamitri. The little river then continues its course in southernly direction till it joins Dhadhar, some 24 Km. south of Baroda. Before the termination of this course, its waters are, a little south of Baroda, increased by the 'Jambuva', a stream in between Makarpura and Sundarpura hunting reserve. 'Jambuva' takes its rise near the village Devalia in Vaghodia taluka and terminates near Khalipur in Baroda taluka. All these rivers and their tributaries are nothing but trickling, sluggish streams during the dry months but overflow

their banks and spread over the level country on their sides during monsoon.

'Dhadhar' takes its rise in the hills south of Pavagadh at Shivrajpur about 56 Km. N.E. of Bhilupur, where it is crossed by a stone bridge on the road from Baroda to Dabhoi. 'Dhadhar' is quite wide here with about 1 meter of water even during the dry months. But after it has been joined by Rangni and Vishwamitri, its size is considerably increased.

The big river Mahi, about 19 Km. N.W. of Baroda, forms the Western boundary of the area under study. The 'Meni' which issues from a tank near Samalaya in Savli taluka falls into Mahi after traversing about 56 Km. of the country.

The area being plain and also industrially developed, has a well-developed communication system in the form of Railways, National and state highways, roads and cart-tracks.

Climate

The climate of this place is markedly periodic and is characterized by a dry and increasingly hot summer from March to June, a dry and cold winter from November to February and a warm monsoon from July to September.

The climatic factors that are of greater importance are rainfall, temperature and relative humidity.

Rainfall: The monsoon every year arrives in the last week of June and continues till September. July and August receive the heaviest downpour. The mean annual rainfall comes to approx. 980 mm. (Table A).

Temperature: One of the most characteristic features of the climate of Baroda is the great extremes of temperature. The heat during the summer (March-June) is intense, the temperature rising as high as 46.7°C during the month of May. June to September is the warm monsoon, while winter sets in the month of November and continues till the middle of February. December and January are the real cold months when the temperatures drop down. In December the mean maximum and the mean minimum temperatures are 33° and 9° C respectively, while in January they are 33° and 7° C respectively (Table B I and II).

Relative humidity: The relative humidity is minimum during the summer months of April and May (Approx. 50%) and maximum during the monsoon, especially in the month of August (91%). (Table C).

(Meteorological data obtained from the meteorological observatory of the M.S. University of Baroda).

Table A. Total monthly rainfall in mm. from 1957 to 1961

Month	Year				
	1957	1958	1959	1960	1961
January	0.5	00	00	2.0	t
February	00	00	00	00	6.1
March	00	00	00	00	00
April	t	00	1.3	t	00
May	00	0.3	t	00	t
June	203.2	231.8	73.9	75.4	203.3
July	452.3	231.1	630.1	153.9	247.4
August	108.7	205.2	280.9	183.3	277.1
September	t	459.2	348.0	126.5	150.2
October	1.0	88.6	110.6	24.8	5.6
November	11.7	4.2	8.4	00	00
December	00	00	00	0.5	00
Total	777.4	1220.4	1453.2	566.4	889.7

t = traces, not measurable

Mean annual rainfall = 981.4

Table B. I. Maximum monthly temperatures (in degrees centigrade)

Month	Year				
	1957	1958	1959	1960	1961
January	33.9	35.0	34.9	32.2	36.2
February	34.7	36.2	37.5	38.9	37.8
March	38.9	42.4	43.3	38.7	42.7
April	43.0	45.9	44.4	42.3	45.2
May	43.0	44.9	45.8	46.7	45.0
June	41.1	43.4	41.7	40.0	39.4
July	36.0	36.8	34.4	39.1	37.2
August	33.9	35.7	32.7	33.3	34.7
September	36.7	33.9	34.4	37.8	33.1
October	38.9	35.1	36.1	38.3	36.1
November	37.8	35.0	35.0	36.6	35.1
December	34.4	34.3	33.4	34.6	32.2

Table B. II. Minimum monthly temperatures (in degrees centigrade)

Month	Year				
	1957	1958	1959	1960	1961
January	6.7	8.9	7.3	6.7	5.8
February	4.4	8.7	7.2	9.1	6.2
March	9.4	11.2	13.3	11.2	13.3
April	17.7	18.9	19.4	16.7	17.6
May	20.8	25.1	24.3	19.9	22.8
June	21.5	23.3	22.6	23.9	22.8
July	23.3	24.1	23.4	24.9	24.8
August	24.0	23.0	24.1	23.5	24.0
September	20.4	23.3	22.7	21.2	23.9
October	13.9	15.5	18.8	13.9	14.5
November	13.4	12.8	12.0	9.4	14.8
December	10.6	10.3	8.9	8.3	8.3

Table C. Relative humidity (at 8.30 A.M.)

Month	Year				
	1957	1958	1959	1960	1961
January	74	69	68	68	57
February	53	63	63	55	61
March	55	44	48	56	50
April	50	55	50	43	42
May	56	62	53	54	58
June	75	73	72	74	77
July	91	86	93	85	90
August	91	90	91	91	91
September	79	91	91	85	93
October	63	79	83	71	80
November	68	62	70	59	74
December	67	73	66	71	68

Soil

The area under study is drained by a few big rivers and their tributaries, hence is a vast alluvial deposit of black soil and red loam. Baroda, which is on the river Vishwamitri, forms a dividing line between the black soils and red loam. Both the regions are very fertile, but the black soil region presents a desert like appearance when not cultivated whereas the red loam region is cultivated throughout the year.

Previous Work Done

The flora and vegetation of Baroda and environs

Barring a few references to Baroda by Woodrow and Cooke in the Cooke's 'Flora of the Presidency of Bombay' and a few papers published before or during the course of author's investigations on the flora and vegetation of Baroda and environs, very little is known about the subject. At least there has never been in the past a systematic and comprehensive work on the flora of this area extended over a number of years.

To start with, Phatak and Joshi (1955, 56) published two sketchy accounts of the flora of M.S. University campus. The first one was based on summer observations

and the second on their monsoon observations. Both these papers have their quota of scientific inaccuracies and hence deserve no consideration.

Chavan and Mehta (1955, 58) gave a good account of the grasses of the M.S. University campus and those of Baroda. The work on the grasses of Baroda and environs has especially been of great help in the compilation of the present work.

Phatak and Oza (1957) published their observations on the weeds of the M.S. University campus. Although the area worked out is very small, the information presented is quite valuable and useful. The same authors in 1958, published a list of 73 useful weeds of Baroda and Pavagadh. Oza (1962), based probably on his earlier observations on the weeds of the university campus, published a list of 39 lawn weeds of Baroda.

Phatak and Satakopan (1957) published a description of pond vegetation at Harni. The work is quite informative.

Shah (1963) published an account of the vegetation of Baroda based on his collection of Baroda plants during the year 1954. The work is apparently a mere compilation of all the available data on the subject published by others till then.

A review of the previous work done shows that only a few parts of whole area have been surveyed so far and that there is not a single work based on careful observations spread over a considerably long period. The first part of thesis is a result of author's continuous work in the field, laboratory and herbarium for a period of 6 years.

Cyperaceae of Gujarat

A review of the previous work done on the Cyperaceae of Gujarat is given in the beginning of part II.

The Present Work

The work on the problem was started in January 1957 with the study of the Cyperaceae of Baroda and environs. The scope of the work was further extended and various localities in different parts of Gujarat were visited in the subsequent years. As regards the study of the flora and vegetation of Baroda and environs, during the year 1957, the flora of the M.S. University campus was more particularly studied to get myself acquainted with the local plants. It was then decided to expand the area of work and collect data from places within approx. 13 Km. radius with M.S. University as the centre. Immediately

a cursory survey of the whole area was undertaken to decide the vegetational pattern. It was observed that majority part of the area was under cultivation and hence the weed flora of the cultivated fields, waste land or the ruderal flora and the hedgeflora formed the most dominant aspect of the vegetation. Natural vegetation, although not absolutely unaffected by biotic factors, existed only at few places. In the years 1958, 1959 and 1960 frequent visits were paid to different localities in all the seasons of the year. This enabled me to study the different aspects of vegetation separately, with a view to recording the seasonal changes. The visits were continued in the years 1961 and 1962 but not with the same frequency.

All the plants collected were identified by reference to Cooke's flora of the Presidency of Bombay or the Hooker's Flora of British India. The identification was further confirmed by reference to various provincial floras especially Gamble's Flora of the Presidency of Madras or Santapau's Flora of Khandala. Other provincial floras were consulted not only for further confirmation but also for data regarding the range of distribution within the subcontiment and outside. A few plants, which defied all my efforts

for proper identification (especially those belonging to compositae, Acanthaceae, Labiatae among the Dicotyledons and Cyperaceae and Gramineae among the Monocotyledons) were then either sent to various leading herbaria such as the F.R.I. Herbarium, Dehra Dun, Central National Herbarium, Calcutta, Blatter's Herbarium, Bombay and the Royal Botanic Gardens, kew or were personally carried by me to the F.R.I. Herbarium, Dehra Dun, where I did the matching of almost all the plants recorded in the thesis.

Illustrations of the new or otherwise noteworthy plants were prepared usually from fresh material. Precise scales have been put to the illustrations, wherever necessary. I feel sure that these illustrations will be of great help in the identification of the plants

Field work: Plants were observed in all the stages of development during various field excursions. Rough diaries were maintained to record the field observations, which generally include:

1. Habit of the plant,
2. Average size of the plant,
3. Actual state of the plant,
4. Colour of the flower,

5. Any other striking morphological character, which might prove to be useful in identification.

6. Ecology:

   (a) Type of ground and habitat,

   (b) Any clear association,

   (c) Relative abundance (depending upon the number of individuals present in a locality).

7. Local name and uses, if any.

Proper field books containing all the information were prepared with the help of rough field diaries. The data was also duly analysed and entered in the index cards.

The plants collected during an excursions were immediately processed and preserved in the usual manner, following the instructions given by Lawrence in Plant Taxonomy and Santapau in his Botanical Collector's Manual with certain modifications as and when necessary.

The mounted specimens were then stored in the herbarium steel cup-boards. The families, genera and species were arranged according to Bentham and Hooker's system of classification, which is still in vogue in this country.

A Brief Summary of Results

The six years of intensive study on the flora and vegetation of Baroda and environs along with the Cyperaceae of Gujarat has resulted in the publication of several research notes and papers in some of the leading journals.

Even though the area is a plain and biotically much disturbed, we have been able to study the various aspects of the vegetation in all the seasons of the year. These observations being repeated for four years reveal data of importance.

During the course of the work, we have recorded a few plants which were earlier not recorded from the erstwhile Bombay state (now separated into Gujarat and Maharashtra states) or from India. A number of plants for which Gujarat has not been cited as a locality by Cooke in his'Flora of the Presidency of Bombay', are reported here thereby adding to our knowledge regarding the distribution of the species in the entire region.

We have been able to study critically the coronal character of Cryptostegia and have observed that the character is very variable and hence unreliable.

We have studied the parasitism of Cuscuta chinensis in great details thereby adding to our knowledge of the nature and extent of parasitism in the said species.

A critical study of all the local plants in the field as well as the herbarium enabled the author to formulate artificial keys to the identification of certain difficult families like the Papilionaceae and Cyperaceae. These keys lead to the identification of the plant itself. This, we feel, is a definite departure from the routine keys to genera and species, and would facilitate quick identification by the undergraduates or the postgraduates in Botany. A special artificial key to the identification of the weeds of agriculture has been appended for the benefit of the agriculturists of the place.

The author has very guardedly proposed a new variety of Solanum nigrum Linn. The plant is notoriously variable but the said variety "has not been reported in the available literature" according to Dr. G. Taylor, Director, Royal Botanic Gardens, Kew (personal communication). There is bound to be some difference of opinion regarding the validity of the proposed variety. But, taking into consideration the fact that the variant was observed year after year with an amazing constancy of the varietal characters (Purple streaks on the corolla

lobe is the main character), the author feels compelled to erect a new variety appropriately named as Solanum nigrum Linn. var. Purpurilineatum Sabnis.

During the course of our investigations on the Cyperaceae of Gujarat, in addition to our original observations on the plants and their ecology, we have been successful in adding 14 new plants, which were hitherto not reported from the Gujarat region by our predecessors. The forest areas of the Dangs, Rajpipla, Chhota Udepur, Devgadhbaria, Ratanmahal were so far completely unexplored. We have made exhaustive collections from these areas with a view to bringing the sedge flora of the state up-to-date and adding to our knowledge of the range of distribution of the various sedges in the remote and inaccessible forest areas of Gujarat. We have also collected data on other angiospermic plants from the above-mentioned areas but it would be out of place to dilate on this topic in the present work.

This intensive work gave us an opportunity to correct or to add to our knowledge regarding the characters of plants, such as colour of flower, flowering and fruiting time and the relative abundance of the species in our region.

The preparation of the thesis gave the author an opportunity to work in the field, laboratory and the herbarium under the expert guidance of my teachers. Moreover, it brought me in closer contact with luminaries in the field of taxonomy of angiosperms, whose unwavering help and constant guidance have made me confident of tackling even more exacting jobs than the one on hand.

It is my very humble claim that the data presented in the thesis are of value being first hand and reliable and will, to a great extent, solve the problem of the students of Botany in our university. If they find it useful for their day to day work, my efforts, I feel, are amply rewarded. The second part of the thesis dealing with the Cyperaceae of Gujarat is my very humble contribution to the proposed comprehensive flora of the state.

Lastly let me mention that I am fully aware of the shortcomings of the work but this is what I could do best under the circumstances.

For the various reasons cited above, the thesis is respectfully submitted to the Maharaja Sayajirao University of Baroda towards the degree of Doctor of Philosophy in Botany.