INTRODUCTION

The Hooker's Flora of British India (1875-1897) compiled during the last decade of 19th century represents the culmination of floristic and taxonomic researches of a team of dedicated scientists. The flora served a useful purpose all these years and accelerated the preparation of many provincial floras like the Flora of Madras, Flora of Bombay, Flora of Upper Gangetic Plains, etc. Looking to the many advances in taxonomy and the changed political boundaries of India, it is necessary to revise the Hooker's flora on the most modern lines. It is heartening to note that the Botanical Survey of India has undertaken this stupendous task of compiling a national flora with the help of taxonomists from various parts of the country.

Western India on the whole boasts of a flora written by Cooke (1901-1908) covering areas upto Sind. Graham (1839), Dalzell & Gibson (1861), Nairne (1894), Woodrow (1897-1901), Talbot (1901-1911), Blatter (1926-1935), Blatter and McCann (1935) and Santapau (1953, 1957) worked out the different parts of western India. In all the above mentioned works, Gujarat has been poorly represented.

Although workers like Blatter (1908), Jayakrishna Indraji (1910), Saxton and Sedgwick (1918), Saxton (1922), Santapau (1954-55, 1962), Santapau and Raizada (1954), Chavan and Oza

(1966) and Patel (1969) have made significant contribution by compiling data regarding the flora and vegetation of some selected localities of Gujarat, very meagre information is available regarding the flora of various forests occupying large areas along the eastern boundary of the State.

Recently the Universities in Gujarat state have taken upon themselves the task of exploring the remote, inaccessible forest areas of south, central and north Gujarat. A few Ph. D. theses based on floristic and ecological works are approved by the Universities and are awaiting publication. Based on these floristic surveys a few research papers and notes have already been published in some of the Indian journals, although the full theses have so far not been published.

But for the few papers published by the author, no information is available regarding the flora of the entire Chhotaudepur division. The present thesis, deals with floristic and ethnobotanical studies of the Kawant Range forests, which have been intensively and extensively explored during the years 1967-1972.

Description of the area

Location : The area surveyed is a part of Chhotaudepur taluka of Baroda district, which lies between 21°55' - 22°15' N latitude and 73°45' - 74°08' E longitude. It is bounded by

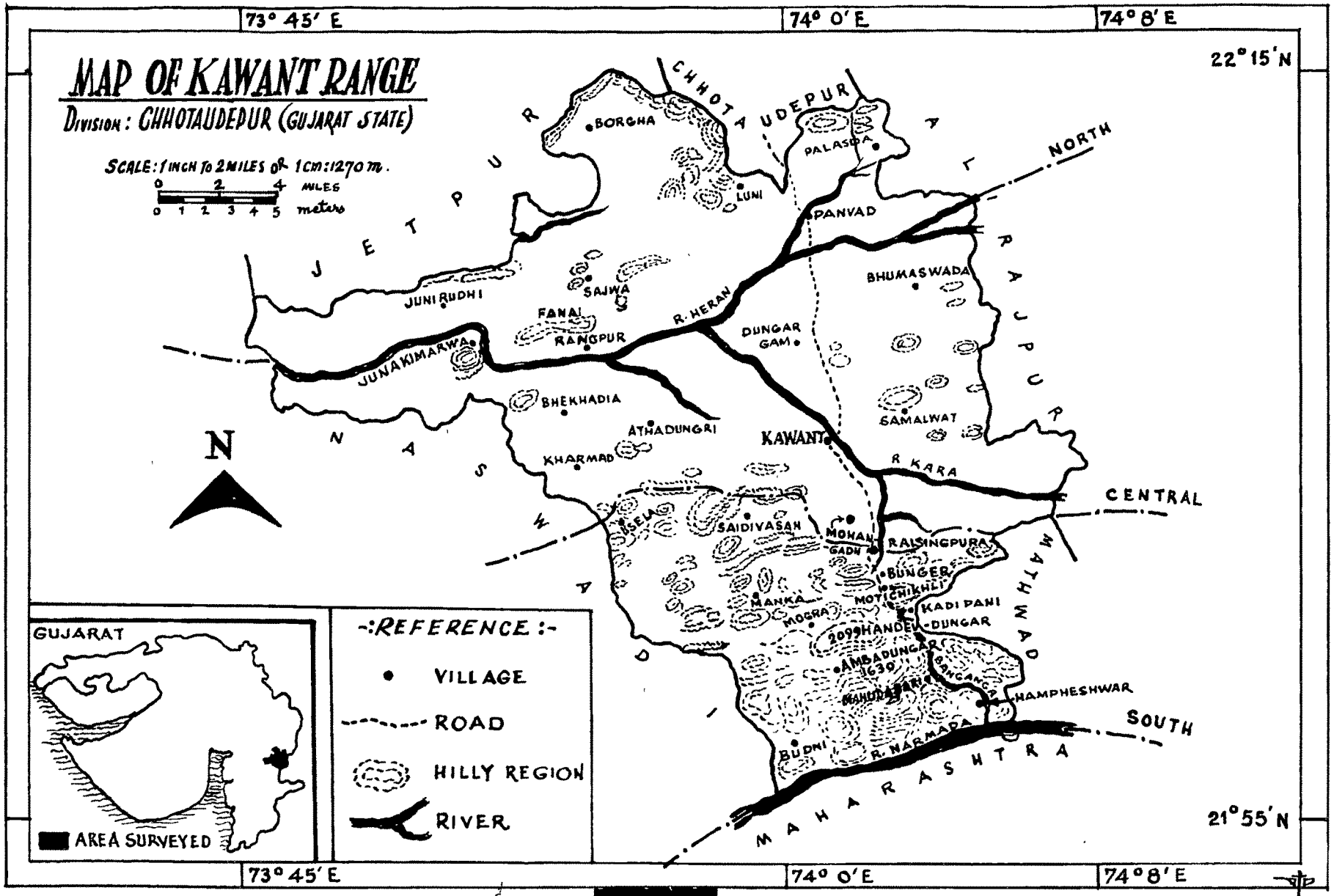
river Narmada on the south, across which the Maharashtra state begins. It has Naswadi Range on the west, Madhya Pradesh on the east and Chhotaudepur and Jetpur Ranges on the north.

Area : The total area surveyed in the present work is about 248.7 Sq. Kms. Physiographically the area is hilly, cut up by valleys. The common trend of hill is east-west. The northern part of the area (N. of river Heran) is having low hills and plains. The central part is mostly plain and is under cultivation. The southernmost part is hilly and rugged. Due to the hilly topography and poor agriculture, the entire area is thinly populated by native tribes (bhils) and the villages are few and scattered. (Map-I)

The area is approachable by railway from Baroda upto Chhotaudepur. There is a good road from Chhotaudepur to Kadipani on which State Transport buses ply all throughout the year. The forest interiors are usually without even a jeepable roads and hence are to be covered on foot only. These forests in the vicinity of Kadipani are virtually cut off from the rest of the area especially during monsoon. Because of the mining activity at Ambadungar, a good road leading to the top of the hill has been recently constructed.

Climate

The region has a strongly periodic climate. Rainfall,


MAP OF KAWANT RANGE
DIVISION : CHHOTAUDEPUR (GUJARAT STATE)
SCALE : 1 INCH TO 2 MILES OR 1 CM : 1270 m.
0 2 4 MILES
0 1 2 3 4 5 meters
73° 45' E
74° 0' E
74° 8' E
22° 15' N
21° 55' N
CHHOTA UDEPUR
BORGHA
LUNI
PALASDA
PANVAD
NORTH
CENTRAL
SOUTH
JETPUR
JUNI RUDHI
SAJWA
FANAI
RANGPUR
R. HERAN
JUNAKIMARWA
DUNGAR GAM
BHUMASWADA
PACHPATH
SAMALWAT
BHEKHADIA
ATHADUNGRI
KHARMAD
KAWANT
R. KARA
NASWADI
ISELA
SAIDIVASAN
MOHAN GADH
RAISINGPURA
BUNGER
MOTICHIKHLI
KADI PANI
MANKA
MOGRA
2099 HANDEV-DUNGAR
AMBADUNGAR 1630
MAHUDARI
BHIMKUND
HAMPHESHWAR
BUDNI
R. NARMADA
MAHARASHTRA
MATHWAD
N
GUJARAT
AREA SURVEYED
-:REFERENCE:-
VILLAGE
ROAD
HILLY REGION
RIVER

Map - 1.

temperature and relative humidity are the three most important climatic factors which affect the vegetation. Climatic data is obtained from Chhotaudepur (Temperature and Rainfall) and Baroda (Relative Humidity).

Rainfall : The rainfall is more and is received during June - September in the form of heavy showers. Maximum rainfall is received in the month of July and August, while, occasional erratic showers are received during other time of the year. The average rainfall is 1009.6 mm. for the years 1962-1972. The maximum (1629.4 mm.) rainfall was recorded in 1969 and the minimum (558.0 mm.) in 1972. (Table-1).

Temperature : One of the most characteristic features of the area is great extremes of temperature. The temperature reaches its maximum i.e. between 43.2°C. to 44.2°C. in the months of April and May. The minimum temperature during these months ranges from 22.2°C. to 29.2°C. The temperature thereafter falls down and by December and January it is between 12.6°C. and 11.2°C. The details of the monthly maximum and minimum temperature for the years 1965-1972 are presented in the Tables 2 and 3 respectively.

Relative Humidity : The relative humidity is maximum during the months of July, August and September, when it is between 84% to 87%. Gradually it decreases to its minimum during the summer months of March and April, when it is between 52% to 55% (Table 4).

TABLE-I

Chhotaudepur — Rainfall in mm. — 8.30 a.m.

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual Rainfall
1961	0.0	5.3	0.0	0.0	4.1	183.6	482.1	169.7	291.3	17.3	1.3	0.0	1154.7
1962	0.0	0.0	0.0	0.0	0.0	7.9	344.2	313.7	318.5	0.0	30.5	2.0	1016.8
1963	14.0	0.0	0.0	0.0	3.3	65.8	257.6	541.0	149.1	58.2	55.9	3.8	1148.7
1964	0.0	0.0	0.0	0.0	20.3	137.9	276.9	302.3	155.2	0.0	0.0	0.0	892.6
1965	2.5	0.0	0.0	0.0	0.0	0.0	391.2	158.0	55.6	0.0	0.0	0.0	607.3
1966	0.0	0.0	0.0	0.0	0.0	62.2	193.3	192.5	239.0	0.0	0.0	0.0	687.0
1967	0.0	0.0	33.5	0.0	0.0	115.3	369.6	295.7	273.6	0.0	0.0	28.7	1116.4
1968	0.0	0.0	5.1	0.0	0.0	2.0	347.0	283.7	137.2	12.2	0.0	0.0	787.2
1969	0.0	0.0	0.0	0.0	0.0	152.4	525.8	369.3	555.5	0.0	4.6	21.8	1629.2
1970	0.0	0.0	0.0	0.0	7.9	416.8	328.2	397.8	442.7	0.0	0.0	0.0	1593.4
1971	0.0	0.0	0.0	0.0	17.0	125.0	367.0	236.0	171.0	8.0	0.0	0.0	924.0
1972	0.0	0.0	0.0	0.0	2.0	49.0	241.0	209.0	56.0	1.0	0.0	0.0	558.0
Mean	1.3	0.4	3.2	0.0	4.5	109.8	343.6	289.0	237.0	8.1	7.6	4.6	1009.6

TABLE - II

Chhotaudepur — Maximum Temperature °C — 8.30 a. m.

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
1965	32.2	33.9	38.9	44.4	45.0	39.4	37.8	37.2	37.2	37.2	37.2	31.7
1966	32.2	38.9	40.6	42.2	45.6	43.9	45.6	33.2	37.8	38.3	36.7	32.2
1967	31.1	36.7	40.0	43.9	45.6	42.2	35.0	31.1	36.7	37.8	33.3	31.7
1968	31.1	34.4	40.0	42.2	42.8	42.2	40.0	33.3	36.7	36.1	34.4	32.2
1969	32.2	35.6	42.2	43.9	43.3	40.6	37.8	35.6	35.0	37.2	35.0	30.0
1970	28.9	33.3	40.0	45.6	45.6	43.3	34.4	35.0	33.2	37.8	33.3	28.9
1971	29.4	35.6	42.8	43.9	43.3	36.7	33.3	33.3	37.8	34.4	33.3	28.9
1972	31.1	34.4	40.6	40.0	43.0	36.0	32.0	33.0	32.0	30.0	34.3	30.0
Mean	31.0	35.3	40.6	43.2	44.2	40.5	36.9	33.9	35.8	36.1	34.5	30.7

TABLE - III

Chhotaudepur — Minimum Temperature °C. — 8.30 a.m.

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
1965	15.6	12.2	15.6	20.0	26.7	25.6	25.6	23.3	23.9	20.6	16.7	15.0
1966	10.6	14.4	17.2	22.2	25.6	25.6	23.9	24.4	23.3	20.0	16.7	11.1
1967	10.0	10.0	17.8	20.0	26.7	23.9	23.9	22.2	22.2	20.2	16.7	15.6
1968	11.1	10.0	15.6	20.0	24.4	26.7	23.3	22.2	22.2	18.3	16.7	8.9
1969	8.9	16.7	17.8	22.2	25.6	23.3	22.8	22.2	21.7	20.6	20.0	13.3
1970	12.8	12.2	16.7	21.1	26.1	22.2	23.3	22.2	21.7	19.4	13.9	11.7
1971	10.0	12.8	13.3	23.3	25.0	23.3	22.2	23.2	22.2	17.8	15.6	12.2
1972	10.6	8.9	15.6	28.9	27.0	25.0	23.0	21.0	23.0	23.0	13.9	13.3
Mean	11.2	12.1	16.2	22.2	29.2	24.4	23.2	22.5	22.2	19.9	16.2	12.6

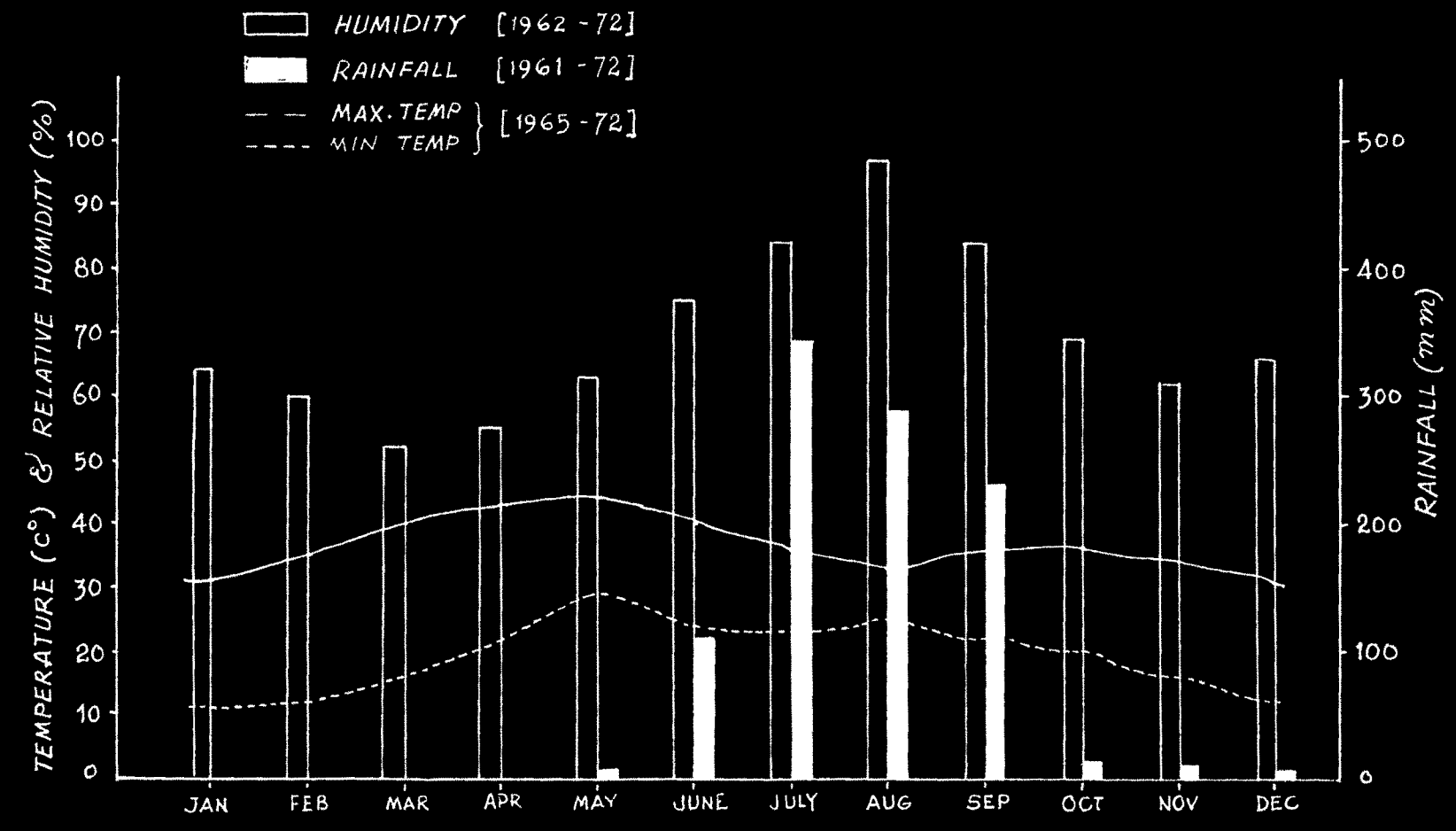
TABLE - IV

Relative Humidity %

Baroda Lat. 22°10' N Long. 73° 15' E 34.0 meters 8.30 a.m.

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1962	67	65	51	53	57	70	85	88	86	65	76	79
1963	69	67	53	58	62	74	86	92	86	73	77	72
1964	68	55	57	58	72	77	91	92	88	74	57	62
1965	68	59	53	44	67	71	85	87	80	66	63	61
1966	58	52	40	64	69	82	86	87	80	66	63	61
1967	49	54	65	51	60	77	91	92	89	69	59	80
1968	68	60	48	51	67	71	85	86	76	65	44	53
1969	56	55	53	44	53	76	84	82	83	65	58	68
1970	69	64	56	61	71	83	82	92	90	74	59	64
1971	66	67	44	62	62	73	72	74	87	80	64	72
1972	74	65	54	61	62	71	84	86	80	66	48	64
Mean	64	60	52	55	63	75	84	87	84	69	62	67

OMBROTHERMIC DIAGRAM FOR KAWANT RANGE



Graph - 1.

Geology and Soil

The area is covered by rocks of Deccan Trap lavas, overlying pre-cambrian metamorphics. There are inliers of cretaceous, marine transgression known as Bagh beds. Prominent among these are the ones near Mohangadh and Handevdungar consisting of Sandstones, Limestones and Shales. The Handev-dungar and Ambadungar outcrops are having rich fluorite mineralization.

The stratigraphic succession is as follows :

Basalts and associated rock	Cretaceo- Eocene	
Lime stones, Shales, Sandstones, Conglomerate	Bagh beds (Cretaceous)	
Granites	Post Aravalli	Pre Cambrian
Quartzite, Dolomite, Gueiss, Schist	Aravalli	

The fluorite mineralization at Ambadungar is, for the most part, of filling type, though at places dissemination and replacement is observed, the replacement being mainly

in brecciated rocks. The most important and economic constituent of the deposit is fluorite with gangue minerals like quartz, calcite, barite, feldspar (altered to clays), siderite, hematite, goethite, pyrolusite, apatite and anhydrite. Fluorite exhibits different colours like yellow, green, blue, violet, chocolate and milky.

Fluorite mineralization at Ambadungar is of post Deccan Trap age as the fluorite veins are found cutting across the Bagh sediments, Deccan Trap and granite rocks.

In the northern part of the main mining block encrustations of green and yellow coloured minerals, in association with fluorite vein are observed. These minerals are found to be radioactive and appear to be uranium minerals. The Bagh sediments of the Lower Narmada valley are devoid of any radioactivity which is suggestive that the uranium mineralization is cognetic with fluorite mineralization.

The outcrop at Mohangadh forms the biggest inliers of the Bagh sediments in this area. The fossiliferous limestones exposed in Mogra - Motichikhli area establish the age of the Bagh sediments as cretaceous.

The resulting fluorspar deposit is of a very great economic importance and is being mined and beneficiated by Gujarat Mineral Development Corporation.

Present work

The area under investigation has been botanically unexplored so far. Regular excursions were conducted in different seasons during the years 1967-1972 with a view to collecting data about the phenology of the plants and the seasonal changes in the vegetational pattern. Attention has been mainly concentrated on the hilly forest areas, which are often inaccessible especially during monsoon. All these efforts have resulted into valuable information on all the plants and an overall picture of the vegetation of the entire Kawant Range. Different aspects of the vegetation have been described quite in detail followed by enumeration of plants along with keys to identification of families, genera and species. Keys based on simple, macroscopic characters to facilitate identification of the trees and shrubs of the area have been prepared for the benefit of all concerned with forest wealth of this region.

A number of plants growing in the area exhibited morphological variability probably because of the peculiar geological formations. Different populations of some of the more conspicuous of them were studied, following Hutchinson's polygraph method, modified by Löve and Nadeau (1961). This has not only helped in a better understanding of the extent of variability but also in assessing the taxonomic status of some infraspecific taxa.

A phytogeographical analysis has been made of the various vegetation types of the area to find out the percentage of eastern, western, Indian and general elements of the flora. Comparision of this flora with those of adjoining regions is attempted to study the distribution of some important constituents of the flora.

Special attempts were made to record data regarding the local uses of plants for food, medicine etc. from the local tribals. The data after proper scrutiny, have been included in a separate chapter of the thesis.

Methodology

The area being 160 Kms. away from Baroda. I had to stay for days together in order to cover the different parts of the area in a particular month. Trips were on an average of week's duration and were covered in different seasons during the period of five years. The four stations viz. Kadipani, Hampheshwar, Saidivasan and Rangpur were selected for camping.

In the field, along with the collections of plants, observations on the habit, size, state in which observed, colour and/or smell of flowers etc. were recorded in rough field diaries. Moreover, notes on associations and their relative abundance, type of the undergrowth, types of rocks, soils etc. were also recorded. In order to give a clearer

picture of the vegetation in different localities of the area, photographs depicting the different aspects were taken. Enquiries were also made, regarding the local names and tribal uses of the plants, with the tribal people. All the above mentioned informations were carefully recorded in field diaries. Plants collected during each excursion were processed and preserved in the usual manner, following the instructions prescribed by Lawrence in his 'Taxonomy of vascular plants' (1951) and Santapau in his 'Botanical Collector's manual' (1955) with certain modifications as and when necessary.

The collection was brought to the laboratory where field identifications were confirmed after dissection of the various parts and reference to various regional floras and monographs available. The collected informations about plants after due checking was entered in the field diaries and then transferred to index-cards. Herbariumsheets of the dried specimens were prepared by mounting the same on standard sized herbariumsheets. After entering relevant informations, the sheets were stored in the departmental herbarium. The families, genera and species were arranged according to Bentham and Hooker's system of classification which is still in vogue in this country. Nomenclature has been brought up-to-date as far as possible in accordance with the International Code of Botanical Nomenclature (1966).

A few plants which defied all my efforts for proper

identification and some others which needed confirmation were either sent or carried to various leading herbaria such as Forest Research Institute Dehra Dun, Central National Herbarium Calcutta, Blatter's Herbarium Bombay and Royal Botanic Gardens Kew, England.

Fresh materials were generally used for making line drawings of plants to scale. Photographs were taken from time to time to depict the vegetation and the changes occurring therein. Only the selected drawings and photographs have been included in the thesis.

A number of plants growing in the area exhibited morphological variability probably because of the peculiar geological formations. Different populations of some of the more conspicuous of them were studied, following Hutchinson's polygraph method, modified by Löve and Nadeau (1961).

For preparation of polygraphs, important morphological characters were selected, and five or three index values were assigned to the morphological variations observed. 'Polygraph Key' is made in the shape of a wheel with radiating spokes, each representing one morphological character. Distance along the spoke represents the variations of that particular character as described in the characters of each taxa. Polygraphs were first plotted on a graph paper, which enabled to point out the particular position of a character

with variation on the spoke. These points were later joined to form a polygonal-graph or polygraph. Polygraphs of different populations of the same taxa or related taxa were interpolate to construct polygram revealing the variability or consistency of characters within the species under consideration.