I. INTRODUCTION

EARLY KNOWLEDGE OF INDIAN MEDICINAL PLANTS:

The knowledge of medicinal plants and their uses in medicine and surgery dates back, perhaps to the origin of human race. But, as no mode of recording the events existed in pre-historic times, there were no data on the methods of treatment practiced in that period. Whenever the curiosity of the present day man probes into the past and brings to light, even fragmentary information on the ingenious methods of our ancestors, it makes a fascinating study.

In India, the references to the curative properties of some herbs in the 'Rigveda' seems to be the earliest records of use of plants in medicine. The identity of several plants referred in the 'Suktas' of the 'Rigveda', can be fixed with reasonable certainty, but the reference to the plants are very brief. More detailed account is available in the 'Atharva-veda'. After the Vedas, there was no information on the development of this science in India for a period of about a thousand years.

Then came the two most important works on the Indian system of medicine, the works of Charak and Susruta,
namely, the 'Charak-Samhita' and 'Susruta-Samhita'. The latter deals with about 700 drugs and some of these are not indigenous to India. With the passing of time, more and more plants found entry into the native medicine. The useful properties attributed to one and the same plants in different parts of India.

The important works on the medicinal plants and drugs of India have to be considered by taking the works done regarding different provinces of the country. Excluding the "Pharmacopoeia of India", the "Pharmacographica Indica" and Watt's (1889-1893) "Dictionary of the Economic Products of India", all the works deal with drugs and medicinal plants of certain provinces only.

Roxburgh (1795-1819), Fleming (1810) and Royle (1839) were the first to write about the medicinal plants and their uses in the Asiatic Researches and the Journal of the Bengal Asiatic Society. But the information concerning the indigenous drugs was scattered until the publication of O' shaughnessy's Bengal Dispensatory in 1842. This was followed in 1844 by the "Bengal Pharmacopoeia." These two works form the important landmarks in the literature of indigenous drugs.

Much illustrated works on Indian Botany were
published in Madras, such as Ainslie's "Materia Medica of Hindustan" published in 1813 and "Materia Medica" published in 1826.

The 'Bombay Flora' 1861 by Dalzell and Gibson were the first works which gave a systematic account of the Bombay drugs. Birdwoods Economic products and Bazar Medicine gave illustrated account of some medicine (1865-1920). Sakaram Arjun's (1879) "Bombay Drugs" gave a catalogue of the Indian Drugs in the Museum of Royal Victoria Hospital at Netley.

Thus, although there are many works on the medicinal plants and drugs of different provinces of India, yet a great deal remains to be done. Yet much laborious works by Hooker (1879) "Flora of British India", the Gangetic Flora describing the plants of the United Provinces of Agra and Oudh by Duthie (1881), Bengal plants by David Prain (1963), Flora of Bombay by Theodore Cooke (1901-1908), Flora of Madras by Gamble (1913-1931), Flora Simlensis by General Collett (1902), Plants of Baluchistan by Burkhill (1909), Flora of Central Provinces by Heines (1910), were of great help to those interested in the medicinal plants of this country.
Lists of medicinal plants of India and their uses have been dealt by many others. Drury (1875) in his *Useful Plants of India*, refers a list of plants of medicinal properties. Bentley and Trimen (1880) published a list of medicinal plants in four volumes. Dey (1896) in his "Indigenous Drugs of India", gives a account of important drugs found in India. Nadkarni (1927) refers many medicinal plants in his "Indian Materia Medica". Chopra (1933) in his "Indigenous Drugs of India" gives a list of important plants and the parts used as drugs. Kirtikar and Basu (1935) touched many of the Indian medicinal plants giving detailed description and their medicinal values in the form of big volumes. The *Wealth of India* (1948-52) has been published in three volumes which gives an elucidate account of economic plants of India. Chopra, Nayar and Chopra (1956) in their book entitled "Glossary of Indian Medicinal Plants" deal with vernacular names of 2535 medicinal plants, their uses in indigenous medicine, chemical composition and distribution. In "Indigenous Drugs", Chopra et al. (1958) listed besides those included in the list of official drugs, 350 vegetable products which are used in the Unani and Ayurvedic system of medicine. Janardhan (1963) enumerated the medicinal plants of Khed taluka, Maharashtra State. The geography of the place and the important uses of the medicinal plants are herewith elucidated.
It is estimated that out of 2000 drugs that have been used in curing human ailments in India, only about 200 are of animal origin and a similar number are of mineral origin. The rest about 1500 are of plant origin. Pharmacological experiments or chemical tests have been done on a very small number of medicinal herbs. Intensification of such work should be the first requirement, if we have to exploit and boast up our medicinal plant resources. Many medicinal preparations based on plants include products from more than one plant, and the proper proportion of different ingredients and processing, administration and doses of the drug are all very important factors in treatment of ailments. Lately, by the progress of modern medicine and surgery, faith in, and popularity of the herbal medicines has been gradually declining. This is much to say in favour of the use of native medicinal herbs or indigenous system of medicine.

**Adhatoda vasica** Nees is a very widely known indigenous drug of India (Vasaka in Sanskrit) and has been prescribed in Ayurvedic texts (Chopra, Nayar and Chopra 1956, Biswas and Ghosh 1951) for chronic bronchitis, asthma and rheumatism. Similarly more than 2000 plants having medicinal properties have been included in literature. Early European Workers in this country took keen
interest in this group of plants and lot of work has been
done on them since hundred and fifty years on their
botanical, economic aspects and to a small extent on
their chemistry. More systematic work started in 1930,
when the Indian Council of Medicinal Research established
a botanical unit for the exhaustive survey of medicinal
plants and allied plants.

The understanding of the natural resources
of the earth requires an appreciation and knowledge.
Botanists have worked towards the compilation of a list
of the kinds of plants. The knowledge has been accumulated
through ages by accident, trial, experience and research.
' Ashwagandh', the root of *Withania somnifera*, is mentioned
in the ancient texts of Ayurveda. The present day
narcoties 'Daturas' (*Datura* species) in criminal practice,
dates back to the remote past.

In spite of the great development of facilities
to travel and explore the hidden regions of the world and
man's unending search in the nook and corner of the world,
there remains many significant parts of the earth yet to
be explored. The inventory, as it stands today, is far
from complete. Probably, we know of no more than three
fifth of the flowering plants of the world. Floras have
been written to account for the plants of most areas of the world. Many of them are century old and were written on the basis of scant collections made at the fringes of the country, before the railroads or roads existed or before modern concept of adequate florestic coverage were developed.

The herbarium is of vital importance for research and investigation of these plants, being the only means by which authentic material for study can be collected and correctly identified before a plant is taken for investigation. An exhaustive and more or less complete catalogue and herbarium of the plants were made under the name of Glossary of Medicinal plants (Chopra, Nayar and Chopra 1956).

THE SAHYADRI RANGES:

The western ghats or the Sahyadri range covering about 1280 km. in length, in the North right from Bombay (19.5N) up to Trivendrum (8.29N) in the South. It commences from the South of Tapti estuary, at once reaching the height of 914.4 metres to 1524 metres with interruption and spreads at the western edge of the three States, Maharashtra, Mysore and Kerala forming a western barrier of the upraised and tilted Deccan Block. There is a very steep and widely dissected fall to the undulating and narrow
coastal lowland which has been divided into Konkan and Malabar coasts. The Deccan Lava (778.2-914.4 m.) form the ghats to a little north of Goa. It then raises again to the great Nilgiris Hill with summit of 2.67 km. The break again for about 320 km. before raising again to 1.89 km. in Kudremukh of South Kanara. In Dharwar, the fractured features of the Sahyadris are not prominent. They are marked by chains of low hills, occasional scrap lands, isolated "hog-backs" and narrow meandering valley courses. The hill ranges of Budangudda between Dharwar and Kalghatgi, the hill ranges near Dhundashi and Hangal, and those of Masur and Maravalli, are in the South.

The western ghats rising from 914.4 to 1828.8 m. form a bull work boundary on the eastern side of South Kanara district. The hills varying in height from 762 to 914.4 m. run through the North Kanara district. The forest has chiefly the teak wood. The Sahyadri ghats in Karnatak dominate with Albizia lobbec, Terminalia arjuna. In addition, local strands of Bamboos are present in the forests of Sirsi and Siddapur. The towns like Halyal, Yellapur, Sirsi and Siddapur are the main gap towns of the ghats.

The zones or the belts of the western ghats may
be distinguished into three parallel parts, following the distribution of rainfall.

1. The evergreen belt stretches along the western ghats with the varying width of 3.75 km. to 25 km. The moist evergreen belt is a narrow strip for about 155 km. covering mountainous country with deep ravines and narrow valleys. The ridges of the mountains are bare except for the grasses while the valley slopes are richly wooded. The hill tops above 914.4 m. have herbaceous plants. The belt has the rainfall averaging 640 cm. or more.

2. The deciduous forest belt situates east of evergreen belt, about 12 to 18 km. wide. *Tectona grandis* is the chief species. The rainfall varies from 63.5 to 152.4 cm. The undergrowth of the forest is grass. The other prominent plants being *Acacia, Lagerstroemia, Zizyphus* etc. *Dendrocalamus* and *Bambusa* are the common bamboos.

3. Dry deciduous fuel tract and scrub is the narrow strip where the rainfall varies from 63.5 to 76.2 cm. The plants found in the region are xerophilous.
The ghat rain forests are important components of the wet forests. Here occur many uncommon species like *Vateria indica*, *Strychnos rheedii*, *Aporosa Lindleyana*, *Glochidion malabaricum*, *Bauhinia Bhoenicia* and *Diospyros ebenum*. The ghats rise to sheer 609.6 m. standing across the main direction of the monsoon winds. The velocity of the wind is responsible for the stunted growth of the trees. The ghats have a western slope and an eastern one which is less steep. The growth consequently hugs the leeward slopes of the top of the hills.

The forests situated on tops of mountains like the Bababudangiris, Kemmengundi, Agumbe etc., have an altitude of 914.4 m. and above. The solitary peaks of Bababudangiri attain a height of 1.7 to 1.82 km. The main species are *Electranthes menthoides*, *Styrium nepalense*, *Strobilanthus* etc. It has evergreen forest in the form of Shola vegetation. The ground flora consists of wealth of ferns and mosses. Several trees are confined to the higher altitudes, among which many be mentioned *Glochidion arboreum*, *Litsea glabrata*, *Pilosporum tetraspermum*, *Elaeocarpus* sp. and others. Numerous epiphytic orchids like *Oberon platycaulon*, *Erica mysorensis*, *Dendrobium herbaceum* also occur.
The last 304.8 metres mountain side is very steep and grown only with grass. The slopes have trees generally low and stunted with smaller sized leaves like Oka, Wendlandia, Allophylus, Eugenia, Symlocos, Electronia and bushy Strobilanthes fringes the tree growth. In the slopes, Hypericum mysorense is common. The dominant grasses are Andropogon, Ischoemum, Themeda, Cymbopogon and Eragrostis.

The south west monsoon commences from June and continues up to October, during which time the western ghats get the rainfall of about 254 cm. The slopes get heavy rainfall and are covered by forest. The western districts adjoining to western ghats receive the maximum amount of rainfall which ranges from 203 cm. to 330 cm. annually and reaches up to 762 cm. in some places. The western ghats come under evergreen rainforest. The annual temperature is about 70 degree F. and the average humidity exceeds 70%.

The soil is red coloured and rich in iron and aluminium. This is called laterite soil which occurs at high level of about 914.4 metres. Another kind of soil is coffee soil. This is red loamy forest soil, rich in humous, occurring in hilly slopes.

The vegetation is mostly concentrated on the main
ridge of the Sahyadries and its spurs. The valleys in between the spurs are composed chiefly of cultivated fields and grasslands.

Geologically, the area is comprised of different hills of Sahyadries.

The climate varies considerably in different areas depending chiefly on the altitude, rainfall and temperature.

The maximum rainfall is 560-625 cm. occurring in the extreme north west and minimum 60-75 cm. in eastern and central parts. The main rainfalls are between June and middle October; the remaining months are practically dry. The maximum temperature of the area does not exceed 38°C and minimum temperature recorded is about 18°C in the month of January.

The forests are almost without exception situated on the upper slopes and tops of the hills. The greater part of the forests, is composed of mixed deciduous species. The evergreen and semi-evergreen forests are found mainly at the tops of western ghats. Scrub jungles occur at comparatively lower altitudes.
In the present investigation, collections of the plants of medicinal properties have been restricted to Mysore State, as the area involved is too large for a single investigation. The Mysore State is situated in the south-western region of the Deccan peninsula with its latitudinal and longitudinal limits 11°30' N to 18°20' N; 74°10' E to 78°30' E. Climatically it is situated in the tropical monsoon region. The Konkan coast of Mysore State, also called Kanara coast, is a narrow strip of land of about 260 kilometres length situated between the western ghats and the Arabian sea. The width varies from 25 to 65 kilometres, narrow in north and broader towards the south.

The western ghats have a steep and precipitous slope to the west and a gentle slope to the east. The Sahyadries may well be described as Mysore State mountains. They vary in their topography. The annual rainfall in the districts covering the western ghats ranges from 203 cm. to 330 cm. annually. The hilltops receive annual rainfall up to 762 cm. (Agumbe of Shimoga district). The hilly tracts of western ghats including Shimoga, South Kanara, Belgaum and Dharwar have laterite soils, formed by the weathering of laterite rocks. Over the uplands and slopes of Chikamagalur and Dharwar districts, red soil containing
loams and red sandy loams prevail. In the down hills, they are much improved in texture and organic contents. In addition, there are black soils in the uplands and slopes in few regions of Dharwar and Belgaum districts.

The area of collection falls under four districts, South Kanara, Shimoga, Dharwar and Belgaum.

South Kanara district is situated along the western ghats between 12°28' - 13°58' N and 74°32' - 75°38' E. It is surrounded at the north by North Kanara and on its south by Coorg and Cannanore districts. The western ghats form a natural frontier where it touches Shimoga, Chikamagalore and Hassan districts.

The mountain of South Kanara is humid monsoonal with an annual rainfall of 370 cm. The rain fall is mainly between June and October. In the ghat region of Karkal, the average rainfall is 495.5 cm.

Three types of soil are available in the district, red soil, laterite and coastal sand. Red soil prevails in the extensive areas of the ghats (Arora 1965, 1966).
Average annual temperature for the district is 27.1°C with its maximum as 30.9°C and minimum 23.4°C.

Botanically the area has been little explored. Metz was perhaps earlier explorer to collect plants from South Kanara and adjoining parts of Malabar and South Mahratta country, an account of which has been given by the German Botanist Hohenacker (1849). Later on, Stolz (1881) was interested on the medicinal plants of this area and he listed nearly 500 plants of medicinal importance and published it in the regional language, Kannada. Gamble (1922) and Davis (1934) have surveyed the area, with the interest of timber yielding plants.

SCOPE OF THE PRESENT WORK:

Modern taxonomy considers not merely the recognition of similarities and dissimilarities between the individuals with common characters and geographical distribution, but also the chromosome number, behaviour and other genetical or geo-botanical criteria in the evaluations of taxonomic categories.

As documented knowledge of the earth's flora accumulates, the taxonomists can begin to understand better the inter-relationship of plants. Other botanists -
Physiologists, ecologists, anatomists, cytogeneticists and morphologists depend on the taxonomic findings to identify and name the plants with which they work. But, now there is an acute consciousness among the botanists to refer various kinds of anomalies, which have been introduced into the so called 'Natural classification' of the flowering plants. The experimental taxonomy (Clements and Hall 1920) which is variously known as Biosystematy (Camp and Gilly 1943), Genealogy (Turesson 1923) and Synthetic taxonomy (Turrill 1953) give an answer to the problem of classification. The most reliable evidence and conclusions are obtained from application of orthodox taxonomy as well as those of cytology and genetics, combined with cultivation in uniform and various environments.

Cytotaxonomy denotes the role of cytology in modern taxonomy. It involves the study of morphology and behaviour of chromosomes indicating genetical differences reflecting on morphological characters. Then the role of cytology in modern taxonomy is of immense value and the classical work of modern scientists give a clue. The apparent conflict of views of various taxonomists working with the same genus can often be classified by the application of a combination of cytogenetic and cyto-taxonomic studies.
For the present study, 500 wild taxa have been collected from different parts of western ghats and critical karyomorphological studies have been made only in 22 species. In 8 of these and other 65 species, a detailed meiotic study showing various complexities and peculiarities is made. Idiograms have been drawn to assess the cytological relationships. Meiotic study might throw light on the nature of speciation. Morphological characters of the plants were critically examined and correlated with cytological observations.

Much of the cytological works done so far on important Indian Medicinal plants, were only to report the chromosome numbers. However, some of the medicinal plants which are also otherwise known either as food crops or as condiments, have been dealt in more detail by the earlier investigators. References of such works have been given in Chapter III.

Several species of the flowering plants which are of great medicinal value to both man and animals, are found as weeds in the waste lands and fields. The authenticity and utility of the drug from these weeds depends upon correct identification of these plants. Minute morphological differences in plants like the presence and
absence of hair, thickness of the leaves or size and nature of the flowers, have been the means of differentiating the species.

However, it has often been shown that medicinal properties of a plant, are independent upon the habitat of the plant. Studies of medicinal plants from different habitats become important, when there is considerable variation in morphology, cytology and their drug contents. It is known that the active principles of a plant vary not only with the different seasons and with the ploidy of the plant. To acquire a complete knowledge of the drug contents of these medicinal plants, distributed in different habitats, there is an immediate need to understand the cytology like the chromosome number, morphology of the chromosomes and behaviour of chromosomes at different ploidy level.

Considering the need for such studies, the present investigation is undertaken. For this projected study, an extensive collection of 87 species from different parts of Sahyadri ranges, is made. Detailed meiosis is studied and whenever possible karyomorphological studies are made.
Morphological characters are studied and minute details are also noted, to enable the correct identification of the species.

A little justification is also done to provide a clear picture of variation and evolution among few species of medicinal plants.