

SOME SIDELIGHTS ON MEDICINAL PLANT RESOURCES OF INDIAN UNION AND KASHMIR*

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From time immemorial, the use of various species of plants in the alleviation of human sufferings and diseases has been known in India. Based on the medicinal and therapeutic values of several plant species, some ancient Hindu literature is extant and most valued and unparalleled among them being *Danvantri's Vaidya Sastra*, *Susruta Samhita*, *Charaka Samhita* and a few others, which treatises are still held in great veneration. India's contribution towards medicinal herbs has indeed been so rich that from the Vedic period to the present day, a number of medical works on the treatment of several maladies and their cure, based on the indigenous medicinal resources of our country have appeared. With the advent of the British rule in India, however, the Western system appears to have set its influence on Indian medical science. But not till the early 19th century did many of the medicinal herbs obtain official and international recognition in the various materia medica, pharmacopoeias, pharmaceutical codex and other related more modern authoritative literature on medicines and their therapeutics. Among the pioneer literature during this period is to be mentioned the work of Van Rheede, Sir William Jones and others. John Fleming's *Catalogue of Medicinal Plants* appeared as early as 1810, and this was followed immediately after by Ainslie's *Materia Medica of Hindoostan* in 1813. It would be of interest in this connection to mention by way of further illustration that the *Bengal Pharmacopoeia* by W.B.O' Shaughnessy was first published by order of the then Government in December, 1844 ably assisted by Nathaniel Wallich. *The British Pharmacopoeia* issued by the Medical Council of England in 1865 and 1867 authorised a great many changes in nomenclature and other matters, which factor rendered the earlier pharmacopoeias valueless for the medical profession. Because of this, the *Bengal Pharmacopoeia* of 1844 had also to be revised and the *Pharmacopoeia of India* by E. J. Waring came out subsequently in 1868. The ultimate quarter of the 19th century, saw a series of authoritative works from Drury (1873), Dutta (1877), Murray (1881), Dymock (1883), George Watt (1889-1896), Dymock, Warden and Hooper (1890-1899), Mohideen Sheriff (1891), Kannai Lal Dey (1896) and Sakharam Arjun (1897). With subsequent

greater accumulation of knowledge and specific information on medicine and therapeutics, the Indian and Colonial Addendum to the *British Pharmacopoeia* of 1898 was released in 1900. Among other valuable literature, subsequent to this date are to be mentioned those of Kritikar and Basu (1918), Nadkarni (1927), Roberts (1932) and R. N. Chopra (1933). In the more recent years, the *Indian Pharmacopoeial List* of 1946 was published in 1947, and the *Indian Pharmaceutical Codex* was released in 1953. It is indeed a happy augury that the Indian Pharmacopoeial Committee was constituted by the Government of India in 1948, and the first publication of the Committee came out in 1955. The present day trends in medical spheres would thus seem to indicate that modern Indian medicinal botany has a comparable position with that obtained in other progressive countries.

Distribution Pattern of Medicinal Plants in India

India possesses varied types of soil and climate, supporting equally varied types of vegetation. It shows such extreme types of vegetation from the purely dry desert vegetation to the thick moist rain forests through the intermediate series of coastal forests, dry deciduous forests, and moist deciduous vegetation. Altitudinally also great variations in forest types exist, and the characteristic among them are the purely tropical deltaic and estuarine forests, forests in the plains, forests of the sub-tropical and temperate belts and finally forests of the alpine regions in the higher ranges of the Himalayan stretches. A complex variety of species thus grow in these different kinds of forests in different regions.

Roughly the following distinctive types can be distinguished :—

I. THE HIMALAYAN AND OTHER MONTANE REGIONS IN THE NORTH OF INDIA

From 304.8m.—1981.2 m. (1000 ft.—6500 ft.) and a little above, monsoon forests flourish in the Eastern Himalayas. In these forests, Magnoliaceae, Guttiferae, Leguminosae, Combretaceae, Rubiaceae, Dipterocarpaceae etc. are very common. *Shorea robusta* or sal, with grasses, herbs and shrubs flourish in several areas in these forests

*The words "and Kashmir" have been added by the Editor.

The monsoon forests are met with in Terai and Bhabar areas also, with sal, *Lagerstroemia*, *Acacia* and *Salmalia*. Among the characteristic species in the monsoon forests in the north are sal, *Cedrela toona*, *Terminalia chebula*, and *Diospyros*. At the foot of the Eastern Himalayas semi-evergreen forests occur with *Altingia*, *Shorea*, *Dipterocarpaceae*, *Michelia*, *Cinnamomum*, *Cedrela*, *Ailanthus*, *Tetrameles*, and among the undergrowths are *Phoebe*, *Machilus*, *Actinodaphne*, *Mesua* and others.

The semi-evergreen types are seen in Nepal and Sikkim regions also. In these places, at higher elevations, however, *Acer campbellii*, *Rhododendron* sp., *Brassaiopsis alpina*, *Daphne cannabina*, *Berberis aristata*, and *Juniperus* flourish. Among shrubs and herbaceous vegetation are to be mentioned *Aconites*, *Anemones*, *Violets*, *Gentians*, *Fritillaria* and *Fragaria* species.

Evergreen forests are seen in various belts in the Himalayas in Sikkim, Bhutan, and in Assam Khasia and Garo Hills. In these regions, the characteristic trees are *Machilus edulis*, *Schima wallichii*, *Betula alnoides*, *Castanopsis*, *Aralia* sp., and *Cinnamomum obtusifolium*. At comparatively higher elevations *Quercus* and other Buck-oaks and Maples come up.

Between 914.4 m. and 1828.8 m. in the Central and Western Himalayas, the forests are more or less characterised by open Chir-pines, with or without evergreen forest-types.

Temperate forests are met with in the Eastern Himalayas between 1828.8 m. and 3048m. In the Central and Western Himalayas, however, they are seen from 1524 m. to 3048 m. Conifers, Oaks, Pines, Spruce, Deodar and Junipers occur in these forests. Generally, there may be a dense undergrowth of herbs and shrubs in some of these temperate forests.

The alpine vegetation is seen throughout the Himalayas, generally above 3048 m. and extends usually upto 4572 m. Birch, Firs and Rhododendrons occur in these alpine forests with low tangled forests of shrubs. In the Western Himalayas, however, the alpine vegetation is seen beyond 3657.6 m. extending up to 4572 m. or even higher. *Betula utilis*, Silver birch, Junipers and Rhododendrons are met with in these forests, but are comparatively far less numerous than in the Eastern Himalayas.

In the alpine and sub-alpine regions of the Himalayas, the characteristic families of flowering plants represented are Compositae,

Primulaceae, Saxifragaceae, Ranunculaceae and others. Among the various species of medicinal plants growing in the Himalayan regions in these belts are to be mentioned *Achillea millefolium*, *Artemisia absinthium*, *Artemisia maritima*, *Artemisia vulgaris*, *Atropa acuminata*, *Berberis vulgaris*, *Ferula narthex*, *Hyssopus officinalis*, *Swertia chirata*, *Corydalis govaniana*, *Corydalis ramosa*, *Hyoscyamus niger*, *Mentha arvensis*, *Mentha longifolia*, *Thymus serpyllum*, *Clematis gouriana*, *Aconitum napellus*, *Paeonia emodi*, *Geranium wallichianum*, *Geranium nepalense*, *Geranium ocellatum*, *Geranium robertianum*, *Skimmia laureola*, *Valeriana wallichii*, *Valeriana hardwickii*, *Valeriana officinalis*, *Inula royleana*, *Inula falconeri*, *Inula racemosa*, *Saussurea lappa*, etc.

In the temperate Himalayas are seen *Berberis asiatica*, *Prunella vulgaris*, *Swertia chirata*, *Podophyllum emodi*, *Nardostachys jatamansi*, *Aconitum balfourii*, *Aconitum chasmanthum*, *Aconitum ferox*, *Aconitum heterophyllum*, *Ephedra Gerardiana*, etc., some of the species even extending to sub-alpine regions.

In the Assam Hills are seen *Abroma angustata*, *Anamirta paniculata*, *Artemisia vulgaris*, *Prunella vulgaris*, *Hedyotis auriculata*, *Myrica nagi*, *Piper longum*, *Rauwolfia serpentina*, *Swertia chirata*, *Aconitum ferox*, *Coptis teeta*, etc.

II. THE GANGETIC PLAINS

In this belt we come across semi-evergreen, evergreen and wet sal forests in different areas. Among the characteristic species are *Shorea robusta*, *Mangifera indica*, *Ficus* sp., *Madhuca indica*, *Michelia champaka*, *Polyalthia*, *Salmalia*, *Terminalia*, *Artocarpus*, *Lagerstroemia*, etc. In the wet sal forests are seen *Schima wallichii*, *Anogeissus latifolia*, *Syzygium*, *Tetrameles nudiflora* and others. Several medicinal species grow in different regions in these forests. Some among them are *Cassia alata*, *Caesalpinia crista*, *Commiphora mukul*, *Mucuna prurita*, *Hemidesmus indicus*, etc.

III. DECCAN AND WESTERN GHATS

In the Western Ghats, semi-evergreen forests are met with, and the species represented are *Terminalia paniculata*, *Xylia dolabriformis*, *Dalbergia latifolia*, *Polyalthia*, *Diospyros*, *Schleichera*, *Vateria*, etc. The undergrowths are represented by Myrtaceae, Lauraceae, Acanthaceae and Rubiaceae. Good deal of teak grows on the slopes of hills in the Western Ghats.

Rain forest types also occur in the Western Ghats with Guttiferae, Dipterocarpaceae, Myristi-

caceae, Sterculiaceae, Meliaceae, Ampellideae, Zingiberaceae, Myrtaceae, Melastomaceae, Piperaceae and Araceae. The characteristic species of these types of forests are *Tetrameles nudiflora*, *Mangifera indica*, *Artocarpus* sp., *Dipterocarpus indicus*, *Hopea parviflora*, *Calophyllum tomentosum*, *Cullenia excelsa*, *Actinodaphne hookerii*, *Terminalia chebula*, *Cedrela toona*, *Vateria indica* and others.

At higher altitudes in mountains, especially at Nilgiris, Pulneys, Anamalais and Travancore Hills, a very characteristic type of forests locally called as Sholas occur, with evergreen types and represented by *Michelia nilagirica*, *Ternstroemia japonica*, *Eurya japonica*, *Gordonia obtusa*, *Ilex*, *Melastoma*, *Euonymus*, *Syzgium*, *Symplocos*, *Elaeocarpus* etc., and at lower elevations are seen *Maesua ferraea*, *Vitex altissima*, tree ferns, *Hydnocarpus alpina* etc. In these Sholas, *Rubus* and *Rhododendrons* and a few other species of a temperate type are also seen.

Elsewhere in Deccan, moist deciduous and dry deciduous forests occur. The dry forests in many of the areas consist of low forests entirely of deciduous trees and shrubs.

Among the more common species of medicinal value in the Western Ghats and Deccan areas are *Ailanthus triphysa*, *Alpinia galanga*, *Anisomeles malabarica*, *Aristolochia bracteata*, *Aristolochia indica*, *Berberis asiatica*, *Caesalpinia crista*, *Oldenlandia auriculata*, *Hydnocarpus laurifolia*, *Piper nigrum*, *Rauwolfia serpentina*, *Acacia arabica*, *Acacia catechu*, *Alhagi pseudalhagi*, *Commiphora mukul*, *Strychnos nuxvomica*, *Strychnos potatorum* and others.

IV. WESTERN INDIA, GUJERAT AND RAJASTHAN

This area is typically characterised by highly xerophytic forests of low and open formations with many species adapted for xerophytic conditions. Thorny trees are common. These forests are seen in Indus plain regions, South Punjab, Saurashtra, Cutch, Rajasthan, Gujerat and portions of Upper Gangetic plains and Deccan plateau. In these tracts, *Aristolochia bracteata*, *Artemisia vulgaris*, *Cassia alata*, *Cassia angustifolia*, *Commiphora mukul*, *Euphorbia neriifolia*, *Urginea indica*, *Acacia senegal*, *Alhagi pseudalhagi*, *Aloe abyssinica* etc. are to be found.

V. SOUTH INDIA AND COROMANDAL COAST

In this belt, dry evergreen forests are characteristic along the Coromandal coast. The species represented here are *Chloroxylon swietenia*, *Diospyros ebenum*, *Strychnos nuxvomica*, *Mimusops elengi*, *Soymida febrifuga* and others. Among thorny shrubs and trees are *Randia*, *Canthium*,

Zizyphus, *Flacourtia*, *Dichrostachys*, etc. Other characteristic species are *Caesalpinia crista*, *Cassia angustifolia*, *Hemidesmus indicus*, *Alangium salvifolium* and *Aloe barbadensis*.

Introduction of Medicinal Plants

Apart from the exploitation of the naturally growing wild plants of India for medicinal purposes attempts were made from time to time to introduce some important foreign species also to augment the drug resources of the country. Even though several useful and interesting plants were thus introduced, in many cases such attempts on the whole had been attended with much less success in our country than what had been attended in other countries. In respect of a few species, however, considerable success were noticed. It would be significant to mention here that nutmeg, cloves and a few others, even though introduced by the beginning of the 19th century, have not formed articles of extensive cultivation or export even in present days.

In the earlier days, several species have come to the notice of botanists and others which could profitably be introduced in our country. By way of one illustration we may state that it was suggested in the early 19th century that in Malabar region *Aerodictidium camata*, *Agathophyllum aromaticum*, *Dryobalanops camphora*, *Caryocar butyrosomum*, *Franciscea uniflora*, *Solanum pseudoquina* and others, could profitably be introduced. But nothing appears to have been done so far in these respects.

Credit goes to Dr. Royle who first brought to the notice of British public the importance of the introduction of *Cinchona* to India about the middle of the 19th century. He very strongly recommended that several species of *Cinchona* could be cultivated on the slopes of Nilgiris in South India and South Himalayas. Dr. Anderson, who was a former Superintendent of the Royal Botanic Gardens at Sibpur, Calcutta, conceived of the possibility of introducing *Cephaelis ipecacuanha*.

The history of the introduction of these species and their cultivation in India is of considerable interest and may, therefore, be very briefly considered here.

After Royle's recommendations, Dr. Falconer, Dr. T. Thomson and Dr. T. Anderson repeatedly advocated the desirability of deputing some responsible gardening collectors to South America to explore the *Cinchona* forests there and procure samples of stocks of plants for cultivation in India. Till 1858, however, there had been little progress.

Ultimately on the recommendation of the British Medical Board, the Secretary of State for India sanctioned the despatch of a special agent for the purpose. Accordingly, C. R. Markham was selected for the expedition to Andes. A team consisting of Markham, Pritchell, Spruce and Cross set out in 1860. They explored the valley of Tambopata, Ecuador, Huanaco, Loxa, New Granada and few other places. As a result of their expeditions, the first experiments with cultivation of *Cinchona* in India, started in 50 acres of land at Ootacamund on the Nilgiris in South India. Dr. Anderson went to Java and had brought also some materials for introduction in India, and by about 1862 *Cinchona* was successfully introduced to India. *Cinchona* cultivation started simultaneously also in Bengal under Dr. Anderson. While the *Cinchona* responded exceptionally well in Nilgiris and Bengal, in several other areas in India, as in Malabar Hills, Wyanad, South Kanara, Coorg, Travancore, Pulneys, Shevroys, Tinnevely Hills, Khasia Hills, North West Provinces, Bombay and Burma, it met with failures only.

Ipecac was first introduced to India in Sibpur Gardens by Dr. King in 1866 and by 1871-72, some fresh consignments were received from Scotland and Kew, which formed the materials on which the cultivation of this species in Sikkim started.

Best results were, however, obtained in Rungbi and at about 915m., above sea-level. In South India, ipecac cultivation was started on a small scale at Barliyar Botanic Gardens, and later on large scale cultivations were initiated at Nilambur and soon a stage was reached when it was possible to pronounce that India could cultivate ipecac to meet her own supplies of this valuable root, and need not have to be dependent on Brazil for its imports.

Likewise *Erythroxylum coca* Lam., was introduced to India by about 1870 from Kew and from the stocks raised in Peradenya Gardens in Ceylon. The plants were first grown in the Agri-Horticultural Society Gardens at Madras. Till 1885 there had been very little enthusiasm for the cultivation of this species. The Agri-Horticultural Society Gardens at Calcutta, however, distributed seeds and other materials to tea-gardens of Assam, Cachar, Duars, Darjeeling, Terai, Jaunpore. At Ranchi also *Coca* was cultivated from seeds obtained direct from Paris. But the cultivation in these areas had a serious set back, because of South America dumping the market with its own products and consequently cheapening the products in European markets. Thus the cultivation of *Coca* ended with the experimental

stage only, even though conditions most suitable for its growth are available in many places in India.

By about the beginning of the 19th century, Royle and Ainsle stressed on the cultivation of Jalep in India. But only by the middle of that century some attempts were made in this direction. Dr. Jameson, who was the Superintendent of the Botanic Gardens at Saharanpur introduced for the first time in 1854, Jalep, into Himalayas. This species was, however, subsequently grown also in the Nilgiris in South India, and the propagation of this drug actually commenced only by about 1877. This species flourished so well in Nilgiris in South India, that by about 1881-82, it was well established that this could be grown as a commercial crop. But in Bengal, however, the cultivation of this did not meet with much success.

The male plant, a species belonging to the family Menispermaceae, is considered valuable as the root of this species furnishes the medicine called *Colomba* which has been known to be much valued in Europe. The first specimen of this root was brought from Mozambique to India in 1805 by Dr. Anderson Berry, who was a member of the Medical Board at Fort St. George at Madras. This root was given to Dr. James Anderson, the Physician General, who considered it as a great acquisition to India. No serious attempts appear to have been made to grow and cultivate this species in the later years, and the endeavours seem to have stopped with a few trials in the early years.

Several other medicinal plants are known to have been introduced at various times in India, and some of them are even known to have met with great success in large scale cultivation. It will be too lengthy to go into the details of all of them. In brief, it may, however, be mentioned that there exist great possibilities for commercial cultivation of several important medicinal species on being introduced to India, as could be easily inferred from the success obtained in earlier trials with many of them. Planned cultivation on a regional basis, with select species, is likely to yield very great results and benefit to the country.

Species Under Cultivation

In passing, we may just refer also to a large number of plants known to be of medicinal value, which are now known to be cultivated in various parts of India on a large or small scale. For the sake of convenience these species are treated below under different regions.

BOMBAY, WESTERN INDIA AND WESTERN GHATS

Among the widely cultivated species, mention

may be made of *Ocimum basilicum*, *Curcuma longa*, *Zingiber officinale* etc.

The various other species under cultivation in this belt are *Nasturtium officinale*, *Thlaspi arvense*, *Bixa orellana*, *Hibiscus cannabinus*, *Averrhoa carambola*, *Averrhoa bilimbi*, *Aegle marmelos*, *Plumbago zeylanica*, *Ocimum sanctum*, *Salvia officinalis*, *Piper nigrum*, *Ficus carica*, *Curcuma amada*, *Curcuma zedoaria*, *Alpinia galanga*, etc. Among these such species as *Nasturtium officinale*, *Aegle marmelos* etc., occur also in the wild state. *Parkinsonia aculeata*, *Adenanthera pavonina* are planted often.

MADRAS, CENTRAL AND EASTERN INDIA

In this zone, the following would merit consideration. *Papaver somniferum*, *Vitis vinifera* (in the hills of Deccan, in Mysore and Kurnool), *Cassia alata*, *Cassia angustifolia*, *Plumbago zeylanica*, *Ocimum basilicum*, *Ocimum sanctum*, *Salvia officinalis*, *Elettaria cardamomum*, etc. *Zingiber officinale* is widely cultivated in these regions, and among the species found in a wild state may be mentioned *Papaver somniferum*, *Cassia alata*, *Plumbago zeylanica* and *Elettaria cardamomum*.

GANGETIC REGION

In this region, the various species cultivated are *Papaver somniferum*, *Hibiscus sabdariffa*, *Vitis venifera*, *Cicer arietinum*, *Plumbago zeylanica*, *Punica multiflora*, *Ocimum sanctum*, *Ocimum gratissimum*, *Ocimum americanum*, *Ocimum basilicum*, etc. Of these, *Papaver somniferum*, *Cicer arietinum*, *Plumbago zeylanica* and the various species of *Ocimum* are extremely or largely cultivated.

HIMALAYAS AND ITS STRETCHES

Several useful species are cultivated in various regions of the Himalayas and at various altitudes. Among the most important are *Crocus sativus*, *Atropa belladonna*, *Digitalis purpurea*, *Digitalis lanata* in the Western regions and in the Eastern extremities, *Cinchona* sp., *Ipecac*, and others.

Apart from the species mentioned above, the following are some of the plants with known medicinal properties or are being used medicinally and which are cultivated in various places as an economic crop.

KASHMIR

Atropa belladonna (on small scale in Baramulla, Darang and Yarikeh)
Crocus sativus (at Pampur at about 5,300 ft.)

Digitalis lanata (Tanmarg, Baramulla)
Digitalis purpurea (Tanmarg)
Fagopyrum jaeschkeana
Trigonella foenum-graecum .. (extensively cultivated)
Iris germanica and others.

PUNJAB

Calendula officinalis
Cuminum cyminum
Papaver somniferum
Trachyspermum ammi
Trigonella foenum-graecum
 and others.

UTTAR PRADESH

Cuminum cyminum,
Papaver somniferum.

DEHRA DUN

Cinnamomum camphora

SAHARANPUR

Cinnamomum camphora

BENGAL

Cinchona ledgeriana,
Crossandra infundibuliformis,
Croton tiglium,
Cuminum cyminum,
Trachyspermum ammi
 and several others.

SIKKIM

Cinchona calisya

DARJEELING

Digitalis purpurea

ASSAM, KHASIA AND JAINTIA HILLS

Cinchona ledgeriana,
Croton tiglium,
Cuminum cyminum,
Fagopyrum esculentum,
Piper longum.

SATPURA RANGE

Cinchona succirubra.

RAJPUTANA

Cuminum cyminum,
Papaver somniferum.

BOMBAY

Trigonella foenum-graecum

WESTERN GHATS, KONKAN, ETC.

Alpinia calcarata,
Croton tiglium,
Elettaria cardamomum,
Piper longum.

NILGIRIS

Cinchona calisya, (in Moyar Valley)
Cinchona officinalis, (in Ootacamund)
Cinchona robusta, (in Naduvattam)
Cinchona succirubra, (in Naduvattam)
Cinnamomum camphora,
Digitalis purpurea,
Fagopyrum esculentum.

ANAMALAIS

Cinchona ledgeriana.

MADRAS, MYSORE, AND SOUTH INDIA

Alpinia khulanjan,
Cinnamomum camphora,
Cinnamomum zeylanicum,
Croton tiglium,
Trachyspermum ammi
Trigonella foenum-graecum.

MANY PARTS OF INDIA

<i>Curcuma aromatica</i> ,	<i>Mentha aquatica</i> ,
<i>Curcuma longa</i> ,	<i>Mentha piperata</i> ,
<i>Curcuma zedoaria</i> ,	<i>Mentha sativa</i> ,
<i>Dioscorea alata</i> ,	<i>Mentha spicata</i> ,
<i>Euphorbia nerifolia</i> ,	<i>Ocimum basilicum</i> ,
<i>Foeniculum vulgare</i> ,	<i>Zingiber officinale</i>
<i>Kaempferia galanga</i> ,	and others.

Species Once Cultivated, Since Discontinued and Similar Others Not Taken Notice of

It is known that certain species of plants were once under cultivation and the products were utilised for medicinal purposes, but in subsequent years they have gone out of cultivation. For

example, *Hyoscyamus niger*, the Henbane, which is a native of Europe and temperate Himalayas was for several years successfully cultivated at Hewra by Dr. Gibson, and at Dapauri near Poona, by Dr. Lush. The extract of this plant was supplied to the Bombay Government Medical Stores. Its cultivation was, however, subsequently discontinued in those areas.

In some cases, the cultivation under Indian climate was found difficult. In this, *Salvia officinalis* and *Croton tiglium* in certain tracts of India may be mentioned. In these cases, the raw products appear to have been imported from outside countries. *Salvia officinalis* is a native of South Europe and the dried leaves of this species were known to be imported into India from Europe. So also in the case of *Croton tiglium*, which was once grown in Hewra near Poona, on its cultivation being stopped, the supply was being obtained through imports from China and other places. *Alhagi pseudalhagi*, known as Persian manna, is common along the Gangetic valleys and is also found in Central India. But the manna of the species is imported into Bombay from Iran, Afghanistan and other countries, as the local species were found to have very poor yield or no yield at all of manna. In all similar cases, the revival of cultivation to stop imports or to culture the species under improved methods to yield the desired products would greatly help to make the country self-sufficient as regards her own needs and would also be conducive to set up well balanced economy and trade relationships with other countries.

It may be mentioned here that while certain species are known to be under cultivation by the Hill tribes at various elevations in the mountainous regions in India, whether any scientific and systematic cultivation of such species for medicinal purposes have been taken up is not known. For example, *Chenopodium album* is cultivated by hill people in the Western Himalayas. It has reputation as a medicine for spleen and bilious disorders. Likewise, some of the medicinal species which were in earlier years cultivated but whose cultivation has been discontinued, may also be taken up for cultivation.

Non-Flowering Plants of Medicinal Value

Besides the flowering plants which are being used medicinally in various ways, quite a few fungi and ferns are also similarly used. But their systematic cultivation or commercial exploitation appears to be limited. Among the fungi, *Claviceps purpurea* is raised in the Nilgiris in South

India. The following are some of the medicinal ferns:—

Actiniopteris dichotoma
Adiantum emarginatum
A. capillus-veneris
A. caudatum
A. flabellatum
A. lunulatum
A. pedatum
A. tenerum
A. venustum
Aspidium polymorphum
Asplenium adiantum-nigrum
A. falcatum
A. fimbriatum
A. furcatum
A. parasiticum
A. ruta-muraria
A. trichomanes
Athyrium filix-femina
Botrychium lunaria
B. ternatum
B. virginianum
Chielanthes tenuifolia
Cyrtomium falcatum
Dicranopteris linearis
Drymoglossum carnosum
Drynaria quercifolia
Dryopteris barbigera
D. blandfordii
D. felix-mas
D. marginata
D. odontoloma
D. schimperiana
Hemidictyum caterach
Lycopodium clavatum
Lygodium flexuosum
L. japonicum
Osmunda regalis
Polypodium vulgare

Species with Great Potentialities

There are several species the medicinal properties of which are very great, but still not thoroughly exploited. *Gisekia pharnaceoides* has been known to be a very powerful specific for taenia or tape worm. Such drugs as *Hagenia abyssynica* *Daphne mezereum* and others though used as medicine for such purposes, do not seem to stand a comparison with *Gisekia pharnaceoides* in regard to its anthelmintic properties. This small succulent herb belonging to the family Ficoideae is found throughout India and often covering extensive tracts in waste lands, in jungles in Ferozepore, Sharanpur, throughout Oudh, Bengal, Gujerat and Western Peninsula. Fresh green leaves are considered most effective for the total expulsion of taenia, and the acrid volatile principle it contains is found to be fatal to the parasite only, without disturbing the digestive system of human beings. It would be highly desirable to have this species thoroughly exploited and extracts of leaves, capsules and stalks are prepared for pharmaceuti-

cal purposes without impairing the virtues of this species.

Species of *Daphne* are officinal and have been recognised in several pharmacopoeias. *Daphne laureola* is made officinal in Indian Pharmacopoeia. In France *Daphne gnidium* is known to be officinal and in Europe *Daphne mezereum* is a recognised medicine. Not much is known of the medicinal attributes of the various Indian species. In view of the fact that several species of *Daphne* have been found to be medicinal, and have also gained officinal status in pharmacopoeias, it would seem desirable that the Indian species are thoroughly investigated and the ones with great promise are thoroughly exploited. Similarly, *Cyrtophyllum peregrinum* the bark of which species is found efficacious in malarious fevers would seem worthy of investigation and commercial exploitation. Likewise several species of *Geranium* as *Geranium robertianum*, and *Geranium maculatum*, are highly valued in Europe and America in medicine. In India we have such species of *Geranium* as *Geranium collinum*, *Gernium graveleanum*, *Geranium lucidum*, *Geranium molle*, *Geranium nepalense*, *Geranium ocellatum*, *Geranium polyanthes*, *Geranium pratense*, *Geranium pusillum*, *Geranium rectum*, *Geranium refractum*, *Geranium robertianum*, *Geranium rotundifolium*, *Geranium taberaria*, and *Geranium wallichianum*. These species may well be investigated for commercial exploitations. *Datisca cannabina*, a tall erect herb found in subtropical and temperate Himalayas, contains a bitter principle similar to 'quassia' in its bark. *Dictamnus albus* has also some bitter principle in its root bark and the hill people esteem it as a favourite medicine. Similarly *Centaurium roxburghii* has a powerful bitter principle. *Ailanthus excelsa* bark is found to be an expectorant, useful in chronic cases of asthma and bronchites, and the bitter principle of the bark is very valuable. Critical investigations on their therapeutics, and well co-ordinated commercial exploitation are likely to lead to beneficial results.

Indian Species as Specifics

The tropical diseases are so many and the afflictions so numerous that it will be beyond the scope of this paper to enumerate them as well as the medicinal plant resources available in the country. However by way of a few illustrations, and limiting the same to the absolute minimum, the following may be given:—

For rheumatism, the oil from *Aesculus indica*, *Alangium salyifolium* *Ahagi pseudalhagi* *Atlantia monophylla*, *Jatropha glandulifera* have been efficacious. In liver and spleen disorders, and

jaundice *Eclipta prostrata*, *Baliospermum montanum*, *Flacourtia indica*, *Aristolochia rotunda*, *Bauhinia tomentosa*, *Ficus retusa* are found valuable. Several species have been reported as antidote in snake bite, such as *Alangium salvifolium*, *Amaranthus spinosus*, *Aneilema scapiflorum*, *Arisaema speciosum*, *Calonyction aculeatum*, *Elaeodendron glaucum*, *Euphorbia antiquorum*, *Flacourtia indica* and several others. For gonorrhoea, *Amaranthus spinosus*, *Juniperus communis*, *Ficus religiosa* and several others are useful. For worms, *Acalypha indica*, *Actiniopteris dichotoma*, *Ailanthus altissima*, *Alangium salvifolium*, *Albizia anthelmintica*, *Aristolochia bracteata* are well known. In elephantiasis, *Conium maculatum*, *Hybanthus enneaspermus* find useful applications. Practically for every type of malady, several plant species are known as specifics. Co-ordinated and concerted efforts in pooling the numerous resources would bring great benefit to the country and her people.

Substitutes

Several species are known to be held as good and efficient substitutes for the standard drugs, in the treatment of specific diseases and ailments. In the following, some examples are given :—

Standard drugs	Substitutes
Ipecacuanha	.. <i>Ailanthus triphysa</i> <i>Alangium salvifolium</i> <i>Tylophora indica</i>
Cinchona and Quinine	.. <i>Ajuga bracteosa</i> <i>Caesalpinia bonduc</i>
<i>Croton tiglium</i>	.. <i>Baliospermum montanum</i>
Sarsaparilla	.. <i>Ichnocarpus frutescens</i>
Santonin	.. <i>Butea monosperma</i>
Cinnamon	.. <i>Cinnamomum tamala</i>
Taraxacum	.. <i>Eclipta prostrata</i>
Gentians	.. <i>Exacum bicolor</i> <i>Exacum pedunculatum</i>
Chirata	.. <i>Exacum pedunculatum</i> <i>Exacum bicolor</i> <i>Centaurium roxburghii</i> <i>Swertia chirata</i>
<i>Coptis teeta</i>	<i>Geranium wallichianum</i>
Tragacanth	.. <i>Astragalus heratensis</i> <i>Astragalus strobiliferus</i>
Adhatoda	.. <i>Phlogacanthus thyrsiflorus</i>
Male Fern	.. <i>Athyrium filix-femina</i> <i>Embelia ribes</i>
Valerian	<i>Nardostachys jatamansi</i>

In several cases the value of these substitutes has been well established and these substitutes have also come into practical use as such. In a few cases, they are claimed as even better and more efficacious than the recognised and standard drugs. For example, it is claimed that the oil of *Gaultheria fragrantissima* from Assam is found to be even superior to the Canadian winter-green oil obtained

from *Gaultheria procumbens*, in its therapeutic properties. *Embelia ribes* which drug as an anthelmintic is even superior to male fern, being quite devoid of nauseating properties of the male fern. In respect of some, however, opinions are varied among the medical profession as regards the potent of the substitute drugs. For example, *Butea monosperma* is claimed by some medical men as a good substitute for santonin and, therefore, could advantageously be used as such, while in other quarters, though its property has been recognised, it is being considered as less powerful than santonin. Future investigations on these and several other drugs, which could be used as substitutes, could possibly help in deriving the maximum use of these vegetable resources, and with much profit and benefit to the country.

Exports and Imports of Crude Drugs

Several crude drugs are known to be exported from India, even from the very ancient times. Likewise, a large number of drugs are also imported into India. In a few cases, even when the particular species are found growing in India the crude drugs in respect of them are still imported without the local resources being exploited for commercial purposes. The obvious causes are that the local produce are not found in sufficient quantities the quality of the drug is inferior or not comparable with the imported goods, or that the potentialities of such species have not sufficiently been recognised and appreciated in the commercial fields. Large scale cultivation of such species where possible, improvement of the quality of the drug and intensive investigations into the possibilities of these crude drugs would seem necessary on a well planned basis to better the economy of the country and make her self-sufficient in these respects.

The Persian manna is collected in Kurdistan and other places and it is imported from such areas and Kabul into Bombay in large quantities, even though the species *Alhagi pseudalhagi* yielding the product is known to grow in Meerut and on banks of Jumna. *Embelia ribes* which has properties as an anthelmintic, has been known as an article of export from Bombay, even from early days, the berries of which being largely exported to Germany and other European countries. *Aristolochia rotunda* which is used as a drug in enlargement of spleen, is imported into Bombay. Similarly *Conium maculatum* or Kurdumana, is imported from Iran and sold in Bombay markets. Among others imported may be mentioned *Onosma bracteatum*, *Verartum viride*, *Verbascum thapsus*, Ackawai nutmegs and others.

Another important product imported into

India is of *Cinnamomum camphora*. Camphor used to be generally imported into India hitherto from China, Japan, Borneo, and Sumatra. With difficulties in imports and restrictions thereto of these products from outside sources, it is high time that serious attempts are made to augment these products by various means in India itself. *Cinnamomum camphora* has been known to be under cultivation in Dehra Dun, Saharanpur, Nilgiris, Mysore and other places. Intensive cultivation, employing improved techniques should be resorted to. Besides several other plants are known to yield camphor, and which species also have been commercially exploited in other countries for camphor. For example, *Blumea grandis* yields plenty of camphor from its leaves and stems, and as such this species is known to have been tapped, and camphor was prepared in plenty in Tenasserim. This species might with advantage be cultivated in suitable areas in India. Likewise, *Blumea densiflora* yields camphor, the quality of which was pronounced as identical with the product imported from China. This plant is found in Assam forests and elsewhere in India and could be a possible source of camphor if brought under extensive cultivation. In this connection, the successful attempts made at the cultivation of *Ocimum kilimandscharicum* and the distillation of camphor from the leaves of this plant at the Pilibhit Forest Division in Uttar Pradesh, and in West Bengal deserve special mention. Among other produce under export and import, we may mention here about cloves and nutmegs. The adjoining table gives an idea of the trade returns in these products:—

From the accompanying table it may be seen that the import figures of values for cloves, nutmegs and camphor for the year 1959, are in the range Rs. 17247576.00, Rs. 1764470.00 and Rs. 434410.00 respectively representing roughly increase over 1943-44 by 12-13% in cloves, by 9% in nutmegs and 50% in camphor. Imports could at least be brought down, if not avoided, if alternative local sources are made productive. This would seem applicable to several other crude drugs imported into India too many to mention here.

The Status of Indian Rauwolfias

According to the *Flora of British India* by Hooker, there are five species of *Rauwolfia* growing in a wild state in India, in the tropical Himalayas, in the plains of India, in Khasia hills in Assam, Deccan, Western Ghats and Travancore. Of these, *Rauwolfia serpentina* is the best known for ages as a most valuable medicinal plant. Strangely enough, this species was not, however, largely employed in internal or external trade, and as such

CLOVES—(EXPORT).

Year	Country to which exported	Quantity in Cwt.	Value in in Rs.	Total
1943-44	British possession	2	400.00	
1959	West Germany	10	8361.00	9,257.00
	Maurituis ..	5	595.00	
	Ghana ..		291.00	
	U.S.A. ..		10.00	

CLOVES—(IMPORT).

Year	Country from which imported	Quantity in Cwts.	Value in in Rs.	Total
1943-44	Zanzibar and Pemba ..	25360	1858972.00	2121235.00
	Kenya Colony	1929	149980.00	
	Aden ..	617	5250.000	
	Ceylon ..	506	43035.00	
	Musket Territory	223	16740.00	
1959	Zanzibar ..	21224	16856429.00	17247576.00
	Kenya ..	361	269337.00	
	Singapore ..	84	60746.00	
	Ceylon ..	257	38044.00	
	Netherlands	138	7767.00	
	China ..	12	6800.00	
	Malaya	4	5000.00	
	West Germany	3	2171.00	
	Union of South Africa.	4	1282.00	

NUTMEGS—(IMPORT).

Year	Country from which imported	Quantity in Cwts.	Value in Rs.	Total
1943-44		854	155564.00	155564.00
1959	Malaya ..	506	897177.00	1764470.00
	Singapore ..	490	762374.00	
	Ceylon ..	312	66261.00	
	Indonesia ..	6	20921.00	
	China ..	7	14560.00	
	U.K. ..	1	2171.00	
	Hongkong ..	1	1006.00	

CAMPHOR—(IMPORT).

Year	Country from which imported	Quantity in Lbs.	Value in Rs.	Total in Rs.
1943-44	U.S.A. ..	120049	210310.00	210680.00
	U.K. ..	23	240.00	
	Hongkong	13	130.00	
1959	Japan ..	207705	398361.00	434410.00
	China ..	8754	21805.00	
	West Germany	3603	8930.00	
	U.K. ..	2003	4810.00	
	Hongkong ..	270	504.00	

till quite recently, *Rauwolfia serpentina* had remained only as a minor drug plant in India. *Rauwolfia* appears to have been recognised in pharmacopoeal list by about 1946 only and later in *Indian Pharmaceutical Codex* in 1953, and in *British Pharmaceutical Codex* only by 1954. It is significant to mention here that India was one of the principal suppliers of the root of *Rauwolfia serpentina* to U.S.A., the other countries from which U.S.A. obtained its chief commercial source of the drug being Pakistan, Ceylon, Siam, and Burma. The various Indian species supplying the drugs, besides *Rauwolfia serpentina* are *Rauwolfia canescens*, *Rauwolfia micrantha*, *Rauwolfia densiflora* and *Rauwolfia beddomei*. All the latter species are also found as substitutes of *Rauwolfia serpentina*. *Rauwolfia perakensis* from Malaya is occasionally seen also adulterated with *Rauwolfia serpentina* roots from India.

Even though *Rauwolfia serpentina* had been known long used in Ayurvedic medicines in India, systematic collection and ledgering of the species, according to the Western system appears to have started only by the middle of the 19th century. One of the earliest collections of *Rauwolfia* in Indian Herbaria is that of Wight, made in 1856 from Peninsular India. Among other important collections made in the 19th century are to be mentioned those of T. Anderson in 1862, from Rangeet Valley in Sikkim at 548.6 m. elevation, Kurz's collection from Sikkim and Rangeet valley and from Rajmahal and Sahibgunj in 1868, Gamble in 1844 from Trichur in South India, Gammie, Lister, Cleghorn, Inayat and King's collections, Mackinnon, Prain and others. In the early 20th century quite a large number of collections have been made from Himalayan regions, Peninsular India, Assam, Burma, Andamans etc., by Meebold, Fischer, Bell, Burkill, Bourdellion, Modder, Ribu, Calder, Craib, Rogers, Graddock, Vicary, King and others.

As regards the distribution and density of the species, generally speaking, it is noticed that *Rauwolfia serpentina* grows sporadically along Singtam and Rangeet valleys at 475 m. to 762m. elevations, but its density in the areas appear to be too scarce for commercial exploitation on a large scale. More or less sporadic growths of *Rauwolfia* species are seen in many other areas also, as in the Punjab, Uttar Pradesh, North and East Bastar and Bindranawagarh in Madhya Pradesh, in Bihar in Saranda Division of Singhbhum district, Santal Parganas near Rajmahal hills, in Orissa in Kalahandi, Koraput, Puri, Phuban and Ganjam districts, West Bengal, Buxa and Cooch Behar and Jalpaiguri District, Assam, Visakapatnam districts and in the latter in Kanakapally Range, Araku Range, Naraiapatnam Range,

Madgole Range, Poderu Range and in Nadyal in Kurnool, Madras, Kerala, Mysore, Bombay, and in the sub-Himalayan tracts in the plain from Sutlej to Assam, and especially in Dehra Dun, Siwalik, Rohilkand, in North Oudh and in PEPSU in Simla hills in Kandaghat Forest Division. In Himachal Pradesh it is poorly represented or does not occur at all, and the same appears to be the case with Bhopal and Manipur States. In Jammu and Kashmir, *Rauwolfia serpentina* is seen in the cultivated stage only.

There appears to be no precise and reliable data as to the exact quantity of roots that may be available for commercial purposes from the different forests and states in India. There is also no correct and complete information available on the quantity that is being collected annually from the Indian forests and cultivated fields, nor of the quantity annually consumed in India. Information on some of these aspects is, however, available in respect of a few areas and they too are rough and approximate estimates only. Thus, the annual output in Andhra Pradesh from Visakapatnam Northern Division is estimated at 2400 lbs. and from the Southern Division about 30 maunds of 40 seers. In Assam, it is gathered that about 40 to 50 tons can be procured annually and in Buxa and Cooch Behar in Jalpaiguri District, about 8 tons of annual production is roughly estimated. In Madhya Pradesh, in North Bastar Division, the estimated number of plants is about 24,000, and from the East Bastar, the availability of dried roots is reckoned as about 30 seers, while in Bindrawagarh, about 1/2 ton of dried root is expected as the output. In many other areas, the plants are too scarce and as such very poor yield is reported and in the present circumstances commercial exploitations may not be promising. This is generally the case with Andamans, Portions of Bihar, Himachal Pradesh, Madhya Pradesh, Mysore, Punjab, Tripura State, Sikkim and other areas. The commercial possibilities are thus poor in such areas, and the Forest Departments have not been engaging themselves in the regular and systematic collection of the products and in certain provinces this article has not even been listed as a forest minor produce. In Orissa, however, the roots can be obtained on a commercial quantity.

It would, however, be interesting to mention here that according to an estimate of an American firm, the total root available in Indian forests is approximately about 15,700 tons, and it is understood that out of this, 400 tons were marketed in 1953. It is also understood that a sustained supply can be ensured on the basis of not more than 300 tons at the most being extracted annually.

It is only in a few places, serious attempts at systematic collection of *Rauwolfia* have been recently taken up. In Andhra Pradesh, the forest departments make their own arrangements to collect, and the dried roots are sold by open auction. In Bombay and Mysore, restrictions have been imposed now, and the species cannot be collected from the forest areas without the permission of the Forest Department.

In Orissa, even though commercial supplies are available, they are not fully exploited and the privilege of collection is given to the lessees. A condition is also made in the agreement for the lessee to restock the area worked by putting in a small stump of root with a portion of the stem above the collar. In West Bengal, in Buxa and Cooch Behar, Forest Divisions, commercial supplies can be expected but the species is not now collected by the Forest Departments as this is understood is due to lack of intending buyers.

Cultivation of *Rauwolfia* in various scales is now done in some parts of the country either on a commercial basis, or on an experimental and nursery basis. Large scale plantation of *Rauwolfia serpentina* is raised at Yellapur, Dandeli, Haliyal and a few places, now in Mysore State. At Dehra Dun intensive cultivation is done by the Himalayan Drug Company. The other areas where cultivation has been done are Rongo in West Bengal,

Mysore, Madras, Saurashtra, parts of Orissa, and among the research institutions, cultivation is done in Kashmir in Jammu and Tawi, by the Drug Research Laboratories in about 5 acres of land in Jammu District and by the Research Nursery at Indore, though on a small scale. A factory is known to have been established in Orissa State and the produce from Kalahandi forests is despatched to this factory for further processing of the drug.

The cultural experiments carried out at the Forest Research Institute gives promise of availability of roots of exploitable size from about 2 to 3 years old plantations, under irrigated conditions. With increasing tempo in the cultivation and extraction of the pure drug, it may be possible to set up a good trade, internal and international.

The accompanying table gives an approximate idea of the trade and commerce on *Rauwolfia* and *Rauwolfia* products.

From the table, it may be observed that there is greater demand for the Indian *Rauwolfia* and serpentina roots in the Western countries. In 1959, however, Serpentina roots had found a growing demand even in the Eastern countries. The heavy consumers of Indian products are U.S.A., U.K. and West Germany in the West, and Japan in the East. Comparatively speaking, the value of

EXPORT FIGURES OF RAUWOLFIA ROOTS, SERPENTINA, EXTRACTS AND ALKALOIDS.

	1957		1958		1959				
	Roots Rs.	Extracts Rs.	Roots Rs.	Extracts Rs.	Roots Rs.	Serpentina Rs.	Extracts Rs.	Alkaloids Rs.	
<i>Eastern:</i>									
Singapore ..	x	x	x	x	x	79	x	718	
Malaya ..	x	x	x	x	x	1426	x	3294	
Burma ..	x	x	x	x	x	2085	x	1333	
Ceylon ..	x	x	12792	x	x	295	x	90	
Nepal ..	67	14	x	90	x	x	x	x	
West Pakistan ..	x	3167	x	x	x	43218	x	5675	
Japan ..	x	93	12460	120	67442	125826	x	50	
Afghanistan ..	x	3167	x	x	x	x	x	x	
Kenya ..	x	x	x	x	x	x	180	x	
<i>Western:</i>									
U.S.A. ..	60178	x	186426	10384	253216	26858	x	344	
U.K. ..	20748	2001	20599	x	46051	x	x	x	
West Germany ..	28216	x	120432	x	234628	45199	x	x	
France ..	108	x	x	x	x	x	x	x	
U.S.S.R. ..	x	x	62076	x	15879	x	x	x	
Netherlands ..	x	x	17104	x	5200	x	x	x	
Belgium ..	x	x	8654	x	43906	x	x	x	
Italy ..	x	3156	3100	x	x	x	x	x	
Argentina ..	x	1329	x	x	x	x	x	x	
Norway ..	x	x	x	x	x	x	2690	x	

Indian products had increased nearly by 2 to 5 times in 1959, than what it was in the immediate preceding years, and this is noticed in the case of Japan, U.S.A., U. K. and West Germany and Belgium. But in U.S.S.R., it has come down nearly by four times. Similarly in Netherlands, the trend shows a considerable fall. However, with the growing demand for the Indian roots in several other countries in 1959, as compared with the preceding years, and also the value of export in respect of many other countries mounting up, it can be safely assumed that there is considerable scope for expansion of trade and commerce in these articles, if tackled on a well-planned and co-ordinated basis. It is hoped that this will engage the attention of the enterprising enthusiasts in the pharmaceutical and commercial lines.

Pharmaceutical Centres in India

Despite the vast expanse of the country, with innumerable vegetable resources available in different environmental conditions in India, centres of pharmaceutical activities appear to be very restricted and comparatively few. Bombay and Calcutta have the largest number of pharmaceutical firms and concerns, with over 50 and 40 such concerns at least in the two cities respectively. Smaller number of firms are situated in Baroda (4), Ahmedabad (4), Hyderabad (3), Nilgiris (3), Madras (3) and 24-Parganas (3). Besides these, other important centres of pharmaceutical concerns are Dehra Dun, Bulsar, Ahmednagar, Patna, Rajasthan, Gujerat, Kanpur, Ghazipur, Delhi, Amritsar, Banglaore, Nagpur, Vijayawada and Pimpri near Poona and Rajapalayam in Rammad District in South India. Most of these firms use imported or indigenous crude drugs to manufacture tinctures, galenicals and various other pharmaceutical preparations. Greater number of firms are of small and medium scale, while comparatively only a few are of large scale.

It is to be mentioned here that besides these firms or concerns, there are about 2000 small scale units also, distributed in various places of India, who are also similarly engaged. With more concerted efforts, and with the rich available resources, it is possible to increase the production of pharmaceutical preparations in India for local consumption and external trade.

A check list of various species of plants found in different regions of India is appended.

Summary

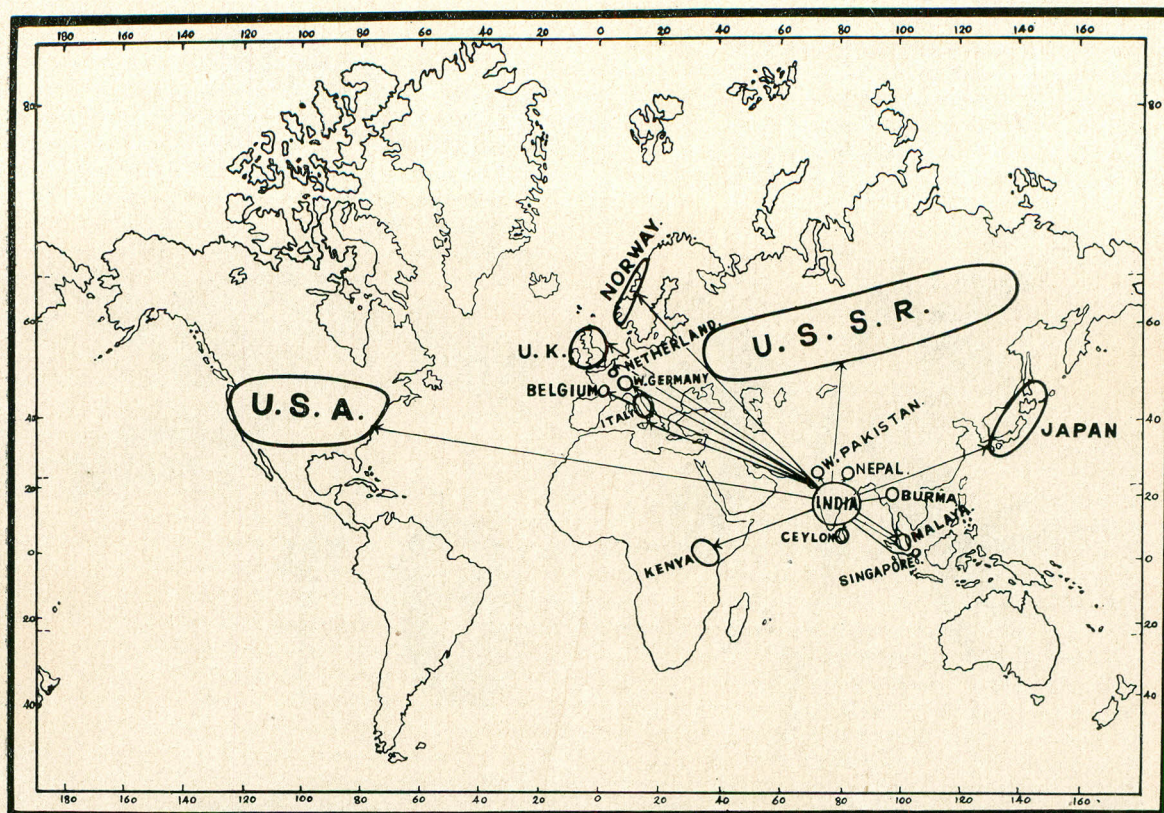
The medicinal use of several species of plants is known in India even from the remote Vedic

periods, and many treatises are available on their medicinal virtues and therapeutics. But only by the beginning of the 19th century have many of the indigenous drug plants obtained official recognition in the more modern pharmacopoeias and materia medica. The works of Van Rheede and Sir William Jones rank among the pioneer 19th century literature on Indian medicinal plants. By the middle of that century, however, by the order of the then Government of India, the Bengal Pharmacopoeia was first published in 1844, which was followed by some valuable literature on the subject by distinguished men as Dymock, Mohiddin Sheriff, Kritikar and Basu, Nadkarni and R.N. Chopra. In 1953, the Indian Pharmacopoeial Codex was released and with the setting up of the Indian Pharmacopoeial Committee by Government of India in 1948, its publication was issued in 1955.

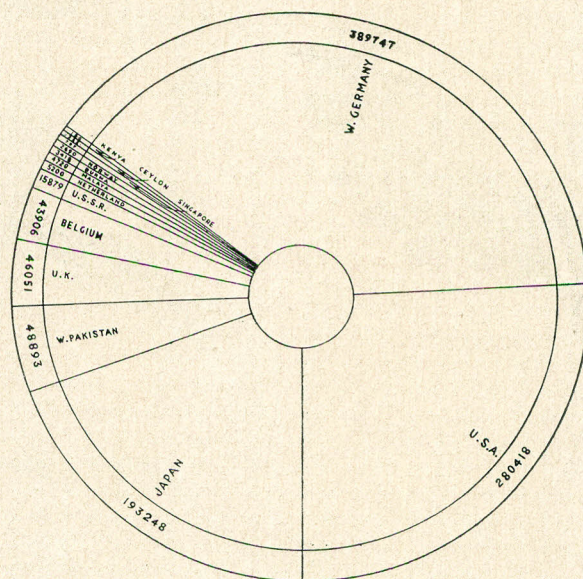
India possesses a rich and extensive forest resource, with varied types of vegetation as the dry deciduous, moist deciduous, moist evergreen, subtropical, temperate and alpine. The various species characteristic of each region, and of medicinal value are described in detail to include such species as *Artemisia subsinthium*, *Atropa acuminata*, *Hyssopus officinalis*, *Hyoscyamus niger*, *Mentha arvensis*, *Paeonia emodi*, *Valeriana wallichii*, *Aconitum napellus*, *Inula royleana*, *Saussurea lappa* etc. from the alpine and sub-alpine regions of the Himalayas; *Podophyllum emodi*, *Swertia chirata*, *Nardostachys jatamansi*, *Ephedra gerardiana*, *Berberis aristata* in the temperate Himalayas; *Rauwolfia serpentina*, *Coptis teeta*, *Prunella vulgaris* in Assam Hills; *Cassia alata*, *Caesalpinia crista*, *Commiphora mukul*, *Mucuna prurita* in the Gangetic plains; *Alpinia galanga*, *Aristolochia bracteata*, *Berberis aisatica*, *Hydnocarpus laurifolia*, *Piper longum*, *Strychnos nuxvomica* in the Deccan and Western Peninsula etc.

Several useful species have been introduced and cultivated in India, and as best examples we have *Cinchona* and *Ipecac*. In some cases, as in *Erythroxylum coca*, cloves and nutmegs, the cultivations have not been on a large scale but most localised and restricted, even though areas suitable for their large scale cultivation in India are available.

The various species under cultivation in different parts of India have been described in some detail. Thus in Bombay, Western India and Western Ghats, *Ocimum basilicum*, *Curcuma longa*, and *Zingiber officinale* are the widely cultivated species and among the other species under cultivation here are *Thlaspi arvense*, *Salvia officinalis*, *Curcuma amada*, *Alpinia galanga* etc. In Madras, Central



Export of Rauwolfia roots and products to different countries in the world.



Quantities and values of exports from India to different foreign countries during 1959 of serpentina roots and other Rauwolfia products.



Fig. 1.—*Toddalia asiatica* (L.) Lamk.

Fig. 2.—*Caesalpinia bonduc* (L) Roxb.
Fig. 4.—*Exacum pedunculatum* Linn.

Fig. 3.—*Ajuga bracteosa* Wall.



Fig. 5.—*Eclipta prostrata* Linn. Fig. 6.—*Ailanthus triphysa* (Dennst.) Alston. Fig. 7.—*Alangium salviifolium* (L) Wang.
 Fig. 8.—*Baliospermum montanum* Muell-Arg.



Fig. 9.—*Centaurium roxburghii* (G. Don.) Druce. Fig. 10.—*Butea monosperma* (Lamk.) Taub.
 Fig. 11.—*Exacum bicolor* Roxb. Fig. 12.—*Geranium wallichianum* D. Don.



Fig. 13.—*Dictamnus albu* Linn.

Fig. 14.—*Datisca cannabina* Linn.
Fig. 16.—*Tinospora crispa* Miers.

15.—*Ailanthus excelsa* Roxb.

Fig. 17.—*Onosma bracteatum* Wall.Fig. 18.—*Veratrum viride* Ait.
Fig. 20.—*Aristolochia rotunda* Linn.Fig. 19.—*Verbascum thapsus* Linn.

India and Eastern India, the species cultivated are *Papaver somniferum*, *Cassia alata*, *Cassia angustifolia*, *Elettaria cardamomum* etc.

In the Gangetic regions, several species of *Ocimum*, *Papaver somniferum*, *Plumbago zeylanica* etc. are cultivated. In the Himalayan regions and its neighbourhood the species cultivated are, *Atropa belladonna*, *Crocus sativus*, *Digitalis purpurea*, *Trigonella foenumgraecum*, etc. In Assam and Khasia Hills, *Cinchona ledgeriana*, *Croton tiglium*, *Piper longum* are cultivated and in the Nilgiris in South India, several species of *Cinchona*, *Cinnamonum camphora*, *Digitalis purpurea*, *Fagopyrum esculentum* are cultivated.

In the earlier days, some medicinal plants were regularly cultivated for their medicinal products but subsequently their cultivation was discontinued. For example, *Hyoscyamus niger*, and *Croton tiglium* were once cultivated near Poona. Revival of their cultivation is recommended. Species with known potentialities as *Gisekia pharnaceoides* as a powerful anthelmintic, *Daphne* sp., from India, *Cyrtophyllum peregriinum*, *Datisca cannabina*, *Dic-tamnus albus*, *Centaurium roxburghii*, etc. may be fully exploited. Indian species which have proved efficient substitutes for standard drugs may be more fully exploited.

The status of *Rauwolfia* in India, its distribution, cultivation, trade etc. is briefly described. The paper concludes with a general survey of the pharmaceutical centres in India, chiefly engaged in the manufacture of galenicals, tinctures and other pharmaceutical preparations from the indigenous crude drugs or from the imported ones. A list of medicinal plants occurring in various parts of India is appended to the paper which gives a fair idea of the distribution pattern of the Indian medicinal plant resources.

Appendix I

Check List of Species of Known Medicinal Virtues Found in Different Parts of India

(The list includes also some of the cultivated species. No claim is made here for the list to be complete and exhaustive).

I. HIMALAYAN STRETCHES AND ADJOINING REGIONS

Chitral Range etc :

Aconitum heterophyllum Wall.
A. napellus Linn.
Actaea spicata Linn.
Adonis aestivalis Linn.
Anemone narcissifolia Linn.
A. obtusiloba D. Don.
Aquilegia vulgaris Linn.
Artemisia vulgaris Linn.

A. sacrorum Ledeb.
A. scoparia Waldst & Kit.

Berberis lycium Royle.
B. vulgaris Linn.

Caltha palustris Linn.
Chenopodium album Linn.
C. botrys Linn.
Clematis orientalis Linn.

Delphinium brunonianum Royle.
D. cashmirianum Royle.
D. denudatum Wall.
D. vestitum Wall.
Dioscorea deltoidea Wall.

Geranium nepalense Sw.
G. rotundifolium Linn.
Gnaphalium luteo-album Linn.

Hedera nepalensis K. Koch.
Hyssopus officinalis Linn.

Nepeta cataria Linn.
N. elliptica Royle.
Origanum vulgare Linn.

Peganum harmala Linn.
Podophyllum emodi Wall.

Ranunculus arvensis Linn.
R. falcatus Linn.
R. muricatus Linn.
R. sceleratus Linn.

Salvia lanata Roxb.
S. moorcroftiana Wall.
S. plebeia R. Br.
Solidago virgaurea Linn.

Tagetes erecta Linn.
Tamarix troupitii Hole.
Thalictrum foliolosum DC.
Thymus serpyllum Linn.
Trigonella corniculata Linn.

Valeriana hardwickii Wall.
V. wallichii DC.
Viola patrinii (DC) Ging.
V. serpens Wall.

Xanthium strumarium Linn.

Chamba and Kangra Valley:

Artemisia vulgaris Linn.
Berberis vulgaris Linn.
Caltha palustris Linn.

Centratherum anthelminticum (Willd) Kuntze.

Ephedra gerardiana Wall.

Gentiana kurroo Royle.
Geranium wallichianum D. Don.

Hamiltonia suaveolens Roxb.

Inula royleana DC.

Origanum vulgare Linn.

Podophyllum emodi Wall.
Ploygala crotalarioides Buch-Ham.

Salvia moorcroftiana Wall.
Spermacoce stricta Linn.

Thymus serpyllum Linn.

Urarica picta Desiv.

Valeriana wallichii D.C.
Viola biflora Linn.
Vitis vinifera Linn.

Zanthoxylum alatum Roxb.

North West and Western Himalayas:

Achillea millefolium Linn.
Ajuga bracteosa Wall.
Alliaria officinalis Andr.
Angelica glauca Edgrew.
Apium graveolens Linn.
Arcitum lappa Linn.
Artemisia maritima Linn.
A. siversiana Ehrh.
Astragalus multiceps Wall.
A. strobiliferus Royle.

Buxus wallichiana Baill.

Calamintha clinopodium Benth.
Caltha palustris Linn.
Capsella bursa-pastoris (Linn) Moench.
Cimicifuga foetida Linn.
Colchicum luteum Baker
Crocus sativus Linn.

Daphne oleoides Schreb.
Elaeagnus angustifolia Linn.

Galium verum (Linn.) Hyssop.
Geranium robertianum Linn.
G. rotundifolium Linn.
G. wallichianum D. Don.
Geum elatum Wall.

Hyoscyamus niger Linn.
Hyssopus officinalis Linn.

Iris kumaonensis Wall.

Origanum vulgare Linn.

Rumex acetosa Linn.

Nepal :

Abroma augusta Linn.
Adiantum capillus-veneris Linn.
Ardisia solanacea Roxb.
Argemone mexicana Linn.
Artemisia vulgaris Linn.

Berberis aristata DC.
B. asiatica Roxb.

Calonyction aculeatum House.
Canscora decussata Schult.
Cassia fistula Linn.
C. occidentalis Linn.
C. sophera Linn.

C. tora Linn.
C. mimosoides Linn.
Celastrus paniculatus Willd.
Centratherum anthelminticum (Willd) Kuntze.
Chenopodium ambrosioides Linn.
Cissampelos pareira Linn.
Clausena pentaphylla DC.
Clematis gouriana Roxb.
Cocculus hirsutus (Linn.) Diels.
Cotoneaster bacillaris Wall.
Crotalaria prostrata Rottl.
C. albida Heyne
C. spectabilis Roth.
C. medicaginea Lam.

Datura metal Linn.
D. stramonium Linn.
Dichroa febrifuga Lour.
Dioscorea pentaphylla Linn.
D. amara Bartlett.

Elaeocarpus sphaericus
Embelia ribes Burm.
E. robusta C.B. Clarke.
Embelica officinalis Gaertn.
Euphorbia nerifolia Linn.
Evodia fraxinifolia Hook. f.
Exacum tetragonum Roxb.
Fagara ovalifolia (wt.) Engler.
Flacourtia indica Merr.

Gaultheria fragrantissima Wall.
Geranium nepalense Sweet.
Glossogyne pinnatifida DC.

Hydrangea aspera Buch-Ham.
Hydrolea zeylanica Vahl.

Ichnocarpus frutescens R. Br.
Ipomoea nil (Linn.) Roth.
Kalanchoe integra (Medic) Kuntze.
Mahonia nepalensis DC.
Mentha arvensis Linn.
Mesua ferrea Linn.
Mucuna prurita Hook.
Myrica nagi Thunb.
Mytragyna parivifolia Korth.

Ochna pumila Ham.
Oscimum gratissimum Linn.

Plantago major Linn.
Plumbago zeylanica Linn.
Prinsepia utilis Royle.

Ranunculus pensylvanicus Linn.
R. sceleratus Linn.
Reinwardtia indica Dum.
Rhus succedanea Linn.
R. wallichii Hk.f.
Rubus moluccanus Linn.

Saurauja nepalensis DC.
Schima wallichii Choisy.
Siegesbeckia orientalis Linn.
Solanum verbascifolium Linn.
Stranvaesia glaucescens Lindl.
Swertia angustifolia Buch-Ham.
S. paniculata Wall.

Terminalia chebula Retz.

Valeriana hardwickii Wall.

Zanthoxylum alatum Roxb.
Zeuxina strateumatica Schlechter.
Zizyphus mauratiana Lamk.
Z. nummularia W. & A.
Z. oenoplia Mill..
Z. rugosa Lam.

Sikkim and Bhutan :

Aconitum laciniatum Stapf.
A. novoluridum Munz.
A. spicatum Stapf.
Angelica archangelica Linn.
Artemisia biennis Willd.
A. vulgaris Linn.
Aruncus sylvestris Kostal.
Berberis aristata DC.
B. umbellata Wall.
B. wallichiana DC.
(Garet) K. Schun.

Caltha palustris Linn.
Chenopodium album Linn.
Cimicifuga foetida Linn.

Delphinium caeruleum Jacq.

Fritillaria cirrhosa D. Don.

Gentiana tenella Rottl.
Geranium nepalense Sweet.

Hydrocotyle javanica Thunb.
H. sibthorpioides Lam.

Mahonia nepalensis DC.
Myricaria germanica Desv.

Nardostachys jatamansi DC.
Nasturtium palustre DC.
Panax pseudo-ginseng Wall.
Plantago major Linn.
Podophyllum emodi Wall.
Prunella vulgaris Linn.
Saussurea obvallata Wall.
S. hypoleuca Spreng.
Sedum crassipes Wall.
S. multicaule Wall.
Skimmia laureola Sieb. & Zucc.
Stellaria media Linn.
S. uliginosa Murr.
Stephania glabra (Roxb) Miers.

Taraxacum officinale Weber.
Thalictrum foliolosum DC.
Thlaspi arvense Linn.

Valeriana hardwickii Wall.
V. wallichii DC.
Viola biflora Linn.

Zanthoxylum oxyphyllum Edgew.

Alpine Himalayas :

Aconitum balfourii Stapf.
A. chasmanthum Stapf.
A. deinorrhizum Stapf.

- A. falconeri* Stapf.
A. ferox Wall.
A. heterophyllum Wall.
A. laciniatum Stapf.
A. palmatum D. Don.
Anemone narcissifolia Linn.
- Nardostachys jatamansi* DC.
- Oxyria digyna* Hill.
- Picrorhiza kurroa* Royle.
- Rheum emodi* Wall.
- Lower Himalayas :
Acampe papillosa Lindl.
Arundo donax Linn.
- Baliospermum montanum* Muell-Arg.
Bischofia javanica Blume.
Buddleja asiatica Lour.
- Cannabis sativa* Linn.
- Dichroa febrifuga* Lour.
- Elaeodendron glaucum* Pers.
- Assam Hills and Plains :
Achyranthes aspera Linn.
Adhatoda vasica Nees.
Alstonia scholaris R. Br.
Anamitra cocculus Wt.A.
Andrographis paniculata Nees.
Anisomeles indica (L) Kuntze.
Aphanamixis polystachya (Wall) Parker.
Aquilaria agallocha Roxb.
Aristolochia tagala Cham.
Artemisia vulgaris Linn.
Asclepias curassavica Linn.
- Barleria cristata* Linn.
B. strigosa Willd.
Blumea blasamifera DC.
B. densiflora DC.
B. laceva DC.
Borreria hispida(Linn.)K. Schum
Caesalpinia crista Linn.
Calatropis gigantea R. Br.
Canscora decussata Schult.
Carthamus tinctorius Linn.
Casearia vareca Roxb.
Cassia alata Linn.
C. fistula Linn.
C. occidentalis Linn.
C. tora Linn.
Celastrus paniculatus Willd.
Chenopodium ambrosioides Linn.
Cinchona calisaya Wedd.
C. ledgeriana Moens.
C. officinalis Linn.
C. succirubra Pav.
Cinnamomum tamala Nees & Ebern.
Cissampelos cordata Ruiz.
Clerodendrum viscosum Vent.
C. serratum (Linn.) Moon.
C. indicum(L) Kuntze.
Coccinia indica W & A.
Croton caudatus Geisel.
- C. tiglium* Linn.
Cryptolepis buchanani Roem & Sch.
Cuscuta reflexa Roxb.
Datura metel Linn.
D. stramonium Linn.
Desmodium gangeticum DC.
Dicliptera roxburghiana Nees.
Dillenia indica Linn.
Diospyros peregrina (Gaertn.) Gurk.
Dischidia rafflesiana Wall.
- Ecbolium linneanum* Kurz.
Eclipta prostrata Linn.
Elephantopus scaber Linn.
Emblica officinalis Gaertn.
Emilia sonchifolia DC.
Enhydra fluctuans Lour.
Erycibe paniculata Roxb.
Exacum tetragonum Roxb.
- Fagara budrunga* Roxb.
Ficus bengalensis Linn.
- Gaultheria fragrantissima* Wall.
Gentiana tenella Roxb.
Gmelina arborea Roxb.
Hedyotis scandens Roxb.
Holarrhena antidiysenterica (L) Wall.
Ichnocarpus frutescens R. Br.
Illigera villosa C.B. Clarke.
Ipomaea nil (L) Roth.
Justicia vasculosa Wall.
Lantana indica Roxb.
Leea macrophylla Roxb.
Leonurus sibiricus Linn.
Leucas cephalotes Spring.
L. lanata Benth.
L. zeylanica R. Br.
Limnophila chinensis Merrill.
Lindenbergia indica (L) O.Ktz.
Litsaea monopetala (Roxb.) Pers.
Maesa indica Wall.
Mallotus philippinensis Muell-Arg.
Mimusops elengi Linn.
Mucuna prurita Hk.
Myrica esculenta Ham.
Myristica angustifolia Roxb.
Nanceia orientalis Linn.
Nepenthes khasiana Hk. f.
- Ocimum basilicum* Linn.
O. americanum Linn.
O. sanctum Linn.
Orthosiphon spiralis(Lour)Merr
Oxystelma esculentum (R. Br.) Schult.
Paederia foetida Linn.
Phlogacanthus thyrsoflorus Nees.
Phyllanthus simplex Retz.
Piper longum Linn.
P. sylvaticum Roxb.
Plantago major Linn.
Plumbago indica Linn.
P. zeylanica Linn.
Plumeria rubra Linn.
Pogostemon parviflorus Benth.
Pongamia pinnata (L) Merr.
- Premna corymbosa* Rottl & Willd.
P. herbaceae Roxb.
Prunella vulgaris Linn.
Pueraria tuberosa DC.
Randia dumetorum Lam-
Rauwolfia densiflora Benth.
R. serpentina Benth.
Rhamnus virgatus Roxb.
Rubia cordifolia Linn.
- Sambucus javanica* Reinw.
Scutellaria glandulosa Hk. f.
Senecio densiflorus Wall.
Siegesbeckia orientalis Linn.
Solanum ferox Linn.
S. indicum Linn.
S. nigrum Linn.
S. spirale Roxb.
S. verbascifolium Linn.
S. xanthocarpum Schrad & Wendl.
Sonchus arvensis Linn.
Sphaeranthus indicus Linn.
Spilanthes acmella Mull.
Stephania glabra (Roxb) Miers.
S. hermandifolia (Willd) Walp.
Stereospermum personatum (Hassk) Chatt.
Strophanthus hispidus DC.
Swertia chirata Buch-Ham.
S. purpurascens Wall.
Symplocos paniculata Wall.
S. laurina (Retz) Wall.
Tamarindus indica Linn.
Taraxacum officinale Weber.
Tinospora cordifolia (Willd) Miers.
Toddalia asiatica Lam.
Tournefortia viridiflora Wall.
Tylophora indica (Burm. f.) Merr.
Uraria hamosa Wall.
U. prunellaefolia R. Grah.
Valeriana hardwickii Wall.
V. wallichii DC.
Vallis solanacea O. Ktze.
Vitex negundo Linn.
- Xanthium strumarium* Linn.
Zanthoxylum alatum Roxb.
Zizyphus oenoplia Mill.

II. GANGETIC PLAINS:

- Acacia catechu* Willd.
Acorus calamus Linn.
Abutilon hirtum G. Don.
A. indicum (Linn) Sweet.
Abrus precatorius Linn.
Acronychia pedunculata (L) Miq.
Adhatoda vasica Nees.
Ailanthus excelsa Roxb.
Alangium salvifolium (L) Wany.
Albizia lebbek Benth.
Alhagi pseudalhagi (Bieb.) Desv.
Andrographis paniculata Nees.
Argemone mexicana Linn.
Asteracantha longifolia Nees.

Balanites aegyptica Linn.
Barleria prionitis Linn.
B. strigosa Willd.
Basella rubra Linn.
Bauhinia purpurea Linn.
B. racemosa Lam.
B. retusa Roxb.
B. vahlii W. & A.
Boswellia serrata Roxb.
Buchanania lanzan Spreng.

Caesalpinia bonduc (L) Roxb.
Callicarpa arborea Roxb.
Calonyctyon aculeatum House.
Canscora decussata Schult.
Cardiospermum halicacabum Linn.
Carica papaya Linn.
Cassia absus Linn.
C. auriculata Linn.
C. fistula Linn.
C. mimosoides Linn.
C. obtusa Roxb.
C. serpens Linn.
C. sophora Linn.
Celastrus paniculatus Willd.
Cissampelos cordata Ruiz.
Clerodendrum viscosum Vent.
C. indicum (L) Kuntze.
Cocculus hirsutus (L) Diels.
Coldenia procumbens Linn.
Commiphora mukul Engl.
Cordia dichotoma Forst.
Coriaria nepalensis Wall.
Crataeva nurvala Bach.
Crotalaria medicagena Lam.
Cuscuta reflexa Roxb.

Datura metel Linn.
Diospyros peregrina Gurke
Dolichandrone falcata Seem.

Elaeodendron glaucum Pers.
Embelia tsjeriam-cottam A.DC.
Enicostemma littorale Bl.
Exacum pedunculatum Linn.
E. tetragonum Roxb.

Fagonia cretica Linn.
Feronia limonia Sw.
Fumaria indica Pugsly.

Geranium ocellatum Camb.
Gisekia pharnaceoides Linn.
Gymnea sylvestre R. Br.
Gynandropsis gynandra (L) Briq.

Helicteris isora Linn.
Heliotropium eichwaldi Steud.
H. indicum Linn.
Hemidesmus indicus R. Br.
Heynea trijuga Roxb.
Hibiscus cannabinus Linn.
H. micranthus Linn.
H. sabdariffa Linn.
Holarrhena antidysenterica Wall.
Hydrolea zeylanica Vahl.

Ionidium heterophyllum DC.
Ipomoea nil (L) Roth.
I. reptans Poir.
Kydia calycina Roxb.

Leea macrophylla Roxb.

L. indica Merrill.

Mimosa rubicaulis Lam.
Mimosops elengi Linn.
Moringa oleifera Lam.
Mucuna prurita Hk.
Murraya koenigii Spreng.

Nymphaea pubescens Willd.

Ocimum basilicum Linn.
O. americanum Linn.
O. gratissimum Linn.
O. sanctum Linn.
Operculina turpethum (L) Silva Manso
Oxalis coriiculata Linn.
Oxystelma esculentum (R. Br) Sch.

Papaver somniferum Linn.
Pavonia odorata Willd.
Peganum harmala Linn.
Pentatropis cynanchoides R. Br.
Periploca aphylla Dcne.
Peristrophe bicalyculata Nees.
Pistaciak hingok Stocks.
Plumbago zeylanica Linn.
Pongamia pinnata (L) Merr.
Psoralea corylifolia Linn.
Pueraria tuberosa DC.
Punica multiflora Hort.

Rauvolfia serpentina Benth.
Rhamnus persica Boiss.
R. virgata Roxb.
Rungia parviflora Nees.

Salvadora indica Wight.
Saponaria vaccaria Linn.
Semecarpus anacardium Linn.
Sesbania grandiflora (L) Pers.
Sida acuta Burm.
S. spinosa Linn.
S. veronicaefolia Lam.
Solanum nigrum Linn.
S. verbascifolium Linn.
Sopubia delphinifolia G. Don.
Soymida febrifuga Juss.
Spondias pinnata Kurz.
Stephania glabra (R) Miers.
Stirreospermum personatum (Hassk) Chatt.

Strychnos nux-vomica Linn.
S. potatorum Linn.
Symplocos racemosa Roxb.
Tephrosia purpurea (L) Pers.
Terminalia chebula Retz.
Thalictrum foliolosum DC.
Tinospora cordifolia (Willd) Miers.
Toddalia asiatica Lam.
Trachyspermum ammi (Linn.) Spragur.
Tribulus saharae A. Cheval.
Trichodesma zeylanicum R. Br.

Uraria picta Desv.

Verbascum thapsus Linn.
Viola cinerea Boiss.
Vitex negundo Linn.
Vitis venifera Linn.

Wrightia tomentosa Roem & Schult.

III. BOMBAY AND WESTERN INDIA

Abrus precatorius Linn.
Acacia arabica Willd.
A. catechu var sundra Willd.
A. senegal Willd.
Adenantha pavonina Linn.
Adhatoda vasica Nees.
Aegle marmelos Correa.
Ailanthus excelsa Roxb.
Alhagi pseudalhagi (Bieb) Desv.
Alpinia galanga Willd.
Alstonia scholaris R. Br.
Amaranthus spinosus, Linn.
Anamitra cocculus W. & A.
Annona reticulata Linn.
A. squamosa Linn.
Andrographis paniculata Nees.
Aristolochia bracteata Retz.
Artemisia vulgaris Linn.
Asteracantha longifolia (L) Nees.
Averrhoa bilimbi Linn.
A. carambola Linn.
Azadirachta indica Juss.

Balanites aegyptiaca (L) Delib.
Barleria prionitis Linn.
Bixa orellana Linn.
Boerhaavia diffusa Linn.

Caesalpinia bonduc (L) Roxb.
Callicarpa tomentosa (L) Murr.
Calotropis gigantea (L) R. Br.
Capparis sepiaria Linn.
Cassia auriculata Linn.
C. fistula Linn.
C. obtusa Roxb.
C. occidentalis Linn. and other *Cassia*.
Ceriops tagal (Perr) C.B. Robins.
Cinnamomum zeylanicum Breyn.
Clematis gouriana Roxb.
C. wightiana Wall.
Clerodendrum viscosum Vent.
Commiphora mukul Engl.
Cordia dichotoma Forst.
C. rothii Roem & Sch.
Croton tiglium Linn.
Curcuma amada Roxb.
C. aromatica Salisb.
C. longa Linn.
C. zedoaria Rosc.
Cuscuta reflexa Roxb.
Cyperus rotundus Linn.

Dalbergia spinosa Roxb.

Diospyros peregrina (Gaertn) Gurke.

Eclipta prostrata Linn.
Elephantopus scaber Linn.
Emblia officinalis Gaertn.
Enicostemma verticillatum (Linn.) Engl.
Exacum bicolor Roxb.

Feronia limonia Sw.
Ficus carica Linn.
F. gibbosa Bl.

Garcinea morella Desr.
Gardenia gummifera Linn.
G. resinifera Roth.
Geophila herbacea Kuntze.
Glossogyne pinnatifida DC.
Gmelina arborea Roxb.

Habenaria grandiflora Lindl.
Heliotropium indicum Linn.
Hemidesmus indicus R. Br.
Holarrhena antidysenterica Wall.
Hugonia mystax Linn.
Hydnocarpus lavrifolia (Dennst)
 Sleumer.
Hymenodictyon excelsum Wall.

Ipomoea pes-caprae (L) Sweet.

Kaempferia galanga Linn.

Leonotis nepetaefolia R. Br.
Listea glutinosa (Lour) C. B. Robinson.
Lobelia nicotianaefolia Heyne.

Mallotus philippinesis Muell-Arg.
Mimusops elengi Linn.
Mucuna monosperma DC.
M. prurita Hk.
Murraya koenigii Spreng.
Myristica malabarica Lam.

Nasturtium fontanum Aschers.

Ocimum basilicum Linn.
O. sanctum Linn.
Orophea zeylanica Hk. f.
Osyris wightiana Wall.
Oxystelma esculentum (R. Br.) Sch.

Parkinsonia aculeata Linn.
Periploca aphylla Decne.
Piper nigrum Linn.

Plantago major Linn.
P. ovata Forsk.
Plumbago zeylanica Linn.
Pogostemon parviflorus Benth.
Polygala chinensis Linn.
Plantago pinnata (L) Pierre.

Psoralea corylifolia Linn.
Pterocarpus marsupium Roxb.

Randia brandisii Gamb.
Rauwolfia densiflora Benth.
R. serpentina Benth.
Rhinacanthus nastus Kurz.

Salvia officinalis Linn.
Sesbania sesban (L) Merr.
Solanum xanthocarpum Schrad &
 Wendl.
Sopubia delphinifolia G. Don.
Soymida febrifuga Juss.
Stephania hernandifolia (Willd) Walp.
Strobilanthes ciliatus Nees.
Strychnos colubrina Linn.
S. nuxvomica Linn.
Swertia decussata Nimmo.

Thlaspi arvense Linn.
Tiliacora acuminata (Lam) Miers.
Tinospora cordifolia (Willd) Miers.
Toddalia asiatica Lam.
Tylophora indica (Burm)

Urginea indica Kunth. Merr.

Vitex negundo Linn.
Vitis venifera Linn.

Xanthium strumarium Linn.

Zingiber officinale Rosc.

IV. MADRAS AND SOUTH INDIA :

Adhatoda vasica Nees.
Aegle marmelos Correa.
Anamitra cocculus (L) W. & A.
Andrographis paniculata Nees.
Anisomeles indica (L) Kuntze.
Aristolochia bracteata Retz.
A. indica Linn.
Artemisia vulgaris Linn.
Azadirachta indica Juss.

Barleria prionitis Linn.

Cassia alata Linn.
C. angustifolia Vahl.
C. obtusa Roxb.
Citrullus colocynthus Schrad.
Clerodendrum viscosum Vent.
C. phlomidis Linn.
C. serratum (L) Moon.

Datura metel Linn.

Eclipta prostrata Linn.
Elettaria cardamomum Maton.
Emblica officinalis Gaertn.
Enicostemma verticillatum (L) Engl.

Gloriosa superba Linn.

Hemidesmus indicus R. Br.
Holarrhena antidysenterica Wall.

Lawsonia inermis Linn.
Mimusops elengi Linn.
Manilkara hexandra (Roxb) Dub.

Ocimum basilicum Linn.
O. sanctum Linn.

Papaver somniferum Linn.
Pedaliium murex Linn.
Phyllanthus niruri Linn.
Piper longum Linn.
Plumbago zeylanica Linn.
Pongamia pinnata (L) Merr.
Psoralea corylifolia Linn.

Rauwolfia serpentina Benth.

Salvia officinalis Linn.
Scilla indica Baker.
Solanum xanthocarpum Schrad. & Wendl
Strychnos nuxvomica Linn..
Swertia angustifolia Buch-Ham.

Tamarindus indica Linn.
Tinospora cordifolia (Willd) Miers.

Vitex negundo Linn.
Vitis venifera (in Mysore and Kurnool)
 Linn.

Zingiber officinale Rosc.