INTRODUCTION

India has been provided with most varied kind of flora by nature, which is not found in any other part of the world. The extreme variability that India presents in its Geographical conditions, is perhaps unrivalled in the world. The tremendous range of variation in temperature from 49°C in desert areas in summer to -10°C in Dras in Kashmir in winters and the prevalence of arctic conditions throughout the year in some of the Himalayan ranges are well known. The annual rain fall varying from 1000 cm. at Cherrapunji in the Hills of Assam to less than 13 cm. annually in the desert areas of Rajasthan, the saturated air with moisture in coastal areas and the hills during South-West Monsoon and practically zero humidity during the dry weather period, are some of the interesting contrasts seen in this vast country. The lower hills, plateaus, extensively rich alluvial plains, sandy wastes and deserts, hills, streams, mighty rivers with their extensive deltaic and estuarine systems, numerous lakes and large marshy tracts provide all kinds of plants, yielding food grains, pulses, oil, rubber, tea, coffee, timber, spices and condiments, including drugs and many other commodities of economic importance like fruits, dry fruits etc. Our country in fact is an epitome of almost all climates, seasons and soils of the world.

Under such a wide range of climatic conditions, it is natural to have a wide range of plants. Even the plants of tropical, sub-tropical, alpine and sub-alpine regions are met in one part or the other. It is difficult to find any other country of similar type, where such a variety of plants especially medicinal, are found growing wild.
Indian flora is closely related to that of Malaysia, Burma and China, which is abundantly represented in Eastern India. Alpine regions of the Himalayas represent Tibbetan and Siberian flora, while Japanese flora is represented in the temperate belts of the country. The Middle Eastern, European and African floras are particularly met with in Western India. About 600 European genera are represented in India, many of them by single species. Moreover, some drug yielding plants introduced from America, Australia and European countries have got completely naturalised in this country. Therefore, all the factors mentioned above made the Indian flora very rich and cosmopolitan in nature. Prof. Greenish has very correctly said that "India owing to the remarkable variation, she posesses of climatic, altitude and soil, is in a position to produce successfully every variety of medicinal herb required by Europe." (29)

Out of a total of about 11000 species found in India more than 2000 plants are reported medicinal in the literature (30), and about 1500 of them are used in Indian Systems of Medicine (Ayurveda and Unani). They are attributed with a number of medicinal properties, uses and also remembered with different vernacular names in the respective systems of medicine. Though in the recent past a number of drugs have been worked out scientifically but still there are many important drugs commonly used in Indian System of Medicine yet to be evaluated on scientific parameters for their medicinal virtues. At present our country is not self sufficient in Pharmaceutical production, despite such an enormous potentiality in drug resources, and it is rather paradoxical that our country even today import drugs worth crores of rupees every year.
to meet internal requirements (116). The reason for this sad state of affair may be many but one of the most important reason for this is the fact that the description of the drug yielding plants given in the literature of Indian Systems of Medicine is insufficient for the present day Pharmacognosist and Taxonomist to ascertain the correct identity of the particular drug of plant origin described in the classical texts of these systems, and also due to the fact that collection of the raw material (crude drugs) is mostly done by the unskilled, untrained and unqualified labourers in the field, which is then sold in the market to the drug dealers who themselves are uneducated and unqualified in this field. These drugs are ultimately sold to the manufacturers without providing the exact identification for each and every drug. This, not only leads into the adulteration of the drugs but also substitution with those of the genuine and authentic drugs used in the formulations of the Indian Systems of Medicine. As mentioned earlier the problems to be tackled are many and vary from the collection point of view to the standardisation of these drugs. The foremost and the important problems that are encountered in the exact identification and assessment in order to lay down the standards of the drugs, is the lack of knowledge about the source of the plant and insufficient identification data for botanical identity, alongwith the absence of the characters of these drugs by which one could differentiate them. In olden days the drugs used were less in number and the physicians used to collect the drugs and identify themselves. Moreover, the description available in the present day text books and literature on the drugs, is not sufficient for the exact
identification and also do not throw light whether the drug specimen is of the particular or genuine drug. Not only this, the vernacular names given to these drugs, in different regional languages in the classical texts, create still more confusion in the identification of the drugs. The regional names vary from place to place and one single drug is remembered with different names. As a result of this many of the plants mentioned in the classical texts have either totally been changed or unknowingly got mixed up with each other or have been replaced with other species, except in those cases where the botanical identity of the drug yielding plants have been confirmed, specially of those which are well known and well recognised. Thus, this has naturally led to an utter confusion. To add further to the confusion, the same name is frequently used for entirely different drug in different parts of the country. For example the drug 'Sariva' of Ayurveda (called Ushbah in Unani and Nannari in Tamil and Malayalam) which is botanically identified as *Hemidesmus indicus* in one part of the country, while in other parts it is identified as *Ichnocarpus frutescens* and *Cryptolepis buchananii*. Similarly two different plants viz. *Marsdenia tenacissima* and *Ipomoea turpethum* yield the drug 'Nishot' or 'Nishotar' of Ayurveda. The first, according to the recent literature, is the exact identification of the Unani drug 'Safed Turbud' (though the official drug Turpeth of I.P. & B.P. is nothing but *Operculina turpethum* Syn. *I. turpethum*). Like this many more examples can be quoted here which cause confusion and problem in the exact identification of the drugs.

Out of a large number of drugs described in the literature of ISM,
still many drugs have not yet been finally identified and are still considered to be doubtful and of controversial nature, though they are considered to be of significant importance because of their use and claims made for their wonderful cures. The description available on these drugs in the literature is so unauthentic and vague that it is not possible to ascertain their correct botanical identity, due to which, number of drugs currently being used in the market, are not genuine (either adulterated or substituted), obviously the practitioners and the manufacturers have to rely upon the material available in the drug markets, which is very often is so much either adulterated or substituted that it leads to the frustrations even to the experts in the field. Therefore, any amount of description of these drugs will not help a Botanist or Pharmacognosist to identify them and thus distinguish the genuine drug from the adulterated one, unless certain diagnostic characters of each drug is established, specially the actual botanical source of the plant and its macro and microscopical characters are made available.

Despite these short comings and difficulties, enumerated above, majority of the people of India use the drugs of Indian Systems of Medicine (Ayurvedic and Unani), as they are easily available and cheaper as compared to the drugs of Allopathic System of Medicine, specially in the remote rural areas, where the Allopathy does not have the excess. Not only this the drugs of ISM, these days are in much demand because of the side effects reported for the Allopathic drugs, not only in this country but also abroad. On the contrary they can often be easily
collected from roadsides, gardens, waste places and the fields. These above facts namely, easy and abundant availability, cheapness, efficacy and suitability to the temperament of the people of this country, bring into prominence, the importance of the indigenous drugs and their utility for the country.

Keeping in view the importance of the Indian Systems of Medicine and the increasing demand of the drugs used in these systems, the Government of India decided to develop these systems on the most modern scientific lines and revive these systems a fresh, which during the British period had gone into total darkness under the shadow of the Allopathic System of Medicine. As a result, Government of India, in the Ministry of Health & Family Welfare (Department of Health), New Delhi have established a full-fledged department with the name "Indian System of Medicine (ISM)" to look into its over all development specially in the field of research, along with education and other allied aspects. To speed up the research work and to lay down the pharmacopoeial standards on these drugs the Ministry has established a Drug Standardisation and Testing Laboratory with the name P.L.I.M. (Pharmacopoeial Laboratory for Indian Medicine) at Ghaziabad. Along with this the Ministry of Health and Family Welfare, has also established separate research councils for Ayurveda, Unani, Siddha Systems and Homoeopathy at New Delhi as Headquarters. These councils carry out the research work on all the aspects of drugs used in Indian Systems of Medicines & Homoeopathy through their research units established throughout the country.
Recently the Ministry of Health has also established a Cell to look into the aspects of cultivation, collection regeneration, and also the aspects of import/export in respect of the medicinal plants, used in these systems as well as in the Allopathic medicine. Not only this the Ministry had long back constituted Pharmacopoeia Committees for the three respective systems (Ayurveda, Unani and Siddha), and also for Homoeopathy, for laying down the standards of the drugs of Indian Systems of Medicine and Homoeopathy in order to publish the Pharmacopoeia of the drugs used in these systems. Besides this, various other organisations in the country like the Central Drug Research Institute, Central Drug Laboratory, Haffkin Research Institute, and the Departments of Pharmacy and Chemistry in various Universities are doing a good deal of research work to solve these problems under the financial aid and grant provided by the University Grants Commission to the research workers interested in carrying out experimental investigation on indigenous drugs. Similarly, recently the Central Institute of Medicinal and Aromatic Plants (C.I.M.A.P.), and a number of Regional Research Laboratories (R.R.L.) under the Council for Scientific and Industrial Research (C.S.I.R.), and the National Bureau of Plant Genetic Resources (N.B.P.G.R.) under the Indian Council of Agricultural Research (I.C.A.R.), New Delhi are engaged in carrying out the research work on various aspects of medicinal plants, in-order to produce new varieties and strains for a better yield, and regenerate the plants which are threatened or at the verge of extinction, and also made available, the requisite information on any of the aspects concerning the indigenous drugs specially the medicinal plants.
However, the problems are tremendous and require a long range planning and devoted work by a large number of workers in a number of institutions. There is an increasing interest, not only in the country, but all over the world in scientific investigation of medicinal plants in the present century. Even the most advanced countries where numerous synthetic drugs and antibiotics have been developed, drugs from the plant sources are being tapped to find out better drugs and the interest of research workers appear now to be extending towards the natural products. It is therefore, realised that even if these studies do not yield more valuable drugs than synthetic ones, it will give valuable information about the chemical structures and pharmacological actions of the drugs, that may eventually open the door of creative synthesis of plant medicaments.

Basically the drugs of Indian Systems of Medicine are used either singly or in combinations (in the form of various formulations) and as mentioned earlier, these drugs are alleged by the physicians of Indian Systems of Medicine to possess medicinal properties. All these plants can not possess the wonderful virtues attributed to them, but it is believed that there are some of these, which might rightly deserve the reputation they have earned as curatives. In order to confirm the virtues attributed to them, a systematic study on these plants was initiated in early parts of the last century, since then many of these drugs have been proved effective by evaluating them on modern standards, and there are others, the claims of which have been found incorrect. There are still many drugs which have not been evaluated by any of the modern parameters and even their botanical identity is not yet confirmed but still
used in the Indian Systems of Medicine to cure various ailments.

Though a number of plants have been worked out for their chemical constituents but they have not been thoroughly screened for their pharmacological and clinical values. Therefore, at this juncture, there is a great need to take up this problem on a large scale for their exact botanical and pharmacognostical identification, chemical, pharmacological testing and clinical trials, inorder to lay down the standards of the drugs used in I.S.M., and then only the real role of these drugs can be understood in combating different diseases, for which they are claimed.
HISTORICAL RETROSPECT

Voluminous and colossal historical records and immense reference are available on the use of plants, minerals and animals as source of medicaments for curing different types of ailments since time immemorial. These were written by the scholars and physicians of Indian, Chinese, Babylonian, Assyrian, Greek, Roman and Arabian civilisations on the basis of their experience and observations. This ultimately led to the development of various schools of medicines independently throughout the world viz., the Indian School of Medicine (4,500 B.C.), the Chinese School of Medicine (2,700 B.C.) in the east; the Egyptian School of Medicine (1,500 B.C.) including Babylonian-Assyrian School of Medicine (460 B.C.) in the west. The Indian School of Medicine gave birth to the present day Ayurvedic System of Medicine, while the Western School of Medicine (i.e. Egyptian, Greek, Roman etc.) to the so called Modern or Allopathic System of Medicine, and an offshoot of the Greek School of Medicine emerged as an independent system of medicine called Greeko-Arabic System of Medicine or Unani Tibb in the Middle-Eastern countries, coming down to India with the Muslim culture, which ultimately flourished and developed as a full-fledged System of Medicine called Unani System of Medicine.
I. INDIAN SCHOOL OF MEDICINE (AYURVEDA)

The vedas are the earliest books of the Indian Mythology. These are Rigveda, Yajurveda, Samveda and Atharvaveda. According to Susruta, Ayurveda is an Upanga of Atharvaveda and was raised to the status of Veda and appended to it to give the science of medicine the necessary sanctity and authority. Ayurveda is the name, which the ancient Indian gave to their science of medicine (Ayu = life and Veda = to know or attain). There are two versions of its origin. The Medical School traces its origin to Bhardwaj who learned it from the God Indra, the Surgical School traces its origin to Dhanvantari who also received it from the same God. According to Charaka, Ayurveda emanated from the creator "BRAHMA" who revealed it in its entirety to Prajapati 'Lord of the Creators'. From him it was passed on to the Aswins "the devine twin horses" the helpers and the healers among Vedic Gods. They passed it on to Indra, King of God, and from him mankind received its devine wisdom. Other sources believed it to be derived from Rigveda compiled between 4,500 - 1,600 B.C. (104)

Whatever may be the origin of Ayurveda it is generally believed that the knowledge of the plants with many of their medicinal virtues was known to the ancient sages of India, which is generally traced to the time of Rigveda, in which many of the plants are mentioned as necessary in performing the religious ceremonies and mention has been made in this book of 'Soma' and 'Apamarga' and their effects on man. The other Vedas also mention the use of a large number of plants on similar occasions, particularly in Atharvaveda, where the medicinal use
of plants has definitely been stated, though their use often taken the form of charms, spells and incantation.

Charaka and Susruta are considered to be the great authority of this age (2,500 - 600 B.C.) in the field of Ayurvedic Medicine. Charaka (1,000 - 800 B.C.) deals more with medicine, while Susruta (800 - 700 B.C.) has dealt in great detail with Surgery. The simple medicines dealt alone by Charaka are grouped in Fortyfive heads (29). The methods of administration of drugs are fully described and bear a striking resemblance to those in use at present time. About 2000 vegetable remedies have been included by Charaka in his famous work called Charaka Samhita, but citing only few mineral and still fewer animal remedies. Charaka gives 50 groups of ten herbs each, while Susruta has arranged 760 herbs in 37 sets. From Charaka and Susruta various systems dealing with different branches of medicine originated. Surgery, Medicine, Materia Medica, and Pharmacy were divided into several systems (228).

In Ayurveda, beside the classical works of Charaka and Susruta, a number of books on Ayurveda and Botany were written. There are many important works called 'Nighantu' on Ayurvedic Materia Medica. The oldest Nighantu (Materia Medica) appears to be that of Deodas Kashiraj of Banaras (a King), who is also believed to be the incarnation of Lord Dhanvantari. He is believed to have taught his 'Dhanvantari Nighantu' to his disciples, amongst them Susruta was the most renowned. He is believed to have written another book called 'Raj Nighantu' on drugs, but some believe it to be written by another Vaidya named Dhanvantari, who lived during the time of king Vikramaditya.
There are about 400 drugs (herbs) described in this book, which has been giving inspiration to many authors later as the main source (104,206).

Ayurveda however, remained a subject of study which all learned men, sages and kings, learnt for the benefit of human race. The kings in particular encouraged the cultivation of medicinal plants specially trees, as may be testified from the fact that Ashoka the benevolent Emperor (274 - 236 B.C.), throughout his empire, established hospitals for men and animals and botanical gardens as source of medicines for the people. This was also the period of original research which resulted in remarkable progress in every respect. Mention may be made of some of the important works by Vagbhata, Madhvakar, Chakradatta, Kanada, Sankarsen and Bangasar (500 - 100 B.C.), who elaborated the vegetable Materia Medica and included many more new drugs of vegetable origin to the list of drugs of this period. The books on Botany like 'Kalpstanum' or 'Vrikshayurveda' described detailed characteristics of vegetable drugs, their geographical distribution, habit and habitat, suitability of soil for their growth, season of collection, duration of their efficacy, methods of storage and preservation, and elaborate classification with detailed instruction on every conceivable point.

Contribution of Sarangdhar (13th Century A.D) on Materia Medica, and Bhavamishra (16th Century A.D.), who has written a comprehensive treatise on medicine named 'Bhavaprakash Nighantu', describing more than 600 drugs, including some drugs of other systems, are worth mentioning. In Saligram Nighantu (18th Century A.D.), 1574 drugs with
some illustrations giving their synonyms in other languages have been described (185,206).

2. CHINESE SCHOOL OF MEDICINE

Origin of the Chinese Medicine is attributed to the mythical God believed to have flourished about 2,735 B.C. (206). The Chinese Medicine has a Pharmacopoeia like compilation in Chinese called 'Pun Tsao' or the 'Great Herbal', having 40 volumes describing several thousand preparations. Chinese were the earliest to employ Goose grease the 'adeps amberinus' of the later Pharmacopoeiae as a preferable fat for inunction, and the modern scientific researches on the penetrating properties of fat places it on top. The other medicines employed by the Chinese from various origin (plant, mineral and animal) are described below:-

Sea Weed as Iodine source, Rhubarb, Aconites, Cannabis, Ephedra (Ephedrine source), Camphor, Iron, Sulphur, Mercury, Alum, Musk, Toad's Eye-lids and Earthworms.

3. EGYPTIAN SCHOOL OF MEDICINE

In the West, before the advent of Greek Medicine, records of drugs usage are also available in the form of Egyptian Materia Medica, Assyrian and Babylonian Pharmacy. The famous "Ebers Papyrus", believed to be written about 1,500 B.C. contains a collection of prescriptions and formulae with a wide range of uses (206,222-224).

The following drugs of plant, mineral and animal origin are described in the Egyptian Materia Medica (Ebers Papyrus). They are:-
Oil, Wine, Beer, Yeast, Vinegar, Turpentine, Figs, Castor Oil, Myrrh, Mastich, Frankincense, Worm Wood, Aloes, Opium, Cumin, Peppermint, Anise, Fennel, Saffron, Lotus flowers, Linseed, Juniper berries, Henbane, Poppy, Mandragora, Gentian, Colchicum, Squill, Cedar, Elder berries, Honey, Grapes, Onion, Garlic, Acacia, Date Blossoms, Iron, Lead, Bitumen, Magnesia, Nitre, Vermilion, Copper Sulphate, White Lead, Crude Sodium Carbonate, Salt, Precious Stone (in finely powdered 'Calcined' forms), Lizard's Blood, Swine's Teeth, Putrid Meat, Stinking Fat, Moisture from Pig's Ears, Milk, Goose Grease, Ass's Hoofs, Animal Fats (From various sources), Excreta of various animals (including Human beings, Donkey's, Antelopes, Dogs and Cats and even Flies).

In the library of Sardana-Palus at Ashurbanipal (650 B.C.) clay tablets have been found belonging to Assyrian and Babylonians, relating to medical and pharmaceutical subjects. Their list of drugs resembles that of Egyptian Materia Medica, where 250 herbs, and 120 minerals and stones are described, among which are Cassia, Cinnamon, Costus, Orris Root, Anise, Jasmine, Oleander, Allamander, Cathartica, Mint, Henbane, Liquorice, Alcohol, Turpentine and Beer of plant origin, while of animal and mineral origin are Fats, Oils, Wax, Bitumen and Alum etc., respectively.

4. GREEK SCHOOL OF MEDICINE

Greek medicines' origin is traced back to Aesculapius, who was probably a historical personage and subsequently deified by the Egyptian and other ancient people. Actually in the West the history of medicine
and pharmacy begins from Hippocrates, who born in the Island of Cos in 460 B.C. and is considered to be the father of medicine and said to be a descendent of Aesculapius. In his writing, Hippocrates has mentioned nearly 400 simples as medicinal substances. Theophrastus (370 - 287 B.C.), later on who received the herb garden of Aristotle, mentioned in "On the Causes of Plants" 500 drugs. However, the most authoritative and significant Pharmacopoeial treatise of the Greeks’ was the text of Dioscorides (60 A.D.). He is said to become Surgeon in Neuro’s army to learn the flora and fauna of different countries. During his army career, he collected a vast number of drug samples of plant, animal and mineral origin and confirmed their identity and mineral virtues whenever he got the opportunity. His famous treatise on Materia Medica was first published in Venice (Greece) in 1499 and for 1600 years it served as Pharmacological Vademecum in the history of medicine. This book was translated into Arabic and other European languages and is very often quoted in the works of Arab authors. This treatise was arranged in alphabetical order and described the drugs of different origin (plant, mineral and animal) (206). These are:-

Acacia, Aconite, Aloes, Anise, Balsam, Bitter Almond, Buck Thorn (Rhamnus), Cardamom, Cumin, Dill, Elaterium (Juice of the Cucumber fruit), Gentian, Hemlock, Juniper, Lettuce Vinegar (Vinegar of Lactuca), Lichens, Licorice (Liquorice), Mandrake (Mandragora), Mint (Mentha), Penny Royal (Penny Wort), Poppy, Rose Oil, Worm Wood, Ammoniac, Arsenic, Bitumen, Bird Lime, Brine (Salt), Calamine, Caustic Lye, Soot, Verdigiris (basic Copper acetate), White Lead, a number of metallic oxides, sulphates
and sulphides, Ash of Hippocampus, Canthrides, Fish glue, Urine, and few others are Boiled Oil, Starch and Wine.

Amongst other Greek Workers the names of Pliny the elder (23 - 79 A.D.) and Galen (130 A.D.) are worth mentioning. Pliny a contemporary of Dioscorides on "Natural History" wrote 37 books, out of which 20 - 27 deal with medical botany (medicines derived from plants), 28 - 33 deal with Materia Medica i.e. other than botany (drugs derived from the bodies of men and other land animals). Similarly Galen, who is believed to have died in Sicily and born at Pergamum, had kept a pharmacy for a long time and is believed to have developed a number of medicinal preparations of plant origin called "Galenicals". On Pharmacology Galen is credited with 30 books. In one of the books (translated into Latin under the title "De Cimplicibus"), items have been arranged in alphabetical orders and enjoyed great repute. His other works were translated into Arabic. He also became the Physician to Comodus and during his travel devoted a great deal of his time in collecting the choicest drugs to have at his disposal. In his writings he always emphasised on the importance of the pure drugs and careful handling of them and advised to the readers "in order to know the drugs, inspect them not once or twice but frequently for though twins look alike to strangers, they are easily distinguished by friends".

5. **ARAB SCHOOL OF MEDICINE**

After the decline of medicine in Rome and the texts of earlier Greek workers were forsaken, Galen gradually assumed highest authority in medicine and luckily the Greek medicine found its votaries
in Arabs, who translated as much work into Arabic as they could find. Great contributions have been made by the Arab physicians on the medicinal properties of the plants, though their publications are based on the Materia Medica of Dioscorides and Galen etc., but with lots of new additions along with the footnotes and commentaries. There is abundance of references of the book "Almaliki" of Ali-ibn-Abbas, and for the development of the Arab medicine as a whole, the names and the contributions of luminaries like Qusta-bin-Lauqa, Hajjaj-bin-Mutar, Ibn-ul-Batriq, Isa-bin-Yahya, Ahmad-bin-abi-al-Ashat, Ibn-i-Jaljal (Galgal), Abu Sahal Masihi, Abi-ibn-Saadiq, Abul Hasan Qarshi, Ali-bin-Rizwan, Ibn-i-Wafid, Hakim Raziuddin Abul Mansoor Saeed bin-Bushar-bin-Abdus, Jarji-Zidan, Abdul Qasim Halaf ibn-al-Abbas al-Zahrawi "Avenzoar", Yuhanna-bin-Masawayh (777 - 857 A.D.), Abul Hasan al-Tabari (9th Century), Yaqub bin-Ishaq al-Kindi (800 - 870 A.D.), Abu Bakr Mohammad bin-Zakaria Razi "Rhazes" (854 - 932 A.D.), Shaikh Bu Ali Seena "Avicenna" (980 - 1037 A.D.), Abdullah Mohammad Al-Idrisi "Sharif" (1100 - 1166 A.D.), Ziauddin Abu Mohammad Abdullah ibn-e-Ahmad al-Maliki "Ibn-al-Baitar" (1197 - 1248 A.D.) and Ibn-an Nafis (1210 - 1288 A.D.) are worth mentioning. (163,10)

Besides all the physicians and workers already mentioned in the preceding paras one should not ignore the names of workers who wrote valuable treatise on Materia Medica like Yahya-bin-Jazla "Mughni". Abu Rehan al-Biruni, Haji Zain Uddin Attar, Shaikh Yusuf of Baghdad. (163,10)

Zakaria Razi "Rhazes" is credited with having written 250 works. Some of which are on Pharmaceutical aspects. Rhazes, amongst his
contemporaries, was known as Galen of his time. His most famous contribution is "Al-Hawi-Kabir" or "Continents of Rhazes". Garison in his "History of Medicine" classes Rhazes with Hippocrates in his influence upon medicine.

Avicenna amongst the Unani physicians was known simply as Shaikh. He is the world renowned author of the book Canon (Al-Qanun). In fact, he was the founder of Greco-Arab School of Medicine. During the middle ages the Canon of Avicenna was by far the most popular text book of medicine in Europe and was most frequently quoted by later writers. Actually Avicenna's work was considered authoritative and used by the Universities of Europe till as late as 1650. It is his likeness that adorns the diploma of Pharmaceutical Society of Great Britain. His second volume of Canon described 719 drugs.

Al-Idrisi was born in Sevta and educated in Spain. He is famous for the collection of herbs. Alongwith him the name of Rasheed-uddin-Suri, who toured the hills and forests of his country Syria is associated in search of medicinal plants. The reference of his work is found in the famous book 'Al-Aqaqir' *(believed to be written by Ibn-al-Baitar)*, where 1400 drugs are described, and references of more than 150 Arab and Syrian Physicians, who were concerned with the collection of the information about these

* According to Leclerc the name 'Sharif' refers to Abdullah Mohammed Al-Idrisi. Previously, the exact period, in which he wrote the Materia Medica, was not known. It is only recently that Prof. Helmut Ritter has announced the presence of the book "Al-Aqaqir" while he was searching the manuscripts on this topic in mosques and libraries of Constantinople, as like the lost book of Al-Idrisi. Later on Dr. Max Mayerhof has published his paper where he has confirmed that this book is the same by Al-Idrisi, which was deemed lost. The manuscript of Al-Aqaqir is kept in the library of History of Medicine, Istanbul, on which no date is written. Previously it was believed that 'Al-Aqaqir' was written by Ibn-al-Baitar.
drugs are mentioned. Out of these 150 Physicians, the name of Al-Idrisi
has been referred as 'Sharif' more than 200 times and is believed to be
an authority of drugs of plant and animal origin of North Africa.

Ibn-al-Baitar was the Chief Botanist in court of Egypt. He travelled
through North Africa, Spain, Greece, Italy, Syria and Asia Minor. He
visited the botanist of every country and the herbs in their natural growth
and investigated their properties experimentally. In his monumental work
"Jame-ul-Mufredat"** collected the remarks of Dioscorides, Galen, Rhazes,
Avicenna and others on drugs. It deals with 2,000 drugs out of which
1,700 are of plants alone. Another book written by him on Materia Medica
is known as 'Kitab-ul-Mughni-fi-al-Adwiya-al-Mufarreda'.

Shaikh Dawood of Antakia wrote a book (about 1008 A.H.) on medicine
named 'Tadhkirat-ul-Albab', better known as "Tadhkira Dawood Antaki",
describes several hundred herbs, besides animal and mineral origin drugs.

Abul Farj-ibn-al-Qaf (630 - 685 A.H.), the pupil of Hakim ibn-i-abi-
Usaibiya (the famous author of 'Tabqat-ul-Atibba' and was given the title
of 'Ameen-ud-Daula' in the royal fort of physician), is the author of several
books on medicine besides a commentary on Canon (Al-Qunun) of Avicenna
in six volumes. His book 'Kitab-ul-Umda-fi-al-Jirahat' contains 20 sections
of which section 11 gives the description of 212 drugs, dealing with surgical
practices, and section 20 deals with Salves, Ointments and Oils, used for
dressing wounds.

Yusuf-bin-Omar 'Sahab-ul-Yemen' (died 694 A.H.), the author of

** An Egyptian edition of the book is available. Part of the work were
published at various times in Latin under the name of 'Simplica'. A French
translation by Leclerc is also available as 'Notices at extraits des manus-
scripts dela Bibliotheque Nationale'.

'Almotamad' printed in Egypt, has described only frequently used drugs with their actions.

Arab's contribution may also be recognised by going through the records on the translation work done on Indian and Persian books into Arabic. This aspect of study highlights the fact that how the drugs of different origins (Greek, Persian, Indian etc.) got mixed up and were included in their medicaments and the Materia Medica through ages. Yuhanna-bin-Masawayh in his book 'Jame-ul-Tibb', wrote that a number of books of Sanskrit were translated into Arabic. The authors whose work was translated are Kinkar, Manjal, Bakhar, Saleh-bin-Bahilla etc. The important books translated are 'Israr-ul-Mawalid', 'Kitab-ul-Adwa', 'Kitab Shark-ul-Hindi', Kitab-ul-Somum, Kitab Sasru-fi-Tibb-Asma Aqaqir-al-Hind, 'Astankar-ul-Jame', 'Mukhtasar-ul-Hind-fi-al-Aqaqir', 'Ilajat-ul-Atibba al-Hind al-Tauhum-fi-al-Amraz-ul-Alal', 'Rae-al-Hind-fi-al-Hayat-o-Samumha' and Shanaq Hindi etc. (222-224).

6. GRECO-ARAB SYSTEM OF MEDICINE (UNANI)

The system which originated in Greece and developed by Arabs into an elaborate medical science, on the basis of the teaching of Hippocrates, Dioscorides and Galen, is called Greco-Arab System of Medicine, which later on, after centuries, came down to India with Muslims advent, and flourished with the name Unani System of Medicine. It has imbibed the best what was known to other contemporary systems of medicines in Egypt, Syria, Iraq, Persia, India, China and other Middle and far Eastern Countries, as already mentioned.
Amongst the Indian Physicians the names of Hakim Syed Mohammad Hussain, Hakim Raza Ali Khan of Deccan, Hakim Mohammad Azam Khan, Hakim Mohammad Najmul Ghani Khan are very important to be mentioned. Similarly Hakim Ali Gilani, Hakim Momin and lastly the name of Hakim Shareef Khan may also be included as important contributors. Hakim Syed Mohammad Hussain, who wrote 'Makhzan-ul-Adviya' is the pioneer worker among the Unani Tabibs (Physicians) in India. His original work is in Persian language which has been translated into Urdu also. It describes nearly 1,500 drugs including hundreds of herbs growing in India. It also describes Cinchona bark and Quinine. Hakim Raza Ali Khan of Deccan is the author of "Tadhkirat-ul-Hind", in Persian language, on Indian herbs. He mentioned the Sanskrit and South Indian names of some herbs on the basis of his own experience and observation. Hakim Mohammad Azam Khan (died in 1902) is the author of the masterpiece "Muheet-i-Azam" in four volumes, describing several thousand drugs, including some used in Allopathic medicine. Hakim Mohammad Ghani Khan (son of Hakim Azam Khan's sister), wrote a voluminous book "Khazanat-ul-Adviya" in 1915. It is on the line of "Muheet-i-Azam" and is in Urdu, which includes more Allopathic medicine, describing 2,612 drugs.

INDIAN SCHOOL OF MEDICINE
AND ITS IMPACT ON FOREIGN COUNTRIES

The Indian medicine made enormous progress after the time of Charak and Susrut, which achieved its highest peak of development upto 1200 A.D., and made its way to the far off countries like Egypt, Greece and Rome. The reference of many Indian plants especially of the aromatic group are mentioned by Dioscorides in his work. Mention of the 'Cinnamon Oil'
exported from India has been made by Ktesias of Knidos, who was a
Physician to Artaxerxes Mnemon (about 400 B.C.) (188). Similarly the
anonymous author of Periplus, states that Costus (Saussurea lappa) was
exported from Sind. Pliny in his book also refers about the import of
costly Indian drugs against the heavy drain of Roman Gold (Historia
Naturalis, Vol. XXIV, P.1).

A mention has earlier been made that the exchange of knowledge
took place during the Arab School of Medicine, by way of translation of
Indian and Persian books into Arabic. Accordingly the great works of
Charak and Susrut were translated into Arabic during Abbasid period
(8-9th Century A.D.). These translations in turn, along with the original
works of Arabic medicine, were translated into Latin, and later these
formed the basis of European medicine, which were taught to the students
in Europe till 17th Century. Along with this a number of work on Indian
medicine and native medicions were translated into Arabic (Dietz, "Analecta
medica", Wustenfeld, "Geschichte der Arabischen Aerzte" (1840), Fluegel
and Others). Reference of many Indian drugs like Pepper, Lac, Nard,
Liquorice (Glycyrrhiza), Asafoetida, Ocimum, Bdehellium, Cinnamon, Myrrh,
Red Sandal, Calamus (Acorus calamus) and Chebulic Myrobalan are available
in the Materia Medica of Arabs, indicating the exchange of knowledge,
and came into use in their medicaments (162).

INDIAN MEDICINE AND ITS POSITION DURING MEDIEVAL INDIA

There were many causes of the decline of Indian Medicine during
the Medieval period. Firstly the import of the Buddhist doctrine of Ahimsa
(Non-killing), led people to consider touching and dissecting of dead bodies
as a sin, which resulted in the decline of Surgery, though medicine maintained its progress, during the Buddhist period and a large number of drugs of plant origin were added to the already extensive list of the Materia Medica of Indian medicine. Secondly due to the successive invasions of India by Greeks, Scythians, Huns and the Muslims, a good deal of the existing literature of Ayurveda, either got lost or mutilated. After setting on the Muslim rule in India (thirteen century onwards), the Greco-Arabic or so called Unani Tibb, became the state system of medicine, which slowly resulted in throwing the Indian System of Medicine into the background. The Arabic System brought with a rich store of its own Materia Medica, which was unknown to India, during the long period of Muslim rule (specially the Medieval period), this system in close contact with the Ayurvedic System of Medicine resulted into a great deal of intermingling and simultaneously progressed.

**INDIGENOUS SYSTEMS OF MEDICINE (AYURVEDA AND UNANI TIBB)
THEIR DECLINE AND EVOLUTION.**

Advent of Europeans in India, firstly the portugese, then the French and lastly the British, made a great loss to the Indian System of Medicine. Both the system i.e. Ayurveda and Unani declined gradually after the fall of the Mughal Empire, when the British rule was established and the European System of Medicine (Allopathy) was introduced into India. As a result the Indian Systems of Medicine were further thrown into the background. However, both these systems were practiced in India and served as the main source of medical relief to the majority of the Indian population, especially to those who were poor, as the medicines of Indian System of Medicine were cheaper as compared to the Allopathic System.
Though the Indian System of Medicine were thrown in the background, but the potentialities and curative properties of the indigenous drugs (especially those of the Indian Medicinal plants) were however, realised even by the British, and since then many workers and scientists have attempted to identify the botanical source and explore many more new drugs with the help of local Vaidyas, Hakims, Pansaris and local people. In this direction the work of Sir William Jones (82), "Botanical observation on selected Indian Plants" was one of the foremost contribution to be recognised. This was followed by many other workers like John Fleming's (60) "Catalogue of Medicinal Plants", Ainslie's (1) "Materia Medica of the Hindustan", Roxburgh's (170) "Flora Indica", and Wight's (227) "Icones Plantarum Indiae Orientalis" and later the works of Wallich (207), Royle (171), Strachey (198), Boissier (22), Kurz (103), Hooker (72) and Duthie (54) etc., can be cited as important works in resolving the problem of identification of the drugs used in these system which added to the knowledge for the later workers. Of the earlier workers on Materia Medica and Pharmacology of Indian Medicinal Plants, the names of O'Saughnessy (124), who has written 'Bengal Pharmacopoeia', for the first time described scientifically the properties and use of drug plants of Bengal. This was followed by Irvine's (73) 'Materia Medica of Patna'. 'Pharmacopoeia of India' by Dr. Waring (221), Dutt's (55) 'Materia Medica of the Hindus' and Dymocks (56) 'Vegetable Materia Medica of Western India' are worth mentioning. However, the two most important and comprehensive works namely 'Pharmacographia Indica' of Dymock, Warden and Hooper (57) and 'Dictionary of Economic Products of India' by Sir George Watt (225,226) stayed as most outstanding and by far the most valuable of all the previous
works and remained even today, with few exceptions, an important source of scientific references for the present day workers. These works were followed by 'Indigenous Drugs of India' by Kanni Lal Day (53), 'Indian Medicinal Plants' by Kirtikar and Basu (93), 'Pharmacopoeia Indica' by Bose (23) and lastly 'Indigenous Drugs of India' by Chopra (29). In this regard some of the important publications of Council for Scientific and Industrial Research (CSIR), Govt. of India, in the field are 'The Wealth of India' (200), which gives the list of available literature on most of the medicinal plants; 'Glossary of Indian Medicinal Plants' (31-34), which is a catalogue, giving the references to important investigations on medicinal plants, with their uses, sources and the individual parts used for different diseases. More or less complete bibliography of published papers on Indian Medicinal Plants, with the name 'Review of work on Indian Medicinal Plants, has been published under the patronage of Indian Council of Medical Research (ICRM), by Chopra and Chopra (30). Recently the Indian Council of Agricultural Research (ICAR), has under taken to publish a review of recent work on phytochemistry of medicinal and allied plants (39), Chopra et. al. (36) in "Chopra's Indigenous Drugs of India" give the most upto date information about almost all the important medicinal plants used in Indian System of Medicine in the country, and Chopra et. al. (38) have also published the book entitled 'Poisonous Plants of India' where the habitat, morphology, chemistry and pharmacology of the important poisonous plants have been enlisted. Chopra et. al. (37), alongwith these books, have also published the list of 'Insecticidal and Pesticidal Plants of India'. A brochure on 'Medicinal Plants of Arid Zones'
has been edited by Chopra et al. (28), and has been published by UNESCO.

In spite of the above mentioned work, very little has been explored on the chemical, pharmacological, and pharmacognostical aspects of Indian Medicinal Plants till recently, with the exception of some workers, from time to time, who have taken up investigations on some of these drugs. Keeping in view the vastness of the problem, a lot has yet to be done, especially in the field of pharmacognosy, which was least attended to as compared to chemistry and pharmacology.

**STATUS OF PHARMACOGNOSTICAL STUDIES DURING ANCIENT AND MODERN PERIODS IN INDIA**

Though, much of references on the exact beginning of the pharmacognostical studis is not available during the ancient period however, reference can be made of 'Kallpastanum' or 'Vrikshayurveda', where along with many of the botanical topics, aspects like geographical distribution, soil, habitat, seasons of collecting of medicinal plants, duration of their efficacy and methods of storage etc., have been described. Not only this even the drugs and medicinal plants have been classified under different heads, which have further been divided into different groups such as bulbous and tuberous roots, root barks, barks of trees having peculiar smell, leaves, flowers, fruits and seeds, acrid and astringent vegetable products, milky plants (with latex), and those having gums and resins. Special instructions have been given for the proper time of collection of different drugs, parts to be collected, methods of preparation of drugs along with weights and measures to be used, while dispensing them. Mention has also been made on the cultivation practices of the drug plants.
during that period. However, the book "Handbuch der Pharmacognosie, Vol. I, Part II, PP. 499-510" by Tschireh, throws the light in detail on the pharmacognostical history of India. Reference may also be made in this regard to "Pharmacographia" by Flueckiger and Henbury (61), and to several other books on pharmacognosy.

As it has already been mentioned earlier that much of the works, due to foreign invasions became mutilated or lost, therefore, records of the works done on the subject, during this period is not known. However, during the end of the last century and beginning of the present century i.e. within few decades some British and few workers of this sub-continent initiated research work on drugs as enumerated above, and many of them have made careful studies on the micro and macroscopical aspects of a number of medicinal plants, especially those which were included in the Indian and Colonial Addendum of 1900 and the contribution of luminaries like Forsdike (62-64), Greenish (66-70), Melville (111-113), Trease (202-204), Wallis (208-220), Youngken Sr. and Jr. (229-247) and others (40, 71, 77, 78, 164, 186, 191-193) are worth mentioning.

On this basis, a number of research workers have also initiated studies recently in India on the Pharmacognostical aspects of Indian Medicinal Plants. Few important names of research workers in this regard are - Bal (11, 12), Bal and Datta (13), Krishnaswamy and David (97), Datta (41), Datta and Bal (42-44), Datta and Mukerji (46-48), Datta et. al. (43, 45, 48, 49), Mehra and his associates (105-109), Bhatnagar (17-21), Sircar (189, 190), Quazilbash (157-160), Shah et. al. (175-183), Nayar et. al. (120-123), Rohatgi (165, 166), Santra (173), Mittal (114, 115), Atal and his associates (2-7), Prasad (125-131, 133, 136-139), Iyer (75), Prasad and his
associates (140-156), Chaterji and Lahiri (26) and a few others (14,65, 86-88,189). It may be noted that most of the pharmacognostical work has been done on microscopical aspect and only few workers have concentrated on cultivation studies (27,90,82,132,134,135). It may also be noted that inspite of the fact that in modern pharmacognosy, many workers in the west, have turned towards chemical and biochemical aspects (161,242-247), but macro and microscopical studies still remains the predominant aspect of study of medicinal plants, though in recent times it further shifted to the study of natural products (main chemical constituents of the active ingredients), which however, does not serve the purpose as the problem of adulteration and substitution is not solved only by the biochemical or natural products studies, as the drugs used in Indian Systems of Medicine are yet to be identified for their, distinguishing characters for identification and standardisation purposes.

Therefore, particularly in India, at present there is a great need to take up the anatomical studies on most of the indigenous drugs, where this work has not been taken on a large scale. To tackle this problem a thorough knowledge of the macro and microscopical characteristics of crude drugs is of utmost importance, especially when adulterant drugs happen to resemble with the genuine drugs in its external form and appearance as in the case of many root and bark drugs, or if the drugs are shrunken, crumpled, or otherwise changed by drying or preparation, or if the drugs happened to be in crushed or powdered form, it is by no means easy to ensure the authenticity of the sample. But when the genuine and adulterated drugs are untire forms or even in somewhat broken conditions, and are dissimilar in external morphology, they can be quite
easily identified because they show clearly recognised gross characters associated with the drugs in question.

ROLE OF PHARMACOGNOSY IN THE IDENTIFICATION OF DRUGS WITH THEIR ADULTERANTS AND SUBSTITUTES

As we all know, the plant body as a whole is made of cells and in-turn tissues, giving rise to the various parts of the plant body. It is also a known fact that each part of the plant body is composed of dissimilar cells of differentiating characters. Most of the drugs (genuine) and adulterants have their own macro and microscopical structures, by which they can definitely be recognised. Hence, the macro and microscopical examination in such cases, whether whole or in powdered form, help in recognising the genuine drug with those of adulterants or substitutes. Moreover, anatomical study of any of the parts of the plant viz. leaves, stems, roots or any other part, reveals that there are basic structural patterns found in different plants thereby giving rise to different diagnostic characters, which ultimately help in their identification.

A number of adulterant drugs, due to their external resemblance, are sold in the market in place of the genuine drugs. These drugs can easily be distinguished by studying their external and internal characters e.g. shape, size and number of per unit area of epidermal cells, the stomata, the trichomes and also by examining in detail their anatomical characters such as presence or absence of crystals of calcium oxalate, their form and location. Even these characters when present, help in identifying not only the genus but also the species of the plant (51,52, 59,167-169,196). Some of the examples of the drugs sold in the market
as adulterants or substitutes are - Henbane leaves, marketed as Dandelion leaves because of their resemblance. Ailanthus leaves have been substituted or mixed with those of Belladonna, Spearmint, or Senna (212) and Vasaka (174). Their exact identity can be confirmed by cutting transverse section of the midrib, and difference in their structure gives definite clue to their identity. Here it will be worth to point out some important examples as to how the pharmacognosists have employed differences in macro and microscopical features in distinguishing allied species or one drug closely resembling with the other drug. The Buchu leaves (Barosma species) have been differentiated, besides the quantitative factors, such as vein-islet numbers, palisade ratio and stomatal measurements, by the variation in radial and outer walls of the cells of epidermis, size of trichomes on laminae and petioles, and also dimensions of calcium oxalate crystals. Spanish or Portugues Digitalis (Digitalis thapsi) is closely similar to Digitalis purpurea but it is easily differentiated by its trichomes, which are glandular, usually uniseriate, with unicellular, spherical glandular head (51). Similarly Digitalis leaves can be differentiated with their adulterants like Mullelin leaves (Verbascum thapsus) which are covered with large, branched wiry hairs, and with the adulterant Primrose leaves (Primula vulgaris) and Comfrey leaves (Symphytum officinale), and other adulterants by shape, margin, venation and nature of trichomes (184).

Seeds of various species of Strophanthus e.g. Strophanthus kombe, S. gratus and S. sarmentosus have also been differentiated on the basis of various pharmacognostical parameters (184). Not only this, the stem drugs can also be differentiated by studying nature of cell walls, occurrence of leaves and trichomes, presence or absence of pith and nature of its cells, position
and nature of xylem elements, nature of cortical and other tissues of the drug, medullary rays, its width and height, presence or absence of particular types of sclerenchyma and its elements and even the cell contents. The Indian hemp is differentiated with Lobelia by the presence of well developed bundles of pericyclic fibres, which are absent in case of Lobelia. The stem of Datura stramonium is similar in general structure with that of Belladonna, but many cells of the pith of D. stramonium contain cluster crystals of calcium oxalate and few sandy microsphenoidal crystals, where as in case of Belladonna, the pith cells do not have the first type of cells but only latter type of crystals. For distinguishing the stem of Swertia chirata with that of S. angustifolia the measurement of the wings are taken into account for identification. Like this many more examples may be cited of various other parts of the plant viz. barks, roots, modified structures like rhizomes which can easily be distinguished by considering different parameters. Barks of Aspidiosperma spp. (98-102, 203) resemble with each other, to a great extent, in their macro and microscopical characters, but differentiated by the presence or absence of latex canals, sclerotic medullary rays, lignified and unlignified cork cells, arrangement of cortical sclereids, and phloem fibres and by the quantitative determination of sclereid fibre ratio. Cascara bark, due to its scarcity, is substituted by Almus glutinosa which can be differentiated by the presence of well defined band of sclereids in the pericycle, and the absence of phloem fibres (220). Presence or absence of stone cells and kinds of crystals present in the sheaths surrounding the fibres can distinguish Frangula and Oak barks (25). Differentiation of Cinchona, Cascara, Cinnamon and Sassafras barks depend on the dimensions of fibres,
as these barks have phloem fibres of varying dimensions (220). The particular arrangement of these fibres is often characteristic. In Cinchona they occur isolated or in short radial rows; isolated or in short tangential rows in Cassia and Cinnamon; in witch Hazel, Cascara and Quillaia they occur in tangential bands, four or five rows deep and extending from one medullary ray to another, while always isolated in *Aspidiosperma excelsa*. Further, several quantitative methods based on the determination of sclereids in the mixed powdered drugs, have been utilised for their differentiation (58, 172, 214, 216, 217, 231).

The measurement and the number of cork cells per unit area, presence of fibres in the secondary phloem, longer vessel elements, longer and more numerous xylem fibres, and absence of starch grains of more than three components, differentiate the roots of Indian Belladonna (*Atropa acuminata*) from the European species (*A. belladonna*) (111). Adulteration of Belladonna root by Marshmallow (*Althea officinalis*) root can be checked by its characteristic cell contents, as some mucilage and cluster crystals of calcium oxalate are found present in few cells of Marshmallow, and absent in Belladonna roots (212), and also the pentarch stele of *Althea officinalis* distinguishes it from Belladonna root, which has diarch stele. Due to superficial similarity the rhizomes of Dog-Grass (*Cynadon dactylon*) and Agropyron repens can be differentiated by the presence of two rings of sclerenchyma and absence of starch grain in Agropyron as compared to Cynadon, which has only one ring of sclerenchyma in the pericycle (194, 195). The rhizome of Swiss Ginger, adulterated with Japanese Ginger, can be differentiated by the presence of numerous compound starch grains of 3-15 diameter (197), and the rhizomes of *Xanthorrhiza apiifolia* and
Coptis teeta, which are adulterants of Hydrastis canadensis, have been differentiated by the peculiar structure of the pith cells and the pericycle. The number of internal glands in the rhizomes and the number of xylocentric vascular bundles in the stripe serve as useful distinguishing characters for D. filiximus and several other members of the family Polypodiaceae (117).