PAKISTAN MEDICINAL PLANTS II

by

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II. NORTH WEST FRONTIER PROVINCE (N.W.F.P.)

This former province of Pakistan has an area of about 142,000 square miles and a population of approximately 3,000,000, with adjacent tribal areas of about 15,600 square miles and 2,500,000 population. The inhabitants in the tribal areas have not been subject to the provincial laws but are under a tribal agent appointed by the Central government (or „Centre").

Four definite zones are recognized in the N.W.F.P.: (1) the HAZARA DISTRICT, mostly mountainous with some fairly level areas; rainfall 30—56" per annum; (2) the PESHAWAR VALLEY, comprising the Peshawar and Mardan districts (including Kurram), together with part of the Malakand agency; rainfall 12—15" p.a.; (3) the KALAT AND BANNU DISTRICTS rainfall 15" p.a.; (4) DERA ISMAIL KHAN (or southern) DISTRICT; rainfall 4—8" p.a. The soils are on the whole rather poor, large areas being overlaid with much stone and gravel; in many places, the soil is thin and deposited by water or winds. There are several irrigation canal systems, which appear to be absolutely essential to agriculture in many areas.

The principal crops in what was the N.W.F.P. are wheat, gram (= pulses of several *Leguminosae* genera), maize, sugar-cane, tobacco, and fruits (pears, peaches, plums, apricots, citrus). This is the chief fruit-growing area, hence has sometimes been called "The California of Pakistan". A survey of medicinal herbs was made here in 1948 (SU).

(i) HAZARA DISTRICT. The chiefly important part of this district from the crude drug standpoint is the Kaghan valley, potentially a valuable source area. Abbottabad is the site of the Forestry College and Research Institute, where work with medicinal herbs is carried on. Some parts of the district have relatively abundant precipitation. Formerly considerable collecting of crude drugs was done here but this was stopped in the reserved forests by order of the provincial government. Undoubtedly this action was taken

to prevent the complete extirpation of plants by the collectors. There would obviously be no objection to cultivation of drug plants in this area.

1) *Digitalis* is one of the most important materials being used in medicine today, even in countries where synthetic medicinals have been given a big play. Much is imported annually. Cultivation has been practiced in Kaghan (1936) as well as in Kashmir, however on too small a scale. It is said that one or more species occur in the Gilgit area, although none was seen during the tour. (Specimens of *D. purpurea* L., observed in the Islamia College medicinal plant garden (near Peshawar) were supported on sticks of *Saccharum arundinaceum*, (the stalks of which were sprouting leaves!!)).

2) *Belladonna* is another outstandingly important drug in all parts of the world and species occur in Indo-Pakistan, *viz.*, *Atropa lutescens* and the ,,Indian Belladonna", *A. acuminata* ROYLE. The plants occur naturally in N.W.F.P. and Kashmir where they have not been exterminated by earlier collections, and are known by many vernacular names, such as ,,pholara" and ,,tambeku sag". Prior to 1936, much belladonna is said to have been imported from Hazara. During both of the twentieth century World Wars, considerable supplies were collected and sold at high prices, much being exported. Cultivation of the European *A. belladonna* has been successfully conducted, thus at Kalabagh on the Indus River. The Indian species however produce a drug with high total alkaloidal content, thus 0.81 % from the root and 0.5 % from the leaves (min. required content of USP, NF and BP = 0,4-0.45 % for root and 0,35 % for leaf).

Adulteration was noted although this appears sometimes to be unintentional. Thus, at a village, Barra Gali, north of Nathia Gali, we ran across an elderly man who had collected the root of *Phytolacca acinosa* (CHANJA) and was drying it in the village streets; when we asked what he called it he replied ,,Belladonna". This is quite understandable in view of the similarity of appearance of the plants both above and below-ground.

3) *Gentian* root is another important drug in many parts of the world, although *Gentiana lutea*, the species used by western countries as a bitter tonic, is not found in the sub-continent. In its place, *G. kurroo* BENTHAM is considerably used in Pakistanian and Indian medicine. The plant grows at 8 to 12 thousand feet elevation in N. W. F. P. and Kashmir, and the root is variously used as an aid to digestion, as febrifuge, and applied locally to wounds (N.W.F. P.) It has been proposed to cultivate *G. lutea* in the Kaghan valley.

Considerable quantities of the native species are available, also of other species deserving of study, such as *G. carinata* GRISEB., *G. tenella* ROTTB., etc.

4) Another bitter tonic drug deserving mention at this point is *Swertia chirata* (and other somewhat less useful species). Chirayata is an herb bitter in all parts but the stems (twigs) wrapped in bundles are the parts mostly marketed and used. This product is extensively used in stomachic and tonic preparations of the Ayurvedic and Unani schools of medicine, as well occasionally as of western medicine. Quantities are available from the N W F P (upper Kaghan valley, etc). Azad Kashmir, etc., and hundreds of maunds annually could be collected. Since it commonly grows rather scatteringly with other plants with which it may be innocently adulterated, it is proposed to cultivate these species, as a step to improvement of quality.

5) *Onosma bracteatum* WALLICH (*Boraginaceae*) supplies the popular domestic drug called „*gaozaban*", although this same name is sometimes applied to other drug materials. It has considerable repute as a tonic and alterative, especially when used mixed with hot milk; in larger dose, it is diuretic and gives comfort (it is said) to the feverish patient. This supposed value is partly supported in the high price of the drug, also in its frequent adulteration. Some has been imported from Iran. The plant grows in high places in the Kaghan valley and in Azad Kashmir, Baluchistan, etc. A related species, *O. echioides*, called „rattanjot" (NWFP) is used in Unani medicine.

6) *Lobelia* (as the species *inflata)* has been generally dropped from Anglo-American medical practice, although the chief alkaloid α-lobeline is still sometimes used. In eastern Europe and Asia, however, lobelia is still considered favorably, and such species as *L. nicotianaefolia* HEYNE and *L. trigona* ROXBURGH, native to this area, are available for medicinal use. This drug is used in allergies, thus in asthma, scorpion sting (anaphylaxis), etc. CHOPRA in India claims about 15 species deserve study. The drug was previously collected in Hazara (Tanglai hills) for sale to a Calcutta firm.

7) *Dryopteris filix-mas* (L.) SCHOTT, the source of Male Fern, still considered the most effective treatment of tape worm, is said very common in Hazara and in Swat. „Pakla root" (as it is called) could be produced from Shogran to Naran, Gallis, and the Bhogarmang Valley.

8) *Valeriana (Valerian* root) in English and American medicine has been largely abandoned, however is still considered a valuable medicine in Germany and other European countries, where much evidence is presented to indicate its value as a nerve sedative. Several species occur — *V. Wallichii* D. C., *V. Hardwickii* WALL., as the European-used *V. officinalis* L. — in N. W. F. P., Azad Kashmir, and the Gilgit agency. Because of the strong characteristic aroma, the plant is also used in perfumes and spices. „Mushkbala" has long been exported from the Kaghan and other areas to the extent that in some places it has become a scarce item. Scientific cultivation should be encouraged.

9) *Cymbopogon jwarancusa* is abundant wild in the Hazara district and presents interesting possibilities since the volatile oil contains 70 % piperitone which can be used for thymol synthesis.

(ii) The KURRAM VALLEY in the western portion of the N.W.F.P. is famous for its production of *Artemisia, Santonica* or *Cina*, the source of santonin.

1) *Artemisia* the crude drug and its chemical derivative, santonin, constitute Pakistan's chief medicinal product, at least from the standpoint of export production sales. Several *Artemisia* species occur here with widely varying yields of santonin, and therefore representing a whole range of values from highly productive to worthless. Thus, the species *A. parviflora* ROXB., *A. scoparia* WALDST. & KIT. (darwang), *A. absinthium* L. (mustiarah), and *A. tournefor-teana* REICHB. (BUK) are of little or no value, whereas *A. maritima* L. and *A. kurramensis* QAZILBASH, (*A. maritima* L. forma *rubicaulis* BADHWAR), and *A. brevifolia* WALL. are commercially useful in at least some strains.

It is not sufficient only to collect plants of the correct species and variety, it is just as important to collect at the proper time and then to properly dry and store the harvest. Yields can also be increased by proper nurture, and the farmers often now grow Artemisia on the bunds (or ridged banks around the cultivated fields), where a larger access of water from the irrigation ditches is available to the plants. Adjacent parts of the Province such as North Waziristan (near Datta Khel) are also said to be suitable areas for production.

The Kurram species, *A. kurramensis*, has been found to yield considerably greater amounts of santonin (2—4 %) than the Kashmir and other types, which commonly run around 1 % yield. Genetic improvement, such as by crossing the native species with the European high-yielding *A. cina* (BERG) WILLKOMM, hold forth interesting possibilities of success.

The Kurram cina crop is harvested just before flowering in August, since flowering exposes and destroys the santonin in the flower-heads. The stems are cut off a little above the ground level, leaving a single stem in each clump to bear seed for extending plantings or re-planting, since these perennial plants sometimes die out. After threshing, the collected flower-heads are sifted free from straw, etc. Santonin extraction is carried out as promptly as possible.

The Agency crop is largely processed at the Kurram Chemical Works near Rawalpindi, which in 1954 produced 7,000 kg. (1104 kg., ca. 1956 (T)), of santonin, processing about 600 tons of artemisia (P). Production constantly rises and was expected to top 1,000 tons (CH-S). Both Kurram and Kaghan artemisias are processed in a factory operating in the old Murree Brewery building near Murree (about 30 miles from Rawalpindi): this is said to be the largest santonin manufactory in the world.*

The yields of santonin from Kurram plants (1.5—2,48—2.57 %, even occasionally reported up to 4.24 % (S)) is considerably higher, even than the supposedly good yield from the Russian (Turkestan) cina, which runs only about 1.2—1.4 % averagely. The possibilities of increasing yields even further by cultivation, selection, polyploid creation, etc., seem excellent.

For several years, Professor QAZILBASH and others have been investigating the production of Artemisia in the Upper Kurram agency, and experiments have been carried out with the plant along genetic and fertilization lines for improvement of plant and santonin yields. The considerable interest in santonin plants currently is indicated in the publications of WICHMANN (WI).

The product from the Khyber and Malakand Agencies was found to be almost devoid of santonin.

The Baluchistan *artemisia* is inferior to that of Kurram, yet has possibilities. *A. maritima* chiefly and other species occur over a vast area, perhaps of 150 to 300 square miles. The different varieties vary so much in chemical content that a combination chemical-botanical survey should be undertaken to determine which areas would produce a profitable item. Samples collected beyond the reservoir at

*) Control was taken over ca. 1954 by the Pakistan Industrial Development Corporation (PIDS). The companies principally interested in past years in Pakistan artemisia were T. and H. Smith (Carnegie Brothers), Biddle Sawyer, and Marker Alkaloids (Quetta, Baluchistan). The first-named firm built the first plant in Rawalpindi for extracting santonin, and the last firm had an operation at Quetta, where ephedrine was also produced. Artemisia is a governmental monopoly in Pakistan. The crude material is purchased in toto for the entire year on the basis of the highest offer on tenders or bids which are let out each year. Total sales of 4.5 million rupees (approx. $ 1,350,000) were reported in 1953.

Spinkarez showed 1.2 % santonin on analysis. Unfortunately, shipments of tons of worthless („spurious") *artemisia* have been sold without careful examination, and this has hurt the reputation of the Baluchistan product.

The Kashmir Santonica *(A. brevifolia* WALL). is found growing at 7—10,000 feet elevation in Gurez, Baltistan, Astor, Telel, Ishkoman, Baramula, etc. This product is plainly inferior in active principle to the Kurram, with yields of around 1 % santonin *(e.g.*, sample from Gurais). However, there have been some commercial collections in the Gilgit Agency (approx. 120 tons p.a. from the Rattu area, ca. 1954), but this area is manifestly too remote from suitable means of transportation to yield an economic crop.

A much more favorable prospect lies in production in the Kaghan valley, where conditions seem most propitious for this plant. In some areas, the hills are literally covered by *chahoo* (chahu), the local common name for *artemisia*. Trials of the Kurram variety have shown excellent growth with no diminution in santonin content.

Other areas of northern West Pakistan deserve study, since the genus is common in Chitral, Swat, and Dir, and so far as can be determined plants from these areas have not yet been studied chemically.

The importance of santonin is large in Asia, with its great concentrations of peoples, many infested with round worms. It is said that in China santonin pills are a form of currency. The Soviet Union has used santonin in barter, as a lure to trade, and in „reverse" lend lease. 90 % of Pakistan's production is exported. (T*).

Artemisia plants have a markedly pleasant aroma and a volatile oil could be obtained from the plant, thereby reducing the costs of production. Such an oil might be usefully employed in scenting cheap soaps, insecticides, and industrial goods.

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*The statistics on Santonica (Artemisia: crude material) and Santonin as published by government agencies in the United States are rather inadequate.

For Santonin, imports into the U.S. in 1950 were 2,932 lbs., in 1951: 1,354 lbs. (This includes the salts of Santonin). Imports in 1943 were 4,863 lbs. Hence, importation appeared to be declining. Most of the product came from the U S S R, with India, the U.K., and France ranking below in various orders for various years. The average value per pound for 1943 was $ 81.18, for 1948 $ 73.23.

Domestic production has also declined, In the period 1930-35, the US production is said to have averaged 800 lbs. per year. and for 1937-9 the average was set at 300-500 lbs. per year. Production and export at present are thought to be small.

There were no imports of Santonin into the U.S. from Pakistan in 1948.

Imports of Santonica are said to be now „nil or negligible" according to the International Economic Analysis Division of the Office of International Trade (U.S. Dept. of Commerce).

2) *Pyrethrum Flowers* (flower-heads) is a product of various *Chrysanthemum* species, which have been successfully grown in the Kurram Agency and elsewhere. This perennial herb has been cultivated successfully at Parachinar and at the Tarnab agricultural experiment station near Peshawar. A yield of 150 lbs. per acre was recorded at Kurram. Quality seemed good. The only objection seems to be that the zamindars feel it is more economic to grow food crops, the sale of which is never in doubt. However, a good market ordinarily exists in Pakistan for spray and dust insecticides of this type.

Perhaps greater possibilities exist in areas of waste land (tribal areas), as in parts of the Kaghan valley and Kashmir. At Gulmarg (Indian Kashmir), large plantations are said to have been successfully established and maintained as commercial ventures.

3) *Withania coagulans* is used somewhat in the Tibbi (native Muslim) system of medicine, but mostly the small brown fruit are used to coagulate milk, as a rennin substitute especially in the cheese industry (a common name, Panir band or punirband, means cheesemaker). The plant is abundant wild in the Kurram and Khyber Agencies, as well as in other parts of N. W. F. P. In Baluchistan, the plant grows over 300 square miles, but is little used if at all (S).

4) The sister species, *W. somnifera* Dun., is common throughout the N.W.F.P. and is considerably used in many ways in the folk medicine of Pakistan and India, and is deserving of further intensive study.

5) The *native (Indian) senega*, obtained from *Polygala chinensis*, occurs in commercial amounts near Ziarat Kaka Sahib in the Nowshera Tehsil. Due to careless collections, it has become increasingly scarce, however, the prices have risen, and hence its use to a considerable extent discouraged. It is used much like the American senega, for cough, etc. An effort should be made to rehabilitate the wild growth and to initiate cultivation.

6) *True Saffron* from *Crocus sativus* L. is not indigenous to Pakistan, but has been cultivated with a degree of success at Parachinar, also around Quetta (Baluchistan) and in Kashmir.

7) *Mulberries* (fruit of *Morus* species) are hardly to be considered medicinal in the conventional sense; however, since they constitute the primary source of vitamin C, etc., during the winter months for many people in the northern areas, it is perfectly logical to consider them in this place. The fruit are collected and dried in the summer months in the Kurram valley, Gilgit Agency, and elsewhere. White fruited forms *(M. alba)* seemed commonest at Gilgit. Dried mulber-

ries from Kabul (Afghanistan) are shipped in; they are said of very good quality. The leaves are used in the flourishing silkworm industry* (ex. near Abbottabad, Rawalpindi, in Kashmir). (Other fruits are also dried for winter use, ex., apricots, as seen in Gilgit).

8) *Tea* from *Thea sinensis* is grown commercially in East Pakistan (the third most important cash crop of Pakistan) and experimentally in the N.W.F.P., looking to eventual plantations in Hazara.

A product called „green tea" unfamiliar to the writer and entirely different from what Europeans and Americans know under the name is popular in the N.W.F.P. and was consumed on several occasions in the Kurram valley. The product was said by some to come from Afghanistan, by others from China, while yet others maintained the product is indigenous to this part of Pakistan. At any rate, it seems to be used in Afghanistan, Chitral, etc., and is generally considered to be produced in the Tribal Areas. It is said cultivated (experimentally) at Dehra Dun. The product is quite variable and the specific origin or origins are apparently not known. The product has medicinal properties, including a very astringent quality, is more stimulant than regular black tea, is carminative, and according to some is aphrodisiac.

III. The Panjab (Punjab) (= West Punjab).

This section of West Pakistan is mostly plains, traversed by the five tributaries of the great Indus River, after which *(panj*: five) the former Province is named. In the north however, there is increasing hilliness until it becomes practically mountainous in the Murree area. The gently rolling Salt Range extends approximately between Jhelum and Mianwali and northwards, and represents an area of little value agriculturally. However, much of the Panjab is overlaid with good alluvial soil which has been borne down from the Himalayas through the ages, soils which are particularly deficient in nitrogen and organic matter.

(i) Murree Hills District and Rawalpindi area. Here in the extreme northern part of the Panjab, fair rainfall occurs, thus there is an average of about 37″ per ann. at Rawalpindi. Considerable erosion occurs, part of which is due to over-grazing by goats and sheep; an effort is being made to control this erosion by growing *Acacia modesta* and other plants. The chief crops are wheat, gram, maize, millet, sugar-cane, and tobacco. An effort is being made to grow trees in this area, the chief difficulty

*) Sericulture is important in Pakistan, with annual production of approx. 40,000 lbs silk (1953).

here being to keep grazing animals from the plants at an early growth stage. Special protection is needed and many devices — masonry, metallic drums, etc. — are used in communities for this purpose.

1) *Cotton* has long been the primary agricultural production of the Panjab — „the silver fiber" it is called to distinguish it from jute, „the golden fiber", the principal crop of East Pakistan. Cotton is of course cultivated throughout India, the Bombay area being for instance a heavy producer. The medicinal importance of cotton (fiber, for absorbent cotton, bandages, dressings, sutures, etc.; the fatty oil; the root bark) is too well known to deserve discussion here.

2) *Cumin (Cuminum cyminum* L.) has long been grown in the Panjab, where about 3,000 maunds (or 247,000 lbs.) was collected annually (about 1936). This condiment is known as the *black zira* (or *zeera)* to distinguish it from the white which is caraway. The plant occurs abundantly in Gilgit and is collected and used in their homes by many local farmers, who find it growing in pastures and on the bunds. Cumin is produced also in many parts of India.

3) Another important spice, *ginger,* is cultivated commonly in East Pakistan and throughout India; to a lesser extent in Panjab. Most of the Pakistan product is imported from India. The demand is high for this spice/medicinal product. Experimental cultivation has been attempted in Bahawalpur south of the Panjab, also at Trest, in the Murree hills. *Azad Kashmir* is said to offer excellent opportunities for successful production.

4) *Curcuma longa* WALL. (turmeric) is grown in areas of Panjab, N.W.F.P., and East Pakistan. It is an important component of chutneys and betel nut chews. The plant is cultivated also in many parts of India.

5) *Pine* is important as a source of turpentine oleoresin and volatile oil, rosin, lumber, and various derivatives. *Pinus longifolia* ROXB., known as the *chir (cheer)* pine, is turpentined in the Panjab as well as in some parts of the N.W.F.P. At Jallo, near Lahore, is a governmentally operated distilling plant, where the crude oleoresin is distilled, 3 grades of oil and 6 or 7 grades of rosin (resina) being produced. Experimental studies in yields, using acid sprays, etc., have been conducted at Ghoragalli (21st mile from Rawalpindi to Murree). Clay pots are used and methods rather similar to those in the southern U. S. twenty years ago. *(P. gerardiana,* the „edible

pine", is found abundantly in Baluchistan, where the seeds are an article of diet.) Turpentine oil and rosin have been produced in Jammu, an adjoining area now under Indian rule, and this suggests the possibility of pine utilization in Azad Kashmir. A factory at Haripur was planned to produce 55,000 maunds of raw rosin and 112,000 gal. spirits turpentine, beginning in 1951 (T).

6) *Berberis* or *barberry* is abundantly represented in the Murree Hills, thus around Murree itself, by the species *B. lycium* ROYLE, variously called sim (b) lu shimlu, chitra, shimly, kashmal, and kishmal. A root extract called *rasaunt* is made from this species and from *B. vulgaris* by rather primitive means; as an astringent tonic, it is used for eyelid diseases, to treat ulcers, pustules, etc. *B. lycium* is also common in Azad Kashmir territory. *B. vulgaris* is found in many parts of W. Pakistan.

7) Miscellaneous minor drug plants:
Geranium wallichianum; Acorus calamus; Corydalis stewartii

(ii) The Plains (the Lahore area and the Southern and Eastern parts of West Panjab). This large former province is generally fertile as to soils but with only about 24″ ann. rainfall typically requires irrigation for many crops, hence, many areas are irrigated. Unfortunately, in many places, the problem of under-drainage also emerges, so that much land has been ruined for agricultural purposes by water logging, with a high water table due to overirrigation. This area is very hot during the summer months, to the extent that all who can do so go to vacation in Murree or Nathia Gali,, the only ,,hill stations" (or summer resorts) in West Pakistan. Here at higher elevations, it is very comfortable during the summer months.

1) *Hyoscyamus niger*, the common henbane, is used in both eastern and western medicine, hence is of value both for internal consumption and for potential export sales. The plant, *khurasani ajwain*, grows wild in the hills, and did well in test plots in Lyallpur, Abbottabad, and Peshawar (CH). Considerable amounts could be obtained (it is said) from areas of wild growth. Lawrence (L) said that leaves and seeds were being exported from the Kashmir area about 1895. There was some cultivation around 1936 in the Panjab. However, the product is said to have been of poor quality (*Ann. Rept. Calcutta School of Tropical Medicine*, 1938).

2) Another henbane species, *H. muticus*, has been much used in alkaloid manufacture on account of the very high yield from the herbage. Experimental cultivations have been made in Kashmir,

and at Lyallpur, where it did well; the plant occurs wild in the Khyber Agency, Swat, and Hazara.

3) *Stramonium (dhatura)* is found in the hilly regions and has done well in experimental plantings at the F. C. College, Lahore, and at Abbottabad. This important medicinal deserves special emphasis, since it is imported for indigenous medical use, whereas an excess should really be available for export, in view of the good demand. Although it is a rather common weed, it has been cultivated in the Panjab in the past. If care is taken, relative to fertilization, time of collection, mode of drying, and storage, a product of good quality should be mangeable.

4) The *peanut* (U.S.) is called *„ground nut"* in Indo-Pakistan, and is very widely and intensively cultivated throughout much of the sub-continent. Good yields have been reported from cultivations in the Rawalpindi area; this oil seed plant has also been experimentally grown at Bahawalpur, south of Panjab.

5) *Brassica juncea* (L.) Koss. (Indian mustard), *B. napus* L. (rape; colza), and *B. nigra* (L.) Koch (black or true mustard) have long been grown in India and since partition in Pakistan. The seeds furnish a large part of the national supply of fatty oils. The estimated 1956 production of rape and mustard was 326,000 tons (long).

6) The *castor bean* is an important oil seed crop and is grown far and wide in the sub-continent, often on the bunds of fields of regular crops. Rawalpindi experimental plantings were very successful. Foreign demand is high.

7) Another widely grown oil seed is *sesame* or *teel* (til), representing a crop cultivated in various areas of both West and East Pakistan, including the Panjab. Both seed and oil are importantly used.

8) *Linseed* is cultivated throughout wide areas of Pakistano-India, and of course is important in foods, medicines, and technology. It can be grown up to probably 6,000' at these latitudes.

The production of these oils, also of cottonseed oil, is constantly being expanded.

9) *Neem* or *Indian lilac, Melia azadirachta* L., which occurs as a large tree south to Sind, is used in the native medicine to prepare an extract (from leaves, bark, and fruit) which has many uses. The fatty oil from the seed (margosa oil) has been used to treat Hansen's

disease (leprosy) but largely now in the manufacture of cooking fats (solidified by hydrogenation) and soaps (saponification).

10) *Fennel* (or *sonf)*, the ripe fruit of *Foeniculum vulgare* GAERTN., is produced in parts of India; about 1936, approximately 5000 maunds (410,000 lbs.) was said produced in the Panjab. It has also been produced in the N.W.F.P. (Q). The Indian fennel „seed" is said smaller than the European grown.

11) *Coriander* (or *dhania)* has been produced in about the same quantities as fennel in the Panjab, and Pakistan has exported this product to India. It is often grown with strictly vegetable type crops.

12) *Black cumin (kalonji* or kalounji) from *Nigella sativa* L. has been extensively cultivated in many parts of the old India, including the Panjab, where it is still cultivated on a small scale.

13) *Celery* is a commercial crop in East Panjab (under India), especially near Karnal and Amritsar, and to the east has been considerably grown in the United Provinces and Bengal, including what is now East Pakistan. Experimental plantings have succeeded at Lyallpur, Lahore, Choa Saidan Shan (in the Salt Range), and elsewhere in Panjab (CH).

14) *Sowa* (soi, soya, Indian dill), *Peucedanum graveolens* BENTH. is cultivated in the Panjab and throughout India/Pakistan. This condiment is used as a substitute for dill, and medicinally as a diuretic, emmenagog, and carminative. It would seem to offer possibilities.

15) *Camphor* trees have been cultivated with success in gardens in the Plains, at Abbottabad (N.W.F.P.), etc. The plant requires considerable water. There is of course the threat of eventual camphor synthesis in technologically advancing Asia.

16) *Ammi visnaga*, a denizen of the Sahara desert and of the Middle East desert regions, is now naturalized near Peshawar. It was also successfully cultivated at Abbottabad. The plant requires no irrigation, hence is of particular interest for many parts of Pakistan. Medicinally, the material is considerably used in treating coronary heart conditions.

17) *Chenopodium ambrosioides* now grows widely in Pakistan, although it is a New World species; experimental plantings at

Abbottabad were excellent, it is said. The var. *anthelminticum* which furnishes American Wormseed Oil should be introduced. *C. album* (plains near Montgomery; seed used medicinally) and *C. botrys* (in the N.W.F.P.) (Q) are also of interest.

18) *Carum ajowan (C. copticum)*, known as *ajowain* (Hindi) is cultivated somewhat in the Panjab and throughout much of India. The plant derivatives are much used medicinally in this part of the world.

19) *Onion* and *garlic* are cultivated widely as condiments, nutrients, and for medicine. The silvery white variety of onion is generally preferred. Some wild species of *Allium* are used in Kashmir for earache (folk medicine).

20) *Red pepper* is cultivated as a spice plant throughout both Pakistan and India. It is much used in preparing chutneys and in the native medicine.

21) *Pomegranate (anar* or hanor) is common wild in the Panjab, Gilgit, and Baluchistan and is also cultivated. Many uses are made: the root bark as anthelmintic; the fruit juice in flavors; the fresh fruit or peels mixed with curds for dysentery (Baluchistan); the seeds (sold in the Gilgit bazars) are used in pickles; the fruit rind is used to check diarrhea; etc.

22) *Cassia fistula* trees thrive in the Lahore area (ex. in the Botanical Garden) and Rawalpindi area (ex. experiment station) and the production of the pods, used as a mild laxative, might be worthy of development.

23) *Cassia absus* L. *(chaksu)* is cultivated in the Panjab and in Sind on a small scale for use in the native medicine. (CH).

24) *Phyllanthus emblica* L. *(amla)*, the fruit of which called „emblic myrobalans" are used as a diuretic and for tanning, is cultivated in the Panjab plains and elsewhere.

25) *Psoralea corylifolia* L., babchi (in Hindi) has been found to do well when trial cultivated at Lyallpur. It has been cultivated in East Panjab (India). The seed is used in the indigenous medicine, for leucoderma, etc.

26) *Henna (mahndi* or mehndi, in Urdu) representing the leaves of *Lawsonia alba* Lam., has been commercially cultivated at least since before 1936 in the Panjab, as well as elsewhere throughout Pakistan and India. The leaves are sold in large amounts in western countries for dyeing the hair; in the near and middle East, this material is

used in dyeing wool, beards, hair, and skin *(i.e.* for tattooing). In 1950, the U.S.A. imported 269,637 lbs.

27) *Psyllium* seed and husks have been grown successfully in the East Panjab (India) for many years, both the species *Plantago ovata* FORSK. (ispagol) and *P. psyllium* L. (black ispagol or isbagol). Considerable of the former seed is exported to the U.S. and other western countries, where prodigious amounts of husks are used in manufacturing laxatives. Blond psyllium, from *P. ovata*, is quite common wild in the Panjab, especially west of the Sutlej River, but naturally production is more economical from cultivated than from wildgrowing plants. *P. psyllium* showed good growth and yields in experiments at the celebrated experiment station at Lyallpur, west of Lahore. This product should furnish a good source of revenue to Pakistani, as is indicated by the annual usage figures of approx. 1,000 tons (U.S.) and 500 tons (India) (H). *P. lanceolata*, also called isapgul or isabgol, is quite popular in Pakistan for much the same purposes as the species named above, and the seed is actually being imported in important quantities from Iran and Afghanistan; cultivation in Panjab or Azad Kashmir would supply domestic demands at an economic benefit to Pakistan. *P. lanceolata* is found along the water courses in Baluchistan, where it („bartang") is used for infants' coughing, etc. The rather similar *Lallemantia royleana*, sometimes used as demulcent, sometimes to prepare a soothing beverage, sometimes to adulterate psyllium seed, has been cultivated at Lyallpur (CH) and Peshawar (Q).

28) *Kaladana*, *Ipomoea hederacea* L., a troublesome weed in the S. E. United States (as in Alabama), has been cultivated in the Panjab for the seed, 400 maunds being produced annually (1936, aprox.). It grows wild and is also cultivated in India; the seed is said to have been exported. It is cathartic.

29) The related *I. turpethum* or Indian jalap is said to be cultivated in India; the tuberous roots are used as cathartic and anthelmintic. It would seem to have possibilities in Pakistan.

30) *Ceratonia siliqua* L., the *carob* or St. John's Bread, has been grown in the Panjab (BRANDIS, 1874). Fruit were noted in the „Pindi" (Rawalpindi) bazar in 1951, although these may have been imported. The pods have been used in Indian medicine according to CHOPRA as purgative, astringent, and expectorant. The tree is excellent for shade and in reducing water run-off and soil erosion. The seed is used in producing a gum with many of the properties of tragacanth. In America, it is presently receiving important medical usage in treating diarrhea and to improve the flora of the intestinal

tract. The pod is eaten as a sweetmeat by children and is used in cattle feeding very considerably. This tree represents one of the great plant resources of southern Europe.

31) *Chicory* (wild or Indian endive, kasni (kashni) grows wild in the Panjab plains and in Kashmir, up to 11,000' a.s.l., it is claimed; it is also a common weed in *berseem*. In addition to such medicinal uses as that made in Baluchistan, where the roots are soaked in water over night and the cold infusion so formed drunk in the morning for fever, it is also useful as an attractive additive for coffee. It could well be cultivated.

32) *Aegle marmelos (bel* or bael in the vernacular) is a small tree frequently cultivated in the plains; while the fruit is edible and indeed esculent, it is frequently used to treat diarrheas and dysenteries. It occurs wild in the submontane (foothills) areas.

33) *Citrus* species are much cultivated in both West and East Pakistan. The fruit are eaten and the juice drunk fresh and preserved („squashes"). Large amounts of the peel for medicinal usage are available. Citrus is an important resource of the nation.

34) *Acacia catechu* (cutch; khair; katha) is found wild and is also cultivated in tree plantations. An extract made from the wood is used as an astringent in diarrhea, sore throat, etc. Considerable is also used in pan (betel mixture) and so, to satisfy the requirements of many pan chewers who „opted" to Pakistan, considerable amounts are imported from India.

35) *Butea frondosa (B. monosperma)* (called dhak) is an occasional tree of the Plains area, producing masses of brilliant flowers which have given it the name „Flame of the Forest". The leaves, flowers, bark, gum, seeds, and seed fatty oil are all used. Thus, the flowers are widely used as astringent, diuretic, aphrodisiac, „blood purifier", emmenagog, and anti-inflammatory agent (antiphlogistic). During our survey, we came cross a native man near Lyallpur collecting the flowers (see Fig. 1 showing collection lying on cloth). The tree offers possibilities of cultivation in water-logged areas.

36) *Mallotus philippinensis (kamala)* occurs wild in the Panjab, N.W.F.P., Kashmir, etc. The hairs and glands of the fruit have long been used as a vermifuge (although now often looked on with disfavor) and for certain parasitic skin diseases.

37) *Terminalia balerica* (bahera), the fruit of which constitutes myrobalan used in the indigenous medicine, tanning, etc., is grown in the Panjab, as is also *T. chebula* (harar or hurr), of which the fruit is used ripe as a laxative, unripe as myrobalan.

Fig 1. *Butea frondosa* flowers gathered near Lahore

38) *Tinospora cordifolia* (gil(l)o), used considerably as a native medicine, is cultivated on the Plains.

39) Following is a listing of other medical plants, mostly of relatively minor significance:

Lepidium sativum (small cultivations)
Moringa pterygosperma (fruits and roots used)
Ocimum basilicum (basil) and *O. sanctum*
Eucalyptus rostrata (red gum; cultivated in irrigated planted forests)
Cedrus deodara (deodar) (volatile oil veterinary antiseptic)
Plumbago rosea (abortient)
Mollugo stricta
Ficus carica and *F. religiosa*
Phaseolus mungo L.
Cephalandra indica (claimed of value in diabetes)
Eulophia campestris
Calotropis procera
Sida cordifolia, S. veronicaefolia, etc.
Tribulus terrestris
Zanthoxylum alatum
Ilex dipyreana
Vitis trifolia and *V. quadrangularis*
Coriaria nepalensis