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ACHIEVEMENTS IN THE UTILIZATION
OF WILD PLANTS DURING THE PAST DECADE

-COMMUNIST CHINA-

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ACHIEVEMENTS IN THE UTILIZATION
OF WILD PLANTS DURING THE PAST DECADE

[The following is a full translation of an article submitted by CH'IAO Tseng-chien and YIN Tsu-t'ang of the Department of Biology, Peiping Normal University appearing in Sheng-wu-hsueh T'ung-pao No 10, Peiping, 2 October 1959, pages 441-448 and 455.]

I. The Role of Wild Plant Utilization in Socialist Construction

Botany plays a most important role in the life of humanity. China is extensive in area and rich in natural resources; it is "80 percent mountains, 10 percent water, and 10 percent farmland." Over the extensive mountainous areas, all over the mountains and wild plains are resources of wild plants which cannot be completely extracted or fully utilized. The extensive utilization of wild plants is an important channel for the solution of the scarcity of raw materials for certain light industrial undertakings in our country.

In April 1958, the State Council issued a directive on the fullest utilization of wild plants. It also pointed out clearly in the 12-Year Plan for Scientific Development, "An accurate inventory of the natural resources of the motherland and a comprehensive utilization of wild plants, constitute one of the keypoints of the Plan." All this shows that the extensive utilization of wild plants has its important significance in the national economy of our country and in scientific research.

The extensive utilization of wild plants can be rapidly developed only in a socialist country and under the leadership of the Party to continually raise the standard of living of the people.

The great Chinese people are, at the moment, engaged in the construction of their beloved motherland at the rate of 1,000 li a day. Since the founding of our state, in the short space of ten years, we have made gigantic achievements on all fronts. In the extensive utilization of wild plants in the service of socialist construction, we have also achieved great development.

The extensive utilization of wild plants has been a task carried out in our country only during the past two years. In the past, we carried out research work only in the field of medicine. It was only with the issuance of the State Council directive in 1958 that work in the wild plant field was universally developed.

According to preliminary statistics, we have thus far discovered between 2,000 and 3,000 kinds of usable wild plants. The wild plant resources of our country are extremely rich. If the wild plants which now lie hidden can be fully utilized, they will play a great role in socialist construction and in the betterment of the people's living conditions.

At the moment, there still exists a scarcity of raw materials for certain of our light industrial undertakings. For this reason, the development of this new channel to supplement raw material supplies for light industry is a task which merits special attention.

According to preliminary estimates, during the next three years, starch from wild plants may completely replace grain for the distillation of spirits except for a few brands of famous drinks. The utilization of wild grown oil-bearing crops may fully replace oil for industrial needs and, at the same time, increase the output of edible oil for the people.

The extensive utilization of wild plants will not only supplement the supply of raw materials for light industry and increase exportable commodities, but also increase the income of peasants and economize state investments.

Wild plant utilization is also of special significance in the transformation of the face of the mountain areas and the improvement of the living conditions of the people in these areas. According to estimates of the Ministry of Commerce, in 1958, the peasants earned more than 200 million yuan from the collection of wild plants.

At the same time, the extensive utilization of wild plants for the manufacture of various kinds of native insecticides provides assurance of agricultural bumper harvests. The utilization of wild plants for the cure of various diseases, and the elimination of the four pests also plays an important role in the safeguarding of the physical health of the people.

China has a wide variety of wild plants which can be utilized. The task of the utilization of wild plants will develop rapidly and vigorously as long as we resolutely implement, under the leadership of the Party, the directive of the State Council on the full utilization of wild plants, mobilize the masses for universal study and research, carry out comprehensive plans, and adopt the policy of full utilization and rapid development.

II . Major Achievements During the Past Decade in the Utilization of Wild Plans in Our Country

I. Wild Fiber Plants

(1) The conception and source of plant fibers: Plant fiber is a kind of plant organism which exists universally in the higher class of plants (with the exception of mosses). The fiber cells are small and long. The general width ranges within the small limits of a few microns to a few scores of microns. The length is measured in units of millimeters.

Viewed from its chemical components, the fiber is a highgrade chemical compound, made up of cellulose, pectin, lignin, protein, fat, wax and water. The basic constituent which determines the composition of the fiber is cellulose.

The major portion of the fiber in wild plants is extracted from the pliable bark. According to the varying location of fiber in plants, plant fibers may be divided into the following categories: seed fibers (such as cotton and willow); pliable skin fibers (such as hemp and jute); bark fibers (also pliable skin fibers, such as citrus and mulberry); leaf fibers and stalk fibers (such as sisal hemp, and rice stalks); fruit fibers (such as kapok and coconut); and timber fibers (such as various kinds of timber trees, like pine and cypress).

(2) The uses of wild plant fibers and methods of investigation: Wild plant fibers are those which have not yet been used in industry in the past. Their uses are considerably extensive. They can be used not only for the manufacture of cotton and paper, but can also be used for 102 itmes of industrial goods including synthetic wool, woolen hosery, and handbags.

At present, we are capable of using plant fibers for the production of various building materials, such as plant fiber boards, molds for cement concrete mixtures, ventilation pipes, flooring boards and decorative boards. They are cheap, of high quality, and make excellent substitutes for timber and steel products.

The method of the universal investigation of wild plants: Universal investigation work is generally carried out in mountain areas. In the field investigation generally depends on the human senses and microscopic observation,

The method of using the senses is as follows. The roots, leaves or parts of the bark of a plant are taken out, and the hand is used to test the capacity for twining, elasticity, and resistance to twisting. The fibers taken down are also studied as to their lengths, sizes and quantities to determine whether they can be utilized.

Microscopic observation is more complicated. The portions taken down are cut into small pieces, and under the microscope, the shapes, sizes, arrangements (whether they consist of one or two layers or many layers, whether they are neatly arranged or scattered) are studied. Slide rules are used to measure the widths, lengths, depths, and areas of units.

In the investigation of fiber plants, selections should also be made of specimens of different localities of origin, ages, positions. Comparative experimental observations should be carried out separately. This makes it possible to arrive at more comprehensive data, facilitates the determination of the specifications for utilization.

In the observation and detemination of the capacity of elastic bark fibers, we have first to carry out the de-collidolization and separation of the fibers. This work should be carried out indoors. The determination of the quality of fibers should be based on their length, fineness, elasticity, transparency and color.

(3) Conditions relating to the universal investigation of wild fiber plants throughout the country: At present, universal investigation is being developed extensively in all parts of the country. Several thousand kinds of usable wild fiber plants have been discovered in large quantities. The preponderance of these plants belong to the category of angiospermae.

These fiber plants are often concentrated in certain species and branches, such as: malvaceae, salicaceae, orchidaceae, urticaceae*, moroaceae, apcymaceae, and gramineae. It is even easier to seek usable fiber plants from species and divisions adjacent to the above. This shows the guiding role played by a knowledge of plant classification in practice.

All of China has made gigantic achievements in the universal investigation of wild fiber plants.

According to statistics from 13 hemp textile mills, in 1958, they utilized 8,400 tan of 15 kinds of wild plant fibers and cotton stalks, and thus increased the production of gunny bags by more than two million.

The provinces of Szechwan, Kweichow and Hunan have registered great achievements in the universal investigation of wild plants. Szechwan province, for instance, has compiled preliminary statistics showing that the annual output of raw materials for synthetic cotton will reach six million tan. By 1960, the utilization of wild plant fibers will lead to the production of 2.5 million tan of synthetic cotton, equivalent to the output of cotton from eight million mou of cotton fields. The output will also produce 600,000 bales of cotton yarn, or 1,860 million feet of cotton cloth, averaging 3 feet per capita for the whole country.

In the course of the universal investigations, special attention has been paid to the selection of fibers which are soft and lengthy, and are found in specially rich quantities, so that large scale production may be undertaken. For example, among the more than 100 kinds of plants of the hems, the lo-puma (cha-yeh-hua, *Apocynum lanceifolium*) of the species apcymaceae is found in the largest quantities and has the highest economic value.

* original character not distinct - translator

Production is highest in the Huai Ho basin, North China and the Northwest. It generally yields three crops a year, and is twice the length of general categories of hemp. Its elastic strength is high, and it is white and soft. It can be used for the manufacture of high grade paper, synthetic cotton, belting for machinery, water hoses, and the weaving of high grade textiles. Lo-pu-ma is a fiber plant with the most promise for future development, and it has received the highest praise in national exhibitions.

There is also the hsiang-yeh ramie (*Boehmeria* spp). This likewise produces excellent fibers. From the hsien of An-hua, Tao-chiang, I-yang and other mountainous areas of Hunan Province alone, the annual production of this fiber may reach 50,000 tan.

Of wood plants, *Broussonetia* in the moraceae species produces excellent pliable bark fiber. The *B. Kaempferi* of this division in Hunan Province has an annual production of 200,000 tan. The length of the fiber is between 1.2 and 8.2 millimeters. The strength of each fiber is between 2 and 15 gram, the width is between 9.44 and 29.5 micron, and the number of wefts is 4,798 under the metric system.

It can be used for the manufacture of high class textiles either jointly with other materials or by itself. It can also be used for the manufacture of high grade paper.

Of rattan plants we have, in the North, the Kang-liu (*Periploca Sepium*) of the asclepiadaceae species, and the Ko-teng (*Pueraria pseudo-hirsuta*) of the leguminosae species. The quality of the fibers of both is good. The kan-liu is distributed more widely in North China.

The fiber is white, soft and has luster. The elasticity is great. It can be used jointly with other materials for the production of high grade textiles. The fiber of the ko-teng is soft, and its capacity for extension is great. It can be used for the weaving of summer cloth, and the manufacture of rope. The dregs from the ko-teng can be used for the manufacture of cotton, and the synthetic cotton cloth weaved is of better luster.

If we are to make wild plant fibers throughout the country play their full role in socialist construction, we must exert our utmost zeal, promote nation-

wide cooperation, and fully investigate our resources. We must make another great leap forward on the basis of our current achievements.

III Wild Oil-Bearing Plants

(1) General conception of oils and fats and sources of supply.

Oils and fats stored in plants exist, in large quantities, in the seeds and fruits. Sometimes they are also found in the stems, roots, leaves or other parts of the plants. The chemical components of fats and oils consist of glycerine and fatty acid. They are organic chemical compounds of a complicated nature.

They are not soluble in water and alcohol (there are a few exceptions, as castor oil, which is soluble in alcohol). They are soluble in fat liquoring agents (such as phenyl cellosolve, petroleum ether, chloroform, and carbon bisulfide).

Because plant oils and fats contain a high quantity of acid not reaching saturation point, they maintain in liquid form under normal temperature, and are called vegetable oils. In accordance with the varying degrees of acid saturation capacity for oils and fats, they are divided into the three categories of: drying oil, semi-drying oil and non-drying oil.

Under normal temperature, when exposed to air, drying oil forms a hard membrane and absorbs iodine to over 120. Semi-drying oil, when exposed to air under normal temperature, gradually becomes sticky and absorbs iodine between 100 and 120. Non-drying oil does not harden when exposed to air under normal temperature, and absorbs iodine under 95.

(2) The uses of oils and fats and the method of investigation.

Vegetable oil is a very important subsidiary food in people's life. It contains a large amount of heat. At the same time, it has rich quantities of vitamins A, E, and K. It is closely related to the growth and development of a person's physique.

Vegetable oil is also an indispensable raw material in industry. It has extensive uses. It is an indispensable raw material for such civilian industries as soap, wax, species and paints. It is also an

indispensable raw material for lubrication, for the national defense industry and for the pharmaceutical industry.

At the same time, the oil grains can be used as fodder and fertilizer. In addition, the increase to the income of the peasants is also of great economic and political significance.

It is, therefore, an important constituent of the development of socialist economy to undertake the all-out development of the production of oil bearing crops, the fullest utilization of existing resources, and the seeking of new raw materials for oils and fats so as to develop the production of oils and fats to meet our needs.

Method of investigation of wild oil bearing plants: In field investigation, we generally use the method of the employment of the organs of sensation to ascertain plants with oil contents. We use filter paper or white paper to cover the fruits or seeds (or other portions with oil content), and press them with hands or boards. When traces of oil are left on the paper, we have preliminary proof of the existence of oils and fats. The larger the oil stains, the greater will be the oil content.

Second, we take note of the characteristics of oils and fats which are not soluble in water and are lighter than water. We crush the fruits and put them into water. If they contain oils and fats, they will float.

Where conditions allow, we may carry with us portable pressing machines for direct pressing processes to estimate the extent of the oil content. In addition, the use of chemicals may also assist in the determination of the existence of oils and fats. In the investigation, attention should be given to the fact that oils and fats from wild plants cannot be utilized at random, but their usefulness must be determined after analysis. Otherwise, the complex nature of oils and fats may lead to undesirable consequences.

(3) The general situation relating to universal investigation of wild oil bearing plants in the whole country.

In China we have discovered about 400-500 kinds of oil-bearing plants. Apart from the well-known peanut, soya bean, rapeseed, sesame, and cotton seed,

wild oil bearing plants are found all over the country, particularly in the various mountain areas and along the coast. From 400 to 500 kinds of wild oil-bearing plants have been analyzed or are recorded in Chinese and foreign documents. Among these, 368 kinds have been found to contain oil, 35 of them edible oil. As to the remaining kinds, analysis has still to be carried out their oil content can be determined.

During the period 1956-1957, the whole country produced 10,000 tons of wild oil-bearing materials. During the single year of 1958, in all parts of China, purchases of wild oil-bearing materials totalled 51,819 tons. The universal investigation of oil-bearing crops is being carried out throughout the country.

In such areas as Szechwan, Hupeh, Hunan, and Kwangsi, great achievements have been reported. The supply and marketing system of Szechwan Province plans to purchase 100,000 tan of oil bearing materials during 1959. In Hupeh and Hunan we have discovered between 70 and 80 kinds of plants with higher oil contents.

Plants of the gymnospermae family are often found to be plants producing oils and fats. Most seeds can be used for the pressing of oil. Many plants of the angiospermae family are also oil-bearing. These are often concentrated in certain species and divisions, such as: leguminosae, rosaceae, lauraceae, juglandaceae, compositae, salicaceae, cucurbitaceaw, and carciferaw. The plants of these species have higher contents of oil.

Hunan Province has found among plants of the lauraceae species, the following 12 kinds with higher oil contents:

chang tree (*cinnamomum camphora*), seed production in the whole province 25,000 tan a year, oil content 24-25 percent;

shang-tsang-tzu (*litsea cubeba*), annual production 80,000 tan, after being used for the distillation of lotion, the dregs contain 38.43 percent oil, and the rate of oil production is 25 percent;

kou-chang (*lindera umbelata*), the annual seed production is 10,000 tan, and the rate of oil production is 35 percent;

wu-yao (*lindera strychnifolium*), the annual seed production is 40,000 tan, and the oil content is 50.21 percent; as well as nan-mu (*phoebe nanmu*);

hsiang-yeh (*Lindera fragrans*); shan-hu-chao (*Lindera glauca*); hung-nah (*Machilus thunbergii*); pao-hua-nan (*Machilus pauhoi*); ta-yeh-nan (*Machilus ichangensis*); hou-chang (*Cinnamomum hupehanum*), and tien-chu-kuei (*Cinnamomum pedunculatum*). These trees produce annually between 7,000 and 8,000 tan of seed, and their oil content is between 30 and 50 percent.

In the compositae species, the seed of the tsang-erh (*Xanthium japonicum*) is today one of the oil bearing plants with a very great future for development. It is produced all over the country, and especially in North China, the Northwest and the Northeast. The estimated output in the whole country is more than 200,000 tan, and the oil yield rate may reach 19 percent.

Moreover, the whole tsang-erh plant is valuable. The fruit is used as medicine, the stalk can be used as gunpowder. Especially gratifying is the cha-teng-kuo found in Chiang-ch'uan Hsien in Yunnan, the kernel of which has an oil content as high as 76 percent.

In Shensi we have found a wild pi-ma with an oil content of 70 percent. These are the plants in China with the highest oil content. It is higher by from one to seven percent compared with the British walnut (69 percent), which is recognized in literature as having the highest oil content in the world.

Some of the wild oil-bearing materials of our country are being exported. Oil from shan-tsang-tzu (*Litsea cubela*) has been exported on a trial basis and has enjoyed a good reputation.

The directive issued by the Party and the Government on seeking oil sources from wild plants is a step in the right direction in guaranteeing the extensive utilization of the oil bearing resources of China to increase the production of oils and fats.

IV. Wild Starch Plants

(1) The general conception of starch and sources of supply.

Starch is the product of the photosynthesis of green plants, transformed from glucose. It is the principal form of storage of carbohydrate in the

bodies of plants. It is usually a carbohydrate, white in color, of unsettled powder form.

Under the microscope we can observe minute granules with special figures, the forms and sizes of which vary according to the different kinds of plants. The constituent parts of starch include direct rings and branch rings.

Direct ring starch is formed by the shrinkage of 200 to 500 a-D glucose units at C_1C_4 . It is water-absorbing and turns into deep blue on contact with iodine. Branch ring starch is formed by linking 2 or more direct ring starch units at C_1C_6 . It is not water-absorbent, and in hot water shows a non-transparent liquid. On contact with iodine it becomes red purple.

Starch universally exists in the seeds, fruits, roots and stalks of plants. Rice contains 75 percent starch; potato tubers contain 20 percent starch; roots of creepers contain 48 percent starch; and the fruits of euryale ferox, also named Lao-ya-t'ou, contain 32 percent starch.

(2) The uses of starch and method of investigation.

Plant starch is a major food of the people. If wild starch can be fully utilized, not only will the peasants increase their income, but the state will also realize a great economy of food grain, and many substitute raw materials will be provided for industry, such as starch yarn, alcohol, glycerin, bean curd, jelly, lotus root powder substitute, and pastries. The Ministry of Food Industry originally planned the purchase in 1958 of 100,000 tons of hsiang-tzu (the fruit of the quercus plant) to substitute for grain in the distilling of alcohol.

This would have saved 70,000 tons of grain and increased the income of peasants by 12 million yuan. Thus, it can be seen that the full utilization of wild starch plants is of great significance to the development of the economy of mountain areas, and the economy of grain by the state.

The investigation of starch plants: The determination of starch is normally carried out by the use of iodine solution to see whether there is any blue reaction, or the use of the human eye for direct observation. In field work, seeds, fruits, stalks and tubers of plants are collected and dried, and kept

from dampness. Generally, from two to four kilograms of each kind of plant are taken, separately marked, named and numbered, with notes on the location of the plants taken, and the number of leaves dried.

The starch content of different plants is related to the age of the plant, its growth environment and seasons. Accordingly, in the collection of specimens, field records must be minutely kept.

The method of extracting starch is very simple. The material is cleansed, ground, put into water and further crushed so that white thick fluids are obtained. Cloth is used to filter the fluid separating from it dregs and other particles. It is then dried.

(3) Conditions relating to the universal investigation of wild starch plants in the whole country.

Wild starch plants are very widely distributed over our country. Between 300 and 400 kinds of plants whose seeds and roots contain starch have already been found.

Not only are there many kinds of plants, but also the starch content of these plants is also very high, in many plants of the pteridium aquilinum class and angiospermae class, including those of the following species: "mao-chu-ko," liliaceae, dioscoreaceae, graminaceae, leguminosae, and polygonaceae. For example, the fruit of the querous plant (hsiang tzu), of the "mao-chu-ko" specie, contains starch averaging over 50 percent.

According to investigations by the Yun-shan Forestry-Agricultural-Pastoral Comprehensive Farm of Kiangsi Province, in the Yung-shan area, there is an annual production of 357,900 chin of hsiang tzu. The output of the whole province is estimated at 200 million chin. Used in wine production, 100 chin of hsiang-tzu will produce more than 50 chin of white wine of 60 degrees strength.

In the tubers of lycoris radiata of the specie amaryllidaceae, the starch content is 64.3 percent. It can be used for the production of wine. It also contains 0.11 percent lycorine (poisonous), a valuable medicine, valued at 1,700 yuan a kilogram.

In the tubers of heterosmilax japonica of the specie liliaceae, the starch content is 69.67 percent. It can be used for grain in the manufacture of wine, and can be used for the making of biscuits and pastries.

This plant is found in large quantities south of the Yangtze. Hunan Province alone produces about 800,000 tan a year.

In the pteridium aquilinum class of plants, the underground tubers (commonly called ko-chin) have a starch content of 40.86 percent. Hunan Province alone produces 1.5 million tan of it a year.

In addition, such wild starch materials as the roots of creepers and tapioca possess special adhesive power, and can be used for the starching of yarns, and as paint and paste in construction.

Furthermore, China has numerous wild fruits. More than 900 kinds are already known. Utilization of wild fruits for the production of wine gives good taste at cheap prices while saving grain. The Tung-hua area in Kirin Province, for example, is utilizing wild grapes for the brewing of the nationally famous "Tung-hua Grape Wine".

V. Wild Quebracho Plants

(1) The general conception of quebracho and sources of supply.

Quebracho is a complex organic matter the effective component of which is the tannic elements of plants (also called tannin). In addition, it also includes non-tannic elements (such as sugar, vegetable albumen, organic acid, inorganic sodium chloride, and rubber), and non-soluble matters (such as wood granules, precipitates, and not easily soluble matter). They are all natural plant products. After the extraction of water and other solvents (such as alcohol and acetone), the liquid shrinks into a thick paste or a colloidal solid, and it is called quebracho.

Tannin is an organic matter formed by re-union of the highest elements, and is organized with the three elements of carbon, hydrogen and oxygen. In some cases, there are also small quantities of nitrogen and phosphorus. There are many kinds of chemical constituents but they are all poly-basic phenol derivatives.

Tannic elements are contained in roots, tubers, leaves and fruits. In the roots and tubers they are

chiefly in the bark. Tannic elements are also sometimes found in wood, but are seldom found in flowers.

(2) Uses of quebracho and method of investigation.

Quebracho is an important industrial item. It is chiefly used in the tanning of leather, to make the leather strong, airy but not porous, and to prevent it from deterioration. For each ton of weather goods (such as belting for wheels, rollers, and rings) 800 kilograms of quebracho must be used. In 1959, Hopeh Province alone used 17,000 tons of quebracho for tanning.

The next use of quebracho is in the tanning and dyeing of fish nets. After such treatment, the nets become strong and bright, will not rot easily, and are most durable. Normally a fish net has to be re-tanned and dyed once every two months. For each chin of fish nets four liang of quebracho must be used.

The third use is as a water softening agent. Water in steam engines and industrial boilers has to be softened, after which the metallic salt is removed. Each locomotive requires more than one kilogram of quebracho each day.

In addition, quebracho is needed in the petroleum industry, the chemical industry and the medical service. It can thus be seen that quebracho has close connections with socialist construction and the people's livelihood.

The tannin contained in quebracho is a very complicated organic matter with many chemical constituents. We cannot quickly and simply decide whether or not a specific kind of tannic material has utilization value. Simple evaluation made in the field can only serve as preliminary reference data.

Generally, evaluation in the field is carried out in the following manner: because tannin turns into black-green or blue-black on contact with trivalent ferric salt, when we cut up a plant with an iron knife (do not use stainless steel), if a black color appears on the body or on the knife, it will generally be an indication of the existence of tannin. In addition, the use of the sensual organs and observation with the human eye may help in determining the existence of tannin.

Tannin is a constringent non-crystallizing body soluble in water. When we taste it with our tongue, there is a big bitter taste, like that of an unripe perssimon. We must avoid touching poisonous plants. The portion of plants containing tannic elements often turn black upon drying. Observation of color changes may serve as reference data.

To arrive at a more correct appraisal, it is necessary to carry out tests with certain chemical agents in the field. The most convenient chemical testing agent is the fluid of trivalent ferric salt, (such as ferric chloride). When this is dropped on a cut portion of a plant, and the latter quickly turns in black, existence of tannin is indicated.

We may also use colloidal solutions for determination. Plant liquids with tannic elements will produce precipitation in colloidal solutions.

Because the chemical construction of tannic elements is comparatively complex, and there are many varieties, it is necessary to take further steps for a decisive analysis.

Tannic elements in their application are divided into three principal categories: gall; catechu; and compounds. Qualitative and quantitative analysis constitute a more complex process and call for definite equipment and techniques. The tannic elements preliminarily ascertained in the field must be collected in sufficient quantities as specimens and sent to competent laboratories for analysis.

After results of an analysis have been obtained, only plants with tannic contents of from five to seven percent, and purity of more than 50 percent (ratio between the tannic element and the non-tannic element) will have utilization value.

For the further determination of the usefulness of tannic materials, we must finally soak the material, extract liquid from it, make it into a paste, and test the tannic qualities. We must further check the quality in actual utilization before we may decide on large scale production and populization of an item.

The first step toward the development of quebracho production is to select excellent varieties of quebracho plants in coordination with the universal investigation of plant resources throughout China.

(3) Conditions relating to the development of quebracho production and the universal investigation of the product throughout the country.

China annually needs large quantities of quebracho. In the past, we depended chiefly on imports. This not only drained large quantities of foreign exchange, but also abandoned without utilization the rich quebracho resources of the country.

Since the Liberation, in accordance with the needs of national construction, quebracho production in the country saw a leaping development.

From 1950 through 1957 the average annual production showed an increase of more than 900 percent over the annual production before Liberation.

The year 1958 saw a greater leap forward spurred on by industry and agriculture throughout the country. The planned output for 1959 provided for a further increase of more than 300 percent over that of 1958. Today we have 54 modern quebracho factories already completed or about to be built.

The leaping development of quebracho production calls for large quantities of raw materials. An important problem today in the field of the utilization of plant resources is to seek quebracho plants with high content, of good quality, and with large output. The universal investigation of quebracho materials is being carried out in all parts of China. It has become an extensive mass movement which has already achieved great results.

Of plants with tall stalks there are several hundred kinds which have tannic elements, but only a few scores of them have utilization value. Preliminary universal investigations in all parts of the country have led to the discovery of more than 70 kinds of tannic plants. The preponderance of these plants belong to the groups diocyledoneae and gymnospermae.

Of plants in the group monocotyledoneae, very few contain tannic elements (such as *Dioscorea cirrhosa* and *Iris lactea*). Likewise, very few plants in the group Pteridium aquilinum, contain tannic elements.

Plants in the group diocyledoneae containing tannic elements are often concentrated in a few species, such as *fugus japonica*, *betulaceae*, *salicaceae*, *juglandaceae*, *bruguiera*, *oleaceae*, *rosaceae*, *anacardiaceae*, *aceraceae*, *polygonaceae*, and *leguminosae*, and some of their branch species.

The following tannic shrubs are the principal types found in China. *Fugus japonica* contains rich tannic elements, and *quercus* is even more outstanding. The fruit (acorn, nut) of *q. variabilis* contains tannic elements to the amount of 27.41 percent, and its purity reaches 65.37 percent. The acorn of *g. acutissima* contains from 19.8 to 32.6 percent tannic elements with purity reaching from 51.9 to 77.9 percent. The acorn of *q. dentata* contains 17.84 percent tannic elements with purity reaching 55.49 percent. The bark of *quercus* plants also contain 9.14 percent tannic elements.

The three kinds of plants of the *quercus* group mentioned above are widely distributed over North China and Central China. Other plants of the *quercus* group also contain tannic elements and are also widely found. The output of *quercus* acorns alone in a year is sufficient for the production of between 60,000 and 70,000 tons of *querbracho*.

Various other members of the *fugus japonica* group also contain rich tannic elements. The acorn, bark and wood of *castanea mollissima*, for example, are rich in tannic elements. The bark and wood of *castanopsis* spp. also contain tannic elements. It can be seen that tannic plants.

Furthermore, in the specie *rosacea*, the *hungken* (which include many plants of the specie) are very good tannic plants. *R. bankisae* var. *normalis*, *microcarpa*, and *r. laevigata* have, in their roots and barks, tannic elements to the extent of 31 percent. One chin of *quebracho* can be produced from three chin of these plants.

Of plants in the specie *oleaceae*, the bark of *fraxinus rhychophylls*, *phyllanthus emblica*, and *aleurites montana*, contain rich tannic elements. So do the leaves of *ainus* spp. of the species *betulaceae*; the fruit root and bark of the *platycarya strobilacea* of the specie *juglandaceae*; the bark of the *kaveelia canda*, and *brugiera conjugata* of the specie *brugiera*, and the *acacia confusa* and *albizzia kalkora* of the specie *leguminasae*; the leaf of the *cinnamomum camp-hora* of the specie *lauraceae*; the leaves of the *rhodomyrius tomentosa* of the specie *myrtaceae*, and the *codinus coggyria* of the specie *anacardiaceae*; and the leaf and the galls of the *rhus* (of the specie *anacardiaceae*).

In the gymnospermae group of plants, there are also some which merit attention as containing tannic elements such as the *larix dahurica* (from Hsing-an), the *picea* spp., the *pinus koraiensis*, the *cunninghamia sinensis*, and the *tsuga chirrensis*. The bark of these plants contain considerable tannic elements. The bark of the *larix dahurica*, felled from Hsing-an each year is sufficient for the production of 20,000 tons of quebracho.

In the extensive production of materials for quebracho, attention should also be specially paid to tannic plants among the herbs. The herbs grow abundantly and fast, and are widely distributed. They can be easily cultivated and domesticated. Many herbs have also been found to contain tannic elements, such as the following: the roots of *runnex acetosa* of the specie *polygonaceae*, with tannic content of 19 to 27.5 percent; the roots of *r. crispus* contain from 15.72 to 38.8 percent tannic elements, and the leaves of the same plant from 7.32 to 26.7 percent.

The roots of *rheum* sp. contain 33.74 percent tannic elements, and their purity reaches 66.95 percent. Some plants of the group *polygonaceae* also contain tannic elements. The tubers of *dioscorua cirrhosa* in the specie *dioscoreaceae* have sometimes as high tannic content as 30.65 percent, and its purity may reach a high of 74.39 percent. There are many other plants among the herbs which contain tannic elements and can be utilized. We must go a step further in investigation and analysis.

The extent of tannic elements in the tannic plants is not only determined by the species of the plants, but also determined by the locality and conditions of growth. Under the same growth conditions, the age and season factors also greatly influence the tannic contents of plants.

Accordingly, in the collection of raw materials, our work must be timely. Dryness must be preserved in storage and transportation, to prevent the loss of the tannic contents.

Furthermore, in the development of quebracho production, important problems are presented in the strengthening of capital construction, the elevation of technique, the unearthing of production potentials, the elevation of quality, and the lowering of cost.

VI. Wild Rubber Plants

(1) General conception of rubber and sources of supply.

Natural rubber is a natural product of the plant world. Rubber may be divided into two kinds according to their nature; elastic rubber and hard rubber. The chemical contents of both are very similar, being a high class non-saturated hydrocarbon compound. The physical properties are not much the same. The major differences are as follows:

Elastic rubber under normal conditions is elastic and softer. After coagulation it becomes with less elasticity. After coagulation it is not sticky but becomes hard and brittle.

Elastic rubber is usually found in the latex of plants (such as *havea brasiliensis* or Brazilian rubber). It is the product of the tubes in tannic bark. Hard rubber, also known as *encommica ulmoides*, is found in the special rubber cells in thin membranes.

(2) The uses of rubber and the method of investigation.

Rubber is of the utmost importance in industry, agriculture, communications; transportation, national defense, the people's livelihood and the medical service. The importance of rubber is not only revealed in such very common rubber manufactures as automobile tires, rubber shoes, and raincoats, but also manifested in the many uses in other fields.

According to statistics, there are more than 30,000 items of industrial goods manufactured with rubber. In agriculture, there are also about 9,000 rubber items. In national defense, the significance is even greater.

The building of a larger gunboat, for example, needs 68,000 kilograms of rubber. A tank needs 800 kilograms. An airplane needs 600 kilograms. Even a truck needs 240 kilograms. The development of the rubber industry has become an important factor in the socialist industrialization of China.

Raw materials for rubber must be sought in two principal directions. On the one hand, natural rubber must be utilized. On the other hand, synthetic rubber must be developed. The utilization of natural rubber

is more important, because natural rubber is strong and elastic and cannot be replaced by synthetic rubber. Accordingly, the development of our rubber plant resources is an important measure for the solution of the supply of raw materials for the rubber industry.

Investigation method for rubber: In accordance with the nature of rubber we may decide on simple methods for ascertaining rubber. The evaluation of elasticity may be carried out with the collection of the latex of plants, placing it in the palm, rubbing it with fingers, using heat of the hand to evaporate the water content and to dry the latex.

The residue can be placed between the thumb and the first finger, and be slightly pulled to see if there are elastic threads. The appearance of such threads means that the rubber is elastic. If there are no threads and the matter is sticky, it means there is no elasticity or that the elasticity is slight.

In the evaluation of hard rubber, the branches, leaves or bark of the plant are torn. If there are threads in quantity, it generally means that there is hard rubber.

In order to understand correctly the content and quality of the rubber, laboratory analysis is necessary.

The world's major natural rubber plant is the *hevea brasiliensis*. Its home is South America, but the major producing area now is in tropical Southeast Asia, which produces 80 percent of the total world output. In China, we must develop extensively the *hevea brasiliensis* on Hainan Island and in other areas where conditions for its growth are available. In addition, it is also an important task to seek rubber plants among the native plants of the country.

(3) Conditions relating to the investigation of wild rubber plants in our country.

In the botanical world, there are more than 2,000 plants with rubber content. But not many of them have utilization value. Among them only three are notable: *hevea brasiliensis*, *taranacum kok-eaghyz*, and *eucommia ulmoides*. *Hevea braziliensis* was discovered only a little more than 200 years ago.

Its full utilization for rubber production has been carried out for only about 100 years. It was a wild plant in the Amazon Basin of South America. When

it was found to produce excellent rubber, it was cultivated extensively in the tropics. In China, it has been under cultivation on Hainan island for several decades. However, it is only since the Liberation that extensive development has been undertaken. It is still our main source of rubber supply.

Tarumacum kok-eaghyz is a rubber plant found in the Tien Shan region. It was discovered by Soviet as recently as 1931. At the time, in order to solve the problem of raw materials for rubber, the Soviet Union studied about 100,000 kinds of plants which could grow in the Soviet Union.

After the discovery of *tarumacum kok-achghyz*, it was cultivated, and its rubber content raised, until it became the major rubber supply source under conditions obtaining in the Soviet Union. We also discovered the plant in Sinkiang, and are cultivating it extensively as a source of rubber.

Eucommia ulmoides is a special plant of China. It is distributed over the provinces of Szechwan, Kweichow, Yunnan, Hupeh, Hunan, Shensi, Honan, Kansu, Anhwei and Chekiang. It is originally a well-known medicine.

The Soviet Union has long utilized it for the production of hard rubber, and has extensively cultivated it as a source of supply of hard rubber. In China, we are actively developing this plant in suitable areas.

In order to develop rubber production, we must develop to the utmost native plants containing usable rubber. The standards for selection are high production, good quality and easy cultivation. Since the Liberation, under the leadership of the Party, scientists have joined forces with the masses in carrying out universal investigation.

Particularly in tropical and subtropical areas, systematic investigation is in progress, and cultivation is being carried out. We have made gigantic achievements in research. For example, in 1951, under the guidance of Professor Chiang Ying, we carried out universal investigation in Shih-want Ta-shan in Kwangsi and discovered many rubber plants. Among them, were plants with very high rubber content, such as *ecdy-sanrhera utilis*, whose rubber content is second only to that of *hevea brasiliensis*.

Rubber plants are often concentrated in certain species, such as the following: euphorbiaceae, apocynaceae, asclepiadaceae, moraceae, compositae, and celastraceae. They are distributed to a greater extent in tropical and sub-tropical zones.

In North China and the Northeast there are also rubber plants which may be studied and utilized. There is, for example, the *Eunoymus alata* *E. maakii*, of the specie celastraceae. Its bark has hard rubber content of from 10 to 16 percent. There are also: the galium verum of the specie rubiaceae; the euphorbia fischeriana of the specie euphorbiaceae; the adenophora stenanthina of the specie campanulaceae; and the lonicera maaokii of the specie caprifoliaceae.

In addition, there is also rubber in the latex of the apocynum lancifolium of the specie apogynaceae, and the periplaca sepium of the specie asclepadaceae. They are all worth further domestication and study, raising the quality of the rubber for utilization.

Under the leadership of the Party, scientific and technical personnel and the masses closely combine efforts for the universal investigation of these resources. They must gradually unearth the rubber resources latent in our rich plant resources as a contribution to socialist construction.

VII. Vegetable Alkali Plants and Medical Plants

(1) Conception of vegetable alkalis and sources of supply.

Vegetable alkali is the effective component of the majority of medicinal plants, and is a natural plant product. Its biological effects on the body of the plant are rather complicated. It protects the plants or stimulates its growth, promoting the life of the plant. The evolution of a vegetable alkali is connected with proteins and amino acids. Its constitution is generally complex, and contains only very little amines.

Vegetable alkalis generally have the following characteristics: most of them are colorless crystalline solids; most of them are insoluble in water (with a few exceptions, such as nicotine); they are generally bitter, some very bitter and hot; most of

them have alkaline reaction, turning red litmus paper into blue; and they generally react against several precipitating agents or a certain precipitating agent and produce a precipitant.

Vegetable alkalis usually are found in the group diocyledoneae. They are seldom found in the group of monocotyledoneae (such as the species liliaceae and amaryllidaceae). They are also seldom found in the group of gymnospermae (such as ephedera and codium fragile). Plants of the diocyledoneae group containing alkali are often concentrated in certain species, such as: rununculaceae, menispermaceae, papaveracea, loganiaceae, solanaceae, leguminosae, and rubiaceae.

The quantity and quality of vegetable alkali content vary not only with the kinds of plants, but even within the same class of plants. They vary also because of growth conditions, different locations in the plants, and different stage of growth. The quantity and quality of vegetable alkalis may undergo very great changes.

(2) The uses of vegetable alkalis and methods of investigation.

There are many kinds of vegetable alkalis. Classification is carried out according to the plant classification, the medicinal properties, or the chemical constituents.

Vegetable alkalis classified according to plant classification include many kinds, and each kind may have many alkalis. Those often met with include ephedrine, nicotine, malic alkali, gentian alkali, quinine, meconic alkali, and caffeine.

Each class contains many individual alkalis. Ephedrine, for example, has six kinds of alkali extracted from it. Meconic alkali consists of 23 individual alkalis. All these vegetable alkalis are important medicines, and at the same time are effective components of medical plants and insecticides.

The method of the investigation of vegetable alkalis: We utilize the reaction of vegetable alkalis to precipitation agents to determine vegetable alkalis. There are many precipitation agents, and many methods of determination. Agents commonly used include mercuric cholride and potassium iodide. For example, when 1.85 grams of mercuric cholride and 49 grams of

potassium iodide dissolved in 1,000 c.c. of water, are mixed with vegetable alkali a light yellow precipitant is formed. We may also use 16 grams of bismuth iodide, 30 grams of potassium iodide and 3 grams of hydrochloric acid dissolved in 1,00 c.c. of water. In this case, the vegetable alkalis will produce a red brown precipitant. Precipitant agents may be manufactured into paper and their use [in the field] is even more convenient.

Vegetable alkalis are complicated organic substances. One plant often has many kinds of vegetable alkalis. For example, opium has 23 kinds of alkalis, quinine has 30 kinds. Accordingly, the determination of vegetable alkalis is a complicated task and calls for specific equipment and techniques. General simple determination methods can be used in universal investigation. Further analysis and research should be carried out in appropriate laboratories.

The extraction and manufacture of vegetable alkalis is also complicated process. Vegetable alkalis generally are not soluble in water, although soluble in organic solutions. But the salt does not dissolve in organic solutions and are easily soluble in water. This special characteristic is utilized as a basic principle in the extraction and production of vegetable alkalis. Many natural vegetable alkalis exist in the form of salt, some are soluble in water and some are not. In extraction, it is best first to use thin acids (hydrochloric acid, sulphuric acid or acetic acid) quickly so that the alkalis turn into soluble salt and can be dissolved in water.

(3) General conditions relating to the investigation and utilization of medicinal plants in China.

The development of medicine in China has a history of several thousand years. The working people of ancient days struggled against disease. Many tested various herbs to find cures for ailments. We thus accumulated a large store of experiences in healing sickness and a knowledge of pharmaceuticals. We established the Chinese medical science which combines theory with practice.

Of medical plants used in the ancient times, 1,095 items were listed by Li Shih-chen in his Pen-ts'ao-kang-mu. However, during the days of reactionary rule,

the reactionary rulers showed no concern for the ills of the people. For a long time Chinese medicine did not register development, and many experiences were lost.

After Liberation, the Party and the Government showed deep concern for the health of the people. They have corrected the mistake of belittling Chinese medicine, and have bent all-out efforts to develop Chinese medicine, and to implement thoroughly the correct policy of the merger of Chinese and Western medicine. Thus, Chinese medicine is receiving the attention due it. The need for plant medicines has also greatly increased.

The State Council has taken into account the needs for Chinese medicine and laid down the policy of development as follows: local production and supply and the transformation of wild plants into domesticated plants. Herbalists throughout the country have correctly implemented this policy. The health departments, medical departments and scientific research departments have joined forces with the masses in the universal investigation of medicines on a nation-wide basis. An overall investigation on the kinds of medicines and their production is being carried out to provide the basis for further development, utilization, cultivation and study.

In Peiping municipality, for example, the Public Health Department has led in the organization of competent medical departments, scientific research organs, and experienced insecticide organizations into universal investigation teams to penetrate the mountains to seek treasures. They have investigated more than 200 plants, examined them in detail, separated the genuinely useful from others, and have collected large quantities of specimens for examination and analysis, to ascertain their usefulness.

Other localities are also carrying out the universal investigation of medicines. In some provinces, the original estimate of useful plants was only slightly above 100, but after investigation, more than 700 were found.

On the basis of this universal investigation, the national Plant Medical Dictionary and many regional plant medical dictionaries have been published or are being compiled. We have created favorable conditions for the fullest development and utilization of plant medicines.

In the course of our nation-wide investigation of medicines and medical research work, we have discovered many plant medicines of very high curative value. One example is the *rauwolfia verticillata*, of the specie *apogynaceae*, which contains the "Lo-fu-chia-su," specially effective for curing high blood pressure.

It can also be used as a substitute for *r. serpentina* from India, which belongs to the same species. This plant is widely distributed over Yunnan, Kwangsi, Kwangtung and Taiwan. By manufacturing our own medicine from it, we shall not only fully meet our own medical needs, but also save a large amount of foreign exchange.

Furthermore, comprehensive utilization of plant medicines has been a new development in the universal investigation. For example, the pods of *sophora japonica* were formerly used only as fodder. Now the Tientsin Pharmaceutical Works has extracted from it, rutin, and also *huai-huang* and malt sugar, while the dregs can still be used as fodder. New excellent medicines and new products will continually emerge in the course of the nation-wide investigation of medicines to create favorable conditions for the well-being and the public health enterprises of the people.

Medicinal plants are often concentrated in certain species and divisions. For example, in the specie *ranunculaceae*, we have gentian, *cimicifuga foetida* var. *simplex*, aconite, *anemone cernua*, *paeonia white*, *maotan peony*, *ranunculus acris* var. *japonica*, and *veronica virginica*.

In the specie *umbeliferae* we have *bupleurum sachalinense*, *ligusticum*, caraway seeds, *cuidium officinale*, *pencedanum decursium*, *angelica sylvestris*, *artemisias apiacea*, *angelica*, *araliaeordata*, fennel seeds, parsley, carrot and, *hydrocotyle sibthorpioides*.

In the specie *labiatae*, we have *scutellaria buglos*, *scutellaria indica*, peppermint, *thymus serpyllum* var. *vulgaris*, sweet basil, *prunella vulgaris*, *eishboltria patrini*, sage (hairy kind), *mosla grosse-serata*, *lophanthus rugosus*, "chin-ku-tsao," "Hui-hua-tsai," wild sesame, and *stachys sieboldi*.

In the species *solanaceae* we have *scopolia japonica*, (*tien-chieh*), *scopolia japonica* (*liang-tang*)/two different Chinese names of the same plant/, *medicago*

denticulata, "fei-yu-ssu," lycium, physalis alkekengi, solanum nigrum, solanum lyratum, tomato, tobacco and pepper.

Furthermore, in the specie araliaceae, we have ginseng; in the specie polygonaceae, we have rhubarb; in the specie compositae, we have "shan-tao-nien;" and in the specie araceae we have pinellia tuberifera.

All these are well-known medicines. They are too numerous to be mentioned in full. The study of the biological characteristics of different plant medicines is of great assistance to the collection, analysis and study of these plants.

(4) General conditions relating to the investigation and utilization of native insecticides in China.

Agriculture in China has a history of several thousand years. We have rich experience in agricultural techniques. Since the Liberation, we have made far-reaching progress. Prevention and suppression of pests are major items in our experience.

In the "Eight-Word Code" for agriculture propounded by Chairman Mao, the protection of crops and the prevention and suppression of pests are listed as important measures in striving for agricultural bumper harvests.

In the course of the agricultural big leap forward in 1958, we fully developed the skyrocketing zeal of the working people and their Communist character of daring to think, to speak and to act. We created many miracles in the field of insecticides. Native plant insecticides made up the main portion of these achievements.

Superior points were found in the availability of supply locally, convenience in processing, timely supply, a high degree of efficacy, and the additional benefit of serving also as fertilizer. Moreover, costs are cheap and supply is plentiful.

In 1958, throughout China, we established 2.4 million native insecticide works, and utilized 17 million tons of native insecticides. Among them more than 400 kinds were plant insecticides, belonging to more than 110 species and 280 divisions.

The most notable insect killers included tobacco of the species solanaceae; chrysanthemum roseum of the species compositae; anemone hupehensis and chematis florida of the species ranunculaceae; sophora

flavescens, pachyrhizus erocus, derris spp., and mille-
tia pachycarpa of the species leguminosae; picrasma
quassioides of the species "su;" polygonum aviculare
and polygonum hydropiper of the species polygonaceae;
veratrum nigrum of the species liliaceae; rhododendron
lolle and rh. micranthum of the species ericaceae;
lycois radiata of the species amaryllidaceae; buddliea
sp. and strychnos spp. of the species loganiaceae; cro-
ton tiglium of the species euphorbiaceae; rhamnus cro-
nata of the species rhamnaceae; and phryma leptosta-
chya of the species verbenaceae.

We have provided preliminary summation of the
native insecticides used during the agricultural big
leap forward, and compiled the "China Native Insecti-
cide Dictionary". It includes 200 major insecticides,
principally native plant insecticides. The scientific
name, Chinese name, native name, production locale,
growth conditions, chemical components, capacities,
method of processing, objects subjected to treatment,
and other uses for each native insecticide are des-
cribed in full detail. It is an important reference
volume for the manufacture, utilization and study of
native insecticides plant.

In the course of the agricultural leap forward,
many advanced elements created all-purpose insecti-
cides. We hope to use a mixture of various kinds of
plant insecticides both for the killing of all kinds
of pests and for the prevention of the plant diseases.

At the same time they will also serve as fer-
tilizers. Initial success has been achieved in this
connection. The subject is worthy of further study,
so that new channels may be opened for the protection
of plants.

VIII. Essential Oil Plants

(1) The general conception of essential oils
and sources of supply.

Essential oil is the product of special organisms
of plants, such as oily glands and glandular hair.
They are mobile fluids, with fragrance and volatility.
They are also called fragrant oils. The chemical con-
stituents of essential oils are very complicated, and

are mostly compounds, with many different organic substances. Their constituents and characteristics are all different from those of oils and fats.

Inside the body of a plant, the essential oils perform the role of producing new organisms inside the cells and are thus of great importance to the plant. They play an important role as a protective and anti-biotic force during the transmission of pollen by insects. The oils are contained mostly in the petals of flowers. When the flower buds have not yet blossomed, the contents are at the highest level.

Essential oils are also found in other parts of plants. Examples are the leaves of plants of the species labiatae; the timber of the camphor tree and the rosin; the bark of cassia; the roots of ginger; the fruits of plants of the species umbeliferae; the peels of tangerines and lemons; and the seeds of bitter almonds.

Different kinds of essential oils are found in these places. The amount of essential oils contained in different organs of plants is decided by the different kinds of plants and their growth conditions, and it also varies according to seasons.

(2) Uses of essential oil plants and method of investigation.

Essential oils are important for industry and medicine. The food industry, the cosmetics industry, and the pharmaceutical industry all use essential oils regularly. In medicine, they are often used as an agent for the cure of rheumatism, the suppression of phelgm, as a sudorific, and for facilitating urination. They are also effective as insecticides, germicides, and slight stimulants.

The determination of essential oils: Essential oils are determined easily. On the basis of their volatility and fragrance, they can be determined through smelling. The observation of the glands may help in the determination. If blotting paper is used to absorb a blot of oil, it very quickly fades, being clearly different from the blot formed by fats.

Detailed determination must be carried out by extraction and analysis. If the essential oils content is more than 0.05 percent, consideration may be given to large scale extraction. This is generally

done through distilling, pressing, or immersion. The first method is the most convenient.

(3) Conditions relating to the investigation of essential oil plants throughout the country.

Plants producing essential oils are often concentrated in certain species and branches. Plants of the species labiatae, umbeliferae, and lauraceae very generally contain essential oils.

Universal investigation carried out throughout China has led to the discovery of essential oil plants of high production and good quality. There is, for instance, the litsea cubeba (also called shan-chi-chiao), of the species laucaceae, widely distributed over areas south of the Yangtze. Hunan Province alone produces 80,000 tan of it annually.

Its fruit is rich in citral. Using the system of distillation, the rate of oil extraction may reach from six to seven percent. The quality of the oil has received favorable comment in the international market.

New and excellent essential oil plant continue to be discovered. The Wild Grown Useful Plants Universal Investigation Team of the Academy of Sciences in 1959 discovered lao-ya-pi in Szechwan and pai-chu-shu at Lei-kung Shan in Kweichow. Both are very good fragrant plants.

IX. Plants Containing Rosin and Other Industrial Chemicals

(1) Vegetable Fat: Vegetable fat is a product emitted by many plants in normal growth. It can be obtained by cutting the body of the plant. The appearance and physical characteristics of fats secreted by various plants are generally the same, but their chemical constituents are often different.

They are solids of no fixed shape and fragile. They soften and dissolve when heated. When burnt, they may produce thick smoke. The chemical constituent belongs to the class of complicated hydrocarbon. The fat is produced through the mixture of various fragrant acids with recinade or vegetable fat yeast.

The chemical evaluation of vegetable fat is comparatively complicated. It cannot generally be easily carried out in the field. Usually, the determination is made according to the manner described above. In outward appearance it is like rubber. The difference between the two is as follows: rubber expands or dissolves in water, turns into carbide when greatly heated, and does not emit thick smoke when burnt. Vegetable fat, on the other hand, does not expand and does not dissolve in water, dissolves when heated, and emits thick smoke when burnt.

In the investigation of plant resources throughout China, rosin from coniferous plants has received great attention. Many conifers (particularly the pine) possess a vegetable fat channel, and emit vegetable fat containing essential oil. When essential oil is distilled, it becomes turpentine oil. The solid left behind, fragile and transparent, is rosin.

The main component of rosin is resinic acid. Both turpentine oil and rosin are important raw materials in industry and medicine. The rosin, buried underground from ancient times, becomes mineral rosin and is called amber.

(2) Dyesstuffs. Many plants can be used as dyestuffs. The peasants of our country have rich experiences, which they have summed up in the investigation of plant resources in all areas.

In the Northeast, for instance, we have investigated and found more than 60 kinds of dyestuff plants. In the yellow dyestuff class, we have the inner bark of *phellodendron amurense*; the bark of *rhamnus* spp.; the plant of *arthrakon spidus*; and the flower of *sophora japonica*.

In the red dyestuff class, we have the roots of *rubia* spp.; and the flower of *carthamus tinctorius*. In the brown dyestuff class, we have the bark and peel of *juglans mandshurica*.

X. The Investigation and Utilization of Other Useful Wild Plants.

The rich plant resources of China can be utilized not only in the above fields, but also in many other

fields as contributions to socialist construction. For example, various kinds of timber play an important role in capital construction.

Many areas have carried out the detailed investigation of trees in forests. Many areas (the Northeast, for example) have compiled special books which deal with the development and utilization of forests, their operation and management, and the development of green belts and forest areas.

The extensive grasslands and the grass on the meadows provide fodder important for the development of animal husbandry. We have published pictures and descriptions of various grasses useful as fodder.

Adequate attention is also being given, in our universal investigation, to fodder plants for the feeding of the silkworm, the tussah, and the "pi-ma" silkworm, as well as plants yielding honey.

Furthermore, overall investigation is also being undertaken of raw materials for activated carbon, various fragrant plants, plants producing cork, spores of lycopodium clauatum which can be used for illumination and for metallurgical needs, various beautiful plants which can be put on display, as well as beverage plants which can replace tea.

Conclusion

On the basis of the above description we can see that during the past decade we have made great achievements in the investigation and utilization of wild plants, under the leadership of the Party. Particularly after the State Council in 1958 issued the directive on the utilization and collection of wild plants in China, all areas have attached importance to the investigation and utilization of wild plants.

According to incomplete statistics, in 1958, throughout China 786,000 tons of wild plants were purchased. Among them were 51,819 tons of wild oil-bearing crops and 157,550 tons of wild starch. They provided important supplementary supplies for light industry, and promoted the development of such industries as oil, food, wine, textile, paper and medicine.

They increased supplies of goods and, at the same time, played an important role in increasing the income of the peasants and in promoting the economic prosperity of the mountain areas.

Nevertheless, the great achievements made so far are still greatly behind the needs of the leaping development of industrial construction in the motherland. Certain light industries still feel a lack of raw materials. Large quantities of wild plants which can be utilized are still not yet fully utilized.

The major problem at the moment is still the overcoming of rightist conservatism, the exertion of the utmost zeal to further implement the directive of the State Council for the fullest utilization of wild plants.

In order to implement the spirit of the directive of the State Council effectively, attention must be paid to the following points:

First, we must continue to implement thoroughly the Party's mass line. Wild plants cover the expansive land of China, and definitely a small fraction of our people cannot fulfill the heavy task of the complete investigation and utilization of these plants. Many areas have thoroughly implemented the correct policy of investigation and research, over-all planning, full utilization, and active development.

The people's communes have also manifested their colossal superiority. At the same time, they have organized departments connected with scientific and technical research for coordinated studies and the determination of the useful items. Accordingly, the achievements they have made are colossal.

However, China is expansive and our plant resources extremely rich. We cannot complete universal investigation within a short time. Many areas have not yet been penetrated. In some areas where investigation has been carried out, the work has not been penetrating. The data investigated have not been fully analysed and determined. There are still difficulties in deciding on plans of their utilization. For this reason it is very necessary to rely on the masses and continue to exert efforts.

Second, in the collection and purchase of the plants we must carry out timely propaganda and educate the peasants to protect and cultivate useful wild

plants. Resources must not be exhausted. Their continued cultivation and growth must be guaranteed.

Where possible, they must be tamed and wild plants transformed into domestic plants, so as to raise output and improve quality. Only by so doing may the land of our motherland forever raise rich and varied raw materials of high quality for our light industries. The materials needs of the entire populace China, which are continually growing, will thus be fully guaranteed.

In secondary and primary schools, teachers may carry out education on the utilization of wild plants in coordination with the teaching of botany and natural sciences. After class, the study of wild plants may be carried out in coordination with production. The students should be led in the collection of useful wild plants. These are beneficial extra-curricular activities.

This article has collected certain fragmentary data and put them into shape for presentation to readers. The utilization of wild plants is an extensive and complicated question which cannot be fully covered in a short article. Our experience is insufficient, and the data collected are not adequate.

Omissions and errors are unavoidable. We sincerely hope that various quarters will bring forward their criticism and supplement our efforts.

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