
BUFFALO GRASS Buffalo grass (*Stenotaphrum secundatum*) grows extensively at the lower altitudes, but is not regarded by livestock men as having great value for pasturage. It is used for lawns in shady locations where manienie (Bermuda) grass does not do well. Ref.—Haw. Exp. Sta. Bul. 65:49, 1933.

BURDOCK Burdock (*Arctium Lappa*), called by the Japanese “gobo,” is a large-leafed plant which produces a long, fleshy tap-root, from one to four feet in length. Although the plant is normally biennial, it is usually grown as an annual so that the root may not become too long and too tough. In about ten months the root size desired by the market is attained. The root is boiled to make it edible. It somewhat takes the place of salsify, or oyster plant, in consumption demand.

The market demand for this root is limited and the production is small, some 30 acres being devoted to it, mostly in the upper portions of the valleys near Honolulu.

See also “Truck Crops.”

BUTTERBUR Small quantities of this Japanese plant (*Petasites japonica*) are grown for market on the Island of Hawaii near the Kilauea Volcano. It is a perennial herb28 with large leaves, the petioles of which are one to three feet long and very succulent, and used in soup by the Japanese.

CABBAGE Head cabbage (*Brassica oleracea capitata*) thrives very well in the cooler uplands of these Islands. The history of its cultivation here runs back to the early part of the nineteenth century, Marin recording it in his diary that among many other things he had planted “cabbages.” In the gardens at lower elevations there has been a limited amount of production of this crop, but always under some handicaps due to insects and diseases.

In spite of this, however, production during the whaling period was large enough not only to take care of all local demand but to provide some surplus for exportation, as well. In 1850, for instance, some 1600 heads were shipped to California.

Cabbage production later suffered the same fate that befell the potato in Hawaii: California reversed the trend of shipments, sending her own crops to Hawaii instead of importing from Hawaii, and as a consequence Hawaiian production of certain commodities almost ceased for a good many years. Some twenty years ago, however, war conditions threatened local food supplies and farmers began producing such crops as cabbage, potatoes and others.

Imports of cabbage from the mainland are now almost negligible in comparison with the amount of local production, practically all consumption demand here being met by producers on Maui (Kula District) and Hawaii (Waimea and Volcano districts). Some 350 acres are devoted to this crop, the yield of which is between 2½ and 3 millions of pounds per year.

Insects and disease present serious difficulties, but probably not materially worse than in other cabbage producing regions.

An important problem confronting our producers has been the profitable marketing of this crop, but the situation is slowly improving as better grading and packaging methods are adopted under the guidance of the Agricultural Extension Service and of the Inter-Island Steamship Co., both of which agencies are doing much to help the farmers.

For a detailed account of good cultivation and marketing practices, consult the Krauss bulletin on Vegetable Production.1

CACAO Cacao (Theobroma cacao), the source of commercial cocoa, is a tree which grows only in tropical regions where rainfall, soil and climate are suitable. There are a few trees growing in Hawaii, the first introduction having been by Dr. Hillebrand about 1850. Sev-

1Agr. Ext. Bul. 16, pp. 72-78.
eral small plantings near Hilo in the latter part of the
nineteenth century aroused some interest,² but the cultiva-
tion of this plant did not develop into proportions of an
industry.

These plantings, however, were a sufficient indication
that conditions here were favorable, and accordingly the
Hawaii Experiment Station in 1905 planted about three
acres on a trial basis at Hilo, with the help of the Hilo
Boarding School. Although lack of funds caused the
abandonment of the project after a year or two, neverthe-
less the trees continued to grow and some are still there.
The manager of the Hilo Sugar Co. planted cacao on his
home premises at about the same time and it has done well.

Dislocation of world shipping during the World War
caused an abnormally high price to be placed on many
commodities, cocoa among them. This served to revive
interest here in the possibilities of establishing cacao plan-
tations. The interest was sufficiently keen to prompt the
1917 Legislature to request a statement from the Hawaii
Experiment Station concerning the matter. Prospects
for Hawaii were outlined as follows:³

"The tree begins to bear fruit about the fourth year
after planting, and increases in production for several
years. The yield of an established cacao plantation runs
from 300 to 600 pounds per acre. The present high prices
are not likely to continue, and for calculating returns,
$10.00 to $14.00 per hundredweight would be as high as
it would be safe to expect, which would make the gross
receipts per acre run from $30.00 to $84.00 per year.

"As curing cacao is a process which does not require
elaborate machinery or expensive equipment, the crop in
this respect is well adapted to the use of small growers
who may be quite widely separated. In addition the
beans, when cured, are not a highly perishable product.
This makes it possible to grow cacao on comparatively
cheap lands at considerable distances from the world's
markets and with the cheap labor so prevalent in most
tropical countries. Hawaii, therefore, would have to

(1891), also of D. H. Hitchcock in Vol. XII, p. 105 (1893); the latter had a
plantation of 1500 trees.
meet strong competition in marketing the raw product. By reason of its nearness to markets and its good transportation facilities, Hawaii could counterbalance this disadvantage by entering the field of manufacture—a thing not yet attempted generally by countries far from the consumer.

"The data in hand indicate that any attempts to establish cacao growing as an industry in Hawaii should be confined to localities near sea level, and only those sheltered places which are warm and moist are to be considered. Sheltered spots in Hilo and Puna, in general, offer the best locations for further trials. The Hana coast of Maui presents some advantages."


CACTUS Several species of cactus produce fruits which are edible. The common panini (Opuntia megacantha) which grows in nearly all dry and uncultivated areas throughout the Territory has an abundance of handsome, red fruits usually called cactus pears, or tuna. Abundant as this fruit is in Hawaii, it is but rarely eaten by people, and is of practically no economic value at present.

This is not true, however, of the cactus plant itself for in many localities its spiny "leaves" (really stems) are eaten by cattle and in some districts constitute a large part of their total diet. A spineless species has been introduced in some of the pastures, but the cattle destroy the plants before they can become well established.

In Mexico, the juice of cactus "leaves" is pressed out and mixed with whitewash to make the latter adhere better to wood surfaces. It is said to be useful for this.

The night-blooming cereus sometimes sets fruits which are delicious to eat. By hand pollination one may produce an abundance of fruits, but at present there is no market demand for them.

CALAMONDIN See "Chinese Orange."

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4This is the Mexican name for the cactus pear, which is very extensively used as food in Mexico, especially by the poor people.

CALCIUM CITRATE A by-product of the pineapple canning industry.

See "Pineapple."

CAMPHOR The camphor tree (Cinnamomum camphora), a member of the laurel family and related to the avocado, is grown in Hawaii chiefly as an ornamental, having been introduced in 1894. The camphor of commerce is extracted from it, but no such use is made of the trees growing here.


CANAIGRE Canaigre, or tanners' dock (Rumex hymenosepalus), came into great prominence in southwestern United States and Florida in the 1890's as an unusually rich source of tannin for use in the leather industry. The plant, a native of California and related to the common rhubarb, produces a greatly enlarged root which is the chief repository of the tannin. It was anticipated that the demand for this product from the dye-stuff industry would stimulate a very extensive planting of this dock.

In 1895 the widespread interest in canaigre made itself felt in Hawaii. The Planters Monthly urged that it be tried here, as a means of diversifying industry, for climatic and soil conditions seemed good and the market outlook very encouraging. In that same year, Commissioner of Agriculture Marsden announced that he was importing a quantity of seed of this plant for trial. It was expected that the cultivation of this crop in Hawaii would "utilize much land hitherto deemed of little value."

As a special incentive to the establishment of the proposed new industry, the government provided tax exemption for producers of canaigre, the exemption extending to all lands, buildings and tools used for the purpose. Import duties on planting materials, also, were to be waived.

7Thrum's Annual 1895, p. 137.
8Act 7, Session Laws of 1895.

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No developments of commercial importance resulted from these efforts, however. The canaigre apparently did not establish itself in the wild state, as it is not reported by botanists in their collections.9

CANEC See “Bagasse.”

CANNA The edible canna (Canna edulis) is an introduction from Australia where it is a plant of some economic importance for the starch content of its fleshy rootstocks. The plant grows upright, about 4 to 8 feet tall, sending up many stems from a single root, somewhat as does sugar cane, requiring 4 to 6 months to reach the stage of first blossoming. Growth of the root system continues after this, however, and harvesting need not take place until 10 to 24 months after planting.

The edible canna is not exacting in its soil and climatic requirements, for experimental plantings indicate that it will do well at any altitude from sea-level to 2,700 feet. Its best growth, however, is at elevations less than 1,500 feet and in good, loamy soil with an abundance of moisture. In short, its requirements are about the same as those of sugar cane, except that its upper range in elevation is higher.

This crop plant seems remarkably free from attacks by insect pests and diseases.

Typical yields of roots have varied from 7 tons per acre after 9 months' growth in the Glenwood (Hawaii) district to 28 tons after 12 months' growth in the Wahiawa region of Oahu, and 34 tons in the same growing period in Honolulu; an average yield may be said to be 18 to 20 tons per acre in 8 to 10 months, in any favorable location.

This plant was introduced into Hawaii in the 1890's and planted occasionally in gardens for food purposes. The cooked corms are not as good to eat, however, as potatoes or taro and the canna never gained much headway as a food crop.

In 1915 Judge J. A. Matthewman brought it to the attention of the Hawaii Experiment Station as a useful crop for the war emergency period and experiments were be-

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9According to Dr. Harold St. John.
gun soon after to ascertain the essential facts concerning its cultivation.

Attention soon shifted to the possibility of developing a starch manufacturing industry on this crop, for the Experiment Station's work on tree-fern starch was not progressing as favorably as had been expected and the edible canna seemed to offer better prospects. Experiments in starch manufacture were carried on for several years on a small scale and by 1922 the findings seemed sufficiently encouraging to warrant the establishment of an industry. A corporation was formed and a small factory was built in the Waimea district of Hawaii. Commercial plantings were made, at first cautiously but gradually over more area until in 1927 a total of about 75 acres was under this crop.

Between mechanical difficulties in the factory and financial troubles in the corporation the industry did not move forward smoothly and finally came to an end when the company was forced into receivership.

Notwithstanding this unfortunate experience, it is believed by several who are acquainted with the facts that the manufacture of edible canna starch does offer good possibilities for the development of a small but important industry in Hawaii. The crop could be grown well on any of the marginal sugar cane lands which have been forced out of use by the quota system of sugar production; planting and cultivation practices would not be greatly different from present plantation techniques. Harvesting the tubers and manufacture of the starch would require new machinery, but the returns should be large enough to warrant the investment.

An important and valuable feature of such an industry would be its usefulness in time of emergency as a source of food for the people of Hawaii. Certain by-products, as the tops and the factory refuse, would be useful as feed for livestock.

See, also, "Starch."

Ref.—Haw. Exp. Sta. Bul. No. 54 (1924), No. 56 (1927) and No. 57 (1928); also, Annual Report 1936:21.

CANTALOupe The cantaloupe (Cucumis Melo cantalupensis) is one of the most popular of all the melons
of commerce and is consumed in Hawaii in larger quantities than it is produced. Importations from California in the summer and fall months are relatively heavy, compared with the amounts produced here. Local producers, however, are able to place good cantaloupes in the market during the winter and spring months because of more favorable growing conditions here. If by a modification of existing quarantine restrictions Hawaii should ever be able to ship this product to the mainland in the winter and spring, a good opportunity would be presented for developing an industry of considerable importance.

Cantaloupe production in Hawaii now occupies only about 50 acres.

See "Melons," also "Truck Crops."

CARAMBOLA The carambola (*Averrhoa carambola*) is of Asiatic origin and was brought into Hawaii many years ago. Its fruits are oddly shaped, about the size and color of a lemon but with five conspicuous flanges or wings extending longitudinally from stem to tip. It is this feature which makes the name "starfruit" appropriate, for the cross-section view is distinctly star-shaped. The pulp is juicy and good to eat, especially that of the sweet variety. The fruit is used to a limited extent in the making of jam and jelly, and in the immature stage is useful for pickles.

Although the carambola has been in Hawaii more than a half century it has not made much of a place for itself in a commercial way, being cultivated only to a very limited extent and appearing in the markets only as a specialty fruit, used more by the Chinese than by others.

CARDAMOM The seed of *Elettaria cardamomum* is known in commerce as cardamom. The plant is a relative of the gingers and is produced commercially in India and Hindustan, which supply most of the seed imported into the United States. A move made in 1883 to establish production in Hawaii was not successful.
Ref.—Planters Monthly II, 266, 1883.
CARISSA  The carissa, or Natal plum (*Carissa Carandas*)\(^\text{10}\) was introduced into Hawaii from South Africa in 1905 by the U. S. Department of Agriculture. It is a shrub, with glossy foliage and forbidding spines, the fruit being about the size of a small plum and of a beautiful red color. When cooked into a sauce it resembles cranberry; it is useful for jam and jelly making, as well.

The four original plants have been multiplied into thousands by the work of the Hawaii Experiment Station and the carissa is now of moderately common occurrence in gardens as a hedge plant and ornamental shrub. Although it seems to offer some promise for commercial exploitation it is not cultivated outside of gardens in Hawaii at the present time.


CAROB  This hardy tree (*Ceratonia siliqua*), common in the Mediterranean region, produces pods which are very nutritious and therefore valuable as feed for livestock. It was introduced into Hawaii over thirty-five years ago, and in 1921 the Hawaii Experiment Station obtained additional seed from California where the tree is grown in many gardens. While the carob tree grows well under Hawaiian conditions, there are few specimens here in spite of past efforts to establish it in these Islands.

Probably its value is no greater than that of our common algaroba, which also has excellent worth as a source of feed for livestock. It is doubtful, in fact, that the carob would grow in all locations where the algaroba does, and therefore it would seem that the better of the two trees has established itself here.


CARPET GRASS  Carpet grass (*Axonopus compressus*) spreads by runners and forms a dense sod which crowds out most other grasses. It provides only moderately good pasturage. It is very widely distributed on all islands.


CARROT  The carrot (*Daucus carota*), long a food of

\(^{10}\)Also, *Carissa grandiflora.*
western peoples, is in steady demand here and is pro-
duced in limited quantities by market gardeners as well
as in home gardens. A recent survey of crops showed
about 75 acres of this commodity in the spring and early
summer months, exclusive of the small backyard gardens.
Several varieties do particularly well in these Islands.

Shipments of carrots from the mainland were about
210,000 pounds in the first quarter of 1936. If this is rep-
resentative of the entire year, it is evident that local pro-
ducers are falling far short of meeting the existing de-
mand, for it is estimated that a typical year’s production
here is a little over 500,000 pounds, compared to perhaps
800,000 pounds imported.

See also “Truck Crops.”

CASHEW NUT The crescent-shaped cashew nut
(Anacardium occidentale) has become very familiar in
the American market in the last decade or two, importa-
tions into the United States having been over 14,000,000
pounds in 1934 and nearly 18,000,000 in 1935. It is a
tropical tree, related to the mango, and thrives very well
in Hawaii. The nut of commerce is the edible kernel
produced within a hard outer shell which is borne at the
end of a small fruit resembling a miniature mango. When
roasted, the nut is considered exceptionally delicious and
is much in demand. The gum surrounding the kernel is
somewhat poisonous.

The cashew tree was introduced into Hawaii from the
West Indies a good many years ago but, until very recent-
ly, was known to but few people and was only sparingly
planted in gardens for ornamental purposes rather than
for its nuts. A few years ago Maunawili Ranch on wind-
ward Oahu planted about 180 acres as an experiment in
forestry. These trees are thriving well and are shading
out the guava bushes which are especially abundant in
that locality. Although not planted for nut production
purposes, this large stand of trees will soon be at the heavy
bearing age and may prove to have a considerable eco-
nomic value apart from forestry considerations.

The Hawaii Experiment Station has some trees grow-
ing on its Kona lands (Annual Report 1936, p. 94).
CASSAVA  Cassava, or manioc (*Manihot utilissima*) is a tropical plant with greatly swollen roots which are an excellent source of starch (tapioca of commerce) and are used, also, as feed for livestock. It has been cultivated in Hawaii for many years and used by the Hawaiians in making starch (pia\(^{11}\)) by their simple, if somewhat primitive, methods.

From 1916 to 1928 both the Hawaii Experiment Station and the University Farm (then separate\(^{12}\)) conducted experiments in the cultivation of the cassava plant; several varieties were tried, various culture methods were compared and the values of certain fertilizers were determined. The good results obtained in these tests stimulated an increased planting of this crop by hog raisers and other livestock producers, for it was shown that cassava roots, when cooked, make excellent feed for swine and can be used in place of some expensive, imported concentrates. This trend toward more extensive growing of this crop did not continue long, however, perhaps because imported concentrates were easier to handle. Present plantings of cassava amount in the aggregate to less than 100 acres, with very little interest in the crop evident.

See also “Starch.”


CASSIE FLOWER  See “Klu.”

CASTILLOA  See “Rubber.”

CASTOR BEAN  This plant (*Ricinus communis*) has been cultivated for many centuries in many parts of the world for the medicinally valuable oil contained in its seeds.

It seems to have been introduced into these Islands be-

\(^{11}\)Pia is the Hawaiian word for starch whether it is made from the cassava root or other source; early Hawaiians made their pia from a native species of arrowroot (*Taccia pinnatifida*).

\(^{12}\)Amalgamation of these was effected in 1929.
before the beginning of the nineteenth century, but this cannot be stated with certainty. Don Marin mentions the castor bean in his journal as growing here before any of his importations.

A number of attempts were made here during the nineteenth century to grow this plant on a commercial basis, and several small plantations were started in various parts of the Islands. A notable example was the plantation of C. Koelling in Heeia (windward Oahu) which was maintained as a commercial undertaking for over twenty years. Other plantings were tried in Kona. The World War caused a sharp rise in the price of castor oil and stimulated more planting, but no concerted effort was made in Hawaii to revive the industry.

The plant requires good soil and at least a moderate amount of rainfall. It will grow on poor lands, but would not pay commercially.

The crop is not a very remunerative one to farmers. One to two tons of harvested beans per acre per year seem to be about the usual yield, for the seeds are relatively light and it takes a good many to make a ton. The explosive-ness of the pod scatters the seeds and makes harvesting difficult. The extraction of the oil is, also, a difficult process and there are no facilities for doing it in the Territory. This means, of course, that the beans have to be exported, and the market price is scarcely high enough to arouse much interest.


CAULIFLOWER Cauliflower (*Brassica oleracea botrytis*) is the compact flower head of a plant closely related to the cabbage and is consumed in much larger quantities than its relative, broccoli. Its production here is not very extensive, however, for it requires cool weather for the formation of firm heads. In the Kula district of Maui, and Waimea, Hawaii, where cabbage does well, truck growers produce some cauliflower, perhaps a total of 15 or 20 acres. Imports of this vegetable from California amount to nearly a half million pounds per year,
while local production provides only about 30,000 to 50,000 pounds.

CAYENNE BERRY  See “Surinam Cherry.”

CEARA RUBBER  See “Rubber.”

CELERY  Although Hawaii consumes over a million pounds of celery (Apium graveolens) per year almost none is produced here, a few hundred pounds per year coming into the Honolulu market from Maui and Kauai. Celery seems to require a cool climate and a certain type of soil not commonly occurring in Hawaii. As a result, this may be one of the truck crops which it is advantageous to import from outside rather than to grow here.

CELLULOSE  See “Bagasse.”

CHARD  See “Swisschard.”

CHAULMOOGRA  Chaulmoogra oil, used for many centuries in the Orient in the treatment of leprosy, is extracted from the seeds of several Asiatic trees, chiefly Hydnocarpus anthelminticus, also Taraktogenos kurzii, and others.

Because of the great local interest in this oil in the 1920’s, the Board of Agriculture and Forestry obtained a supply of seeds of the first named species from Siam, through the help of J. F. Rock, and planted about 2,500 seedlings in the Waiahole Forest Reserve (Oahu) in 1921 to 1923. The trees grew well and found the new environment favorable. The first fruits were produced in 1929 and a moderate production has been noted each year since then.

A less extensive planting of the second species was made in the same region in 1922 to 1924, the first fruiting occurring in 1930.

The fruits are large, each with about 30 seeds the size of a peanut packed neatly inside; the oil is contained in these seeds.

Thus far no effort has been made to extract the chaul-

13Dr. Krauss believes that interest in the production of celery here is increasing and that it is one of the promising crops for local farmers.
The use of this oil in the treatment of leprosy has been all but discontinued in Hawaii.

CHAYOTE The chayote (*Sechium edule*) is a relative of the squash and cucumber and is a comparatively recent introduction from Mexico. It is a climbing vine and produces an abundance of pear-shaped fruits which are succulent and tasty when cooked, resembling in flavor and consistency the summer squash.

It is but rarely cultivated in Hawaii, but deserves much more attention in spite of the fact that it is sometimes attacked by the melon fly. It grows wild in certain forest areas, as Hamakua, Olaa and Kona.

CHERIMOYA The cherimoya (*Annona cherimola*) was one of the many introductions made by Marin some time prior to 1813. Since then it has been planted sparingly in home gardens, but never on a commercial scale, for the fruit is somewhat exotic both in appearance and flavor and there seems to have been very little demand for it. As a full grown tree it is not particularly ornamental, so that from no point of view has there been any great incentive to general planting.

The Royal Hawaiian Agricultural Society in the 1850's used to mention the cherimoya occasionally as a desirable fruit tree worthy of more exploitation in Hawaii, and in more recent years the Hawaii Experiment Station has given a little attention to it horticulturally, but it still remains a novelty and rarity in home gardens, with the average person wholly unaware of its existence.

The fruit is difficult to eat, even when one has learned to like its flavor. Probably the only commercial use to which it might be put would be by expressing and canning the juice for blending with other fruit juices in punches and cocktails.

See, also, "Custard Apple," "Sour Sop," and "Sweet Sop."
CHERRY  This temperate zone fruit (*Prunus Cerasus*) is but rarely produced in Hawaii. In the higher uplands, at elevations above 5,000 feet, there are a few trees here and there, to a total of one or two acres, but cherry production offers no commercial possibilities worthy of note.

CHICKENS  See “Poultry.”

CHINESE CABBAGE  Chinese cabbage (*Brassica ke-tsai*) is different from the common head cabbage, being of Asiatic origin while the other is from Europe. The Chinese species has a number of varieties, some of which form compact heads but the majority are loose, non-heading.

This cabbage grows best in the cool upland regions where the head cabbage also thrives, the Kula district of Maui and the Waimea district of Hawaii producing most of the crop for this Territory. The area devoted to it is perhaps about 70 acres, exclusive of small plantings in many vegetable gardens.

See also “Cabbage” and “Truck Crops.”

CHINESE DATE  See “Jujube.”

CHINESE ORANGE  The Chinese orange or calamondin (*Citrus japonica hazara*) is more frequently grown as an ornamental in Hawaii than for its fruits, which are small and sour.

See also “Orange.”

CHINESE PEA  This edible podded pea (*Pisum sativum saccharatum*), usually known locally as the “Chinese pea,” is closely related to the common garden pea but is eaten pod and all in the immature stage, while in the other only the seed is used. The Chinese pea is of Asiatic origin and was introduced into Hawaii by the Chinese for their own use, but it has proven to be so popular with other racial groups that its consumption is becoming general. Cultivation is not yet, however, very extensive, the total acreage now being about 20 acres.

See also “Beans,” “Pea,” and “Truck Crops.”

CHIVES  Chives (*Allium Schoenoprasum*) is a perennial closely related to the commercial onion, but it is the leaves that are used in this case and not the bulbous root. The leaves resemble onion leaves but are shorter and more slender. They are used for flavoring vegetable dishes, especially by the Chinese.

Production in Hawaii is very limited.

See also "Truck Crops."

CHRYSANTHEMUM  Young plants of *Chrysanthemum coronarium* are used by the Chinese and Japanese as greens. Two varieties are cultivated in Hawaii, but only in very small amounts, for the market demand is limited.

Several varieties of the common garden species (*Chrysanthemum hortorum*) are grown abundantly by market gardeners. See "Floriculture."

See, also, "Pyrethrum."

CINCHONA  Quinine, a drug commonly used in the treatment of malaria, is extracted from the bark of several species of tropical trees belonging to the genus *Cinchona*, notably *C. succirubra* and *C. officinalis*. This discovery of quinine and its medicinal value, made in 1639, aroused much interest in the growing of the trees in various tropical countries. At first known only in South America, they were introduced into Netherlands India and a lucrative industry was established there in the nineteenth century.

The first introduction of the cinchona into Hawaii seems to have been in 1876 when Captain Makee planted a few trees at Ulupalakua (Maui). In 1887 some samples of the bark were tested and found to be quite as good as the product of other countries.

A much more ambitious move toward the establishment of a cinchona industry here was made by W. H. Purvis in 1883, when he paid a visit to India and Ceylon to obtain a quantity of seed and first-hand information about cultural practices. On his return he planted 16,000 seedlings on the slopes of Maunakea, above Kukuihaele (Hawaii),

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14W. J. Forsyth reports having inspected these trees in 1888 when they were twelve years old. *Planters Monthly* VII, 15 (1888).
and a year later added more by importing seed from South America. In a report on his work in 1886 he indicated great enthusiasm for the prospective industry, apparently considering well invested the $3,500 which he had spent in this foundational work. It was suggested in 1884 that the Hawaiian government ought to give Mr. Purvis a prize for this important service, but his only reward seems to have been the satisfaction of public esteem. The Planters Monthly declared editorially, apropos Purvis' efforts, that "one man who will demonstrate the feasibility of establishing a new industry is doing more good and is worth more to the country than a syndicate of capitalists and a Government House full of politicians." Those are strong words to come from the organ of the sugar planters!

The Purvis plantings grew well and in due time samples of bark were sent to London for analysis. The reports indicated that the Hawaiian bark was an excellent source of quinine, especially the species *succirubra*, and this seemed to confirm the general idea that there were good prospects for the development of an important new industry here, for this drug was then commanding a very high price.

Within a few years, however, commercial extraction of quinine in Netherlands India was developed to such large proportions that the price for the commodity dropped to a relatively low figure, making the production here seem far less attractive. No other plantations had been developed in these Islands, but Purvis maintained his plantings in spite of falling prices, until it appeared to be hopeless. He made no commercial shipments and after some years abandoned the little plantation.

The trees are still thriving, however, and seem to have established themselves as well as in their original home environment. Some natural dissemination by seed is taking place, for seedlings are to be found a half mile or more away from the original trees.

In 1919 the Hawaii Experiment Station introduced

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15Planters Monthly V, 111 (1886); see, also, Vol. II, 259 (1883).
16The suggestion was made by W. B. Oleson (Planters Monthly III, 593).
17Vol. V, 124 (1886).
some additional varieties of Cinchona, believing that even at prices then prevailing there might be some attractive possibilities in commercial production of this drug. No important results followed this effort, and Cinchona joined the company of those other might-have-been industries.

The Dutch monopoly of this industry seems now to be threatened by recent developments in Formosa and the Philippine Islands. In Formosa the Japanese are undertaking to develop an industry sufficient at least for their own national needs, while a similar movement is under way in the Philippines.


CINNAMON The cinnamon tree (Cinnamomum zeylanicum) is a member of the laurel family and related to the avocado. Its bark is used for the making of commercial cinnamon. Although this tropical tree was introduced into Hawaii many years ago it has not become widely planted, occurring only sparingly in gardens as an ornamental.

CITRIC ACID A by-product of the pineapple canning industry.

See "Pineapple."

CITRON The citron (Citrus Medica) is grown in Hawaii chiefly as an ornamental. Its fruits have an exceptionally thick rind which is made into the citron of commerce by a preserving process.

See also "Citrus Fruits."

CITRUS FRUITS Oranges, lemons, limes, grapefruit and citrons are commonly grouped together as citrus fruits. They are among the most valuable and important fruits known to humanity, and they are to be found in nearly all markets of the world, for countries which are not situated favorably for producing these fruits almost invariably import them. The commerce in citrus fruits, if it could be computed, would reach a stupendously large total. In

the United States alone the production in 1934 was over 58,000,000 boxes.

This interesting group of fruits was unrepresented in Hawaii before the arrival of western civilization, but in the past 150 years several kinds have been introduced and are successfully established. None, however, have become of great commercial importance here.

The species which are more or less well known in this Territory are the following, each discussed briefly under its own heading:

- Citron (*Citrus Medica*)
- Grapefruit (also, Pomelo and Shaddock)
- Kumquat (*Fortunella japonica*)
- Lemon (*Citrus limonia*)
- Lime (*Citrus aurantifolia*)
- Orange—Chinese Orange (*Citrus japonica hazara*)
- Mandarin Orange (*Citrus nobilis*)
- Ordinary Orange (*Citrus aurantium*)

**CLOVER** See “Hubam Clover,” “Sweet Clover.”

**CLOVES** The cloves of commerce are the dried flower buds of *Eugenia aromaticia*, a tropical tree cultivated in Zanzibar, Madagascar, Sumatra and other islands of the Indian Ocean. Dr. H. L. Lyon has at various times obtained seeds for trial in Hawaii, but thus far has not been successful in his effort to germinate them.¹⁹ Interest in this as a possible crop for Hawaii was in evidence last century, but no serious effort was made to introduce the plant.²⁰

**COCOA** See “Cacao.”

**COCAINE** Cocaine, a useful drug of commerce, is made from a tropical plant (*Erithroxylon coca*) which grows well in Hawaii. No effort has been made here to develop an industry for the manufacture of this drug, although there was a brief interest shown in such a possibility in 1892.²¹

**COCONUT** The coconut (*Cocos nucifera*) was prob-

¹⁹ Verbal statement to the author.
²⁰ Planters Monthly Vol. III, p. 524 (1884), and XII, p. 216 (1893).
ably one of the few food plants growing in these Islands before the coming of the original Polynesian immigrants. If it did not precede them, it was introduced by them at an early date, for it has been present here for a very long period of time. To the ancient Hawaiians it was one of the most valuable of economic plants, for it yielded food, shelter and clothing materials, and provided them with utensils, tools and trinkets. In some tropical regions there is in addition to this a considerable commercial value because of the immense market for copra, fiber and shell of the nuts. It was estimated by Barrett in 1930 that the world crop of coconuts is about 10 billion nuts per year, with a commercial value of about $350,000,000.

In Hawaii the coconut is important chiefly for local consumption. Several attempts have been made to develop a large industry around it, but with no great success. High cost of labor and land makes it very difficult to compete with the Philippines and other tropical countries noted for their copra exports, and several coconut groves which have been planted here for commercial purposes now are little more than ornamental spots; one developed on Kauai by E. H. W. Broadbent yields a moderate income from sale of nuts for local consumption. A grove on Oahu has been abandoned as a commercial venture and the land subdivided for country homes. On several of the islands there are coconut groves of ancient planting which were associated with the village life of the early Hawaiians. These groves still yield an abundance of nuts as well as providing spots of rare beauty.

In 1905 Ralph Hosmer called attention to the great possibilities in the production of copra in Hawaii. His suggestion was that the many miles of unused coastal lands could be covered with coconut trees and become the source of great wealth to the Territory. While some planting of coconuts resulted, there was no immediate move to establish an industry.

In 1913 a movement was started here to develop the

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23For evidences of early interest in this as a crop plant for Hawaii the reader is referred to the Planters Monthly (H.S.P.A.) wherein are numerous statements of interest, as in Vol. III, p. 361 (1884); X, p. 426 (1891), and others.
manufacturing of foot-mats, brushes and brooms from the short, stiff fibers (coir) of the husk which encloses the nut. An ingenious machine was invented for this, but inadequacy of capital and the prospect of higher wages here as compared with the Philippines forced a transfer of activities to the latter country. At present, however, there is a new effort being made to stimulate the manufacture of coconut fiber articles, but on a home industry basis rather than in large factories, for it is felt that in this way the wage factor may not be so serious a handicap.

In this same manner there is developing a considerable home industry in the manufacture of buttons, buckles and other novelties from the ivory-like shell of the coconut.

A new and promising possibility which is beginning to be exploited is the weaving of hats from fine fiber strips of the flower stalk; it is said that these hats resemble somewhat the so-called panama hats and have some good points not possessed by the latter.

We should mention, too, the extensive consumption of coconut ice cream, made from a blending of cow's milk and coconut milk, and other uses of locally produced coconuts as food.

The coconut oil sold in the local market is not made from locally produced coconuts, but is imported.

Although the supplying of coconuts for local consumption is not organized into a commercial industry, it is nevertheless a source of income of no small importance to some homes. The majority of homes have one or several coconut trees which not only enhance the beauty of the grounds but furnish nuts for home use on frequent occasions. In the aggregate there must be at least 100,000 trees in the Territory, yielding with varying degrees of abundance from 40 to 100 nuts per year; while some of the total crop is wasted, a great many thousands of nuts are consumed in the various ways indicated above.24


24J. M. Westgate estimated in 1932 that the commercial crop of coconuts in Hawaii amounted to about 250,000 nuts per year. In addition, there are many bearing trees the nuts of which do not enter commercial channels, as the interest in them is only for ornamental purposes.
COFFEE The coffee industry in Hawaii, now a hundred years old, has been only indifferently successful. In some respects the situation here is ideal for this industry—excellent climate, good soil, freedom from storms, no troubles from political instability, easy access to a huge market—but after a century of effort it has little in the way of results to show: the acreage under coffee, now about 6,000 acres, is less than it once was; in several regions coffee production has ceased altogether, as on Oahu, Maui, Kauai and several portions of Hawaii Island; the industry is deeply in debt, with almost no prospect of coming through it whole; as compared with other industries in its class, coffee production here is relatively primitive, having made little effort to apply modern science either to production, processing, or marketing. Even after a hundred years it is still uncertain what might be done for this industry if it were completely revamped and modernized.

Coffee production in this Territory began in 1825 near Honolulu, at the same time that the sugar industry had its beginning. This first effort failed in a few years, but another and this time a successful undertaking was begun on Kauai in 1835, again both sugar and coffee being tried. At that time labor was becoming scarce, for the population of the Islands was rapidly decreasing and outside sources were not then being drawn upon; as a result, the cost of harvesting the coffee proved to be too much of a handicap, making the industry much less profitable than sugar production. Consequently, it was pushed down to a secondary position and did not receive the attention that was given to sugar. While sugar forged ahead under the stimulus of the science of mass production, coffee came to be thought of as a good crop for the “little fellow” to handle, but not worthy of attention from the big concerns. An instance of this attitude was the official report of the director of the Hawaii Experiment Station some years later in which he declared that coffee “is a crop

25 The first planting of coffee in Hawaii was on January 21, 1813, by Don Marin, according to an entry in his journal. (Information furnished by Mr. Y. B. Goto, who is compiling a history of the coffee industry in Hawaii.)
especially suited to the small farmer and the small investor.”

When the Kauai effort failed the trees were uprooted, but the production of coffee did not cease in the Islands, for small plantings were made in many scattered places. The fact that the coffee beans, when properly prepared for market, not only had a ready commercial value but also were of a relatively non-perishable nature made this product available to the native kings and chiefs as a medium for the commoners to use in paying taxes. Thus the industry developed into a backyard and small scale affair. Some exports of coffee were made, for the superior quality of Hawaiian coffee was recognized very early in the American market, but until the close of the century the shipments were comparatively small, considerably less than a million pounds per year.

Although developed in small units, the total was sufficient to make the coffee industry second to sugar among the commercial (plant) crops grown in the Islands, until 1862 when rice production had a boom and pushed coffee into third place. In the 1880’s coffee reached a very low point in its history, exports almost ceasing and even the local market almost disappearing because of the inroads of cheaper coffee from America. The reciprocity treaty made with the United States in 1875 had been a great benefit to the sugar industry, for it removed the necessity of paying the American tariff, but it was a serious blow to the already waning coffee industry, for it removed the Hawaiian tariff on coffee imports which had protected local producers against foreign competitors, and American shippers began sending in cheap grades to flood this market.

In the 90’s, however, the world market offered higher prices for coffee and this caused a sudden but not well considered expansion of the nearly dormant industry in these Islands.27 Hundreds of thousands of dollars were sunk in the new coffee ventures in many locations, some of

27 Just prior to this, in 1887, W. H. Purvis had introduced the Liberian variety of coffee which produced larger beans of better flavor than the varieties previously cultivated, but it did not find wide favor because of its tendency toward scanty bearing. It was the Guatemalan variety (Coffea arabica) on which this new expansion of planting was based.
which were quite unsuited for the purpose. Jared Smith, writing in 1901, declared that "probably $10,000,000 has been sunk in unprofitable coffee cultivation in these Islands during the past ten years." As a result of this expansion the coffee industry again rose in 1899 to second place, above rice, but held that position only a few years, for by 1905 the pineapple industry had begun to surpass both coffee and rice.

Meanwhile, there had been significant changes taking place in the human side of the industry. Originally begun by foreigners, the production of coffee had passed into the hands largely of Hawaiians for a half century or so, for it proved to be an easy way for them to meet their tax obligations, and those responsible for the industrializing of agriculture here were not much interested in the industry. The boom at the end of the century, however, changed this greatly, for American, German and British operators came back into activity again when there seemed to be a prospect of developing it into something of large economic importance; it is not in Hawaiian temperament to become greatly stimulated by a boom in industry or trade. But the bubble soon burst and the new operators lost interest (as well as most everything else). The industry no longer, however, was in the hands of Hawaiians, but was taken over by Portuguese, operating on a small scale as the Hawaiians had done before them. In a few years they, too, lost heart as coffee prices went down and earnings dwindled, and Japanese began to displace them. Today, almost all coffee planters in Hawaii are Japanese who formerly were sugar plantation laborers, attracted away by the prospect of economic independence in the production of coffee.

The Hawaii Experiment Station, established in 1901 by the U. S. Department of Agriculture, was much more interested in the diversification of agriculture in the Islands than in the advancement of any industry already well established. While coffee production was an old industry, it was not well established, and, quite properly, the new station turned some of its attention in that direction. Its

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28Annual Report of Hawaii Experiment Station, p. 366, 1901.
annual reports for several years had a good deal to say about the ideal conditions in Hawaii and the desirability of expanding and modernizing the industry. It was declared that instead of using only about 5,000 acres there were “half a million acres suitable for coffee cultivation in these Islands—enough land to support 30,000 white families.” Repeatedly it was urged that the United States government levy a tariff against foreign coffee, for it was believed that, with a protection of 2½ to 5 cents per pound, Hawaii and Porto Rico could produce as much as the entire country could consume.

By 1906 this interest seems to have subsided, for no response was in evidence to the invitation to cover a half million acres with coffee to be cultivated by 30,000 white families. Between 1906 and 1918 the Station’s reports scarcely even mention coffee; then, at the latter date a little resumption of interest came to the surface again when the coffee farmers appealed for help in combating a sooty mold disease. Assistance in their problems of pruning, fertilizing and propagation began to be given a little later, after the merger of the Station with the University in 1929 made it possible through the availability of larger support. Now there is a substation in Kona, devoting a large part of its time and attention to coffee problems. By this help the coffee growers have been enabled to reduce production costs through more judicious fertilizing, effective pruning, control of diseases and pests including the rat, and in other ways.

But even these economies will probably not be sufficient to save the industry; it will require some heroic measures to keep it from going on the rocks.

To survive and amount to anything, the coffee industry has five very urgent needs:

1. Relief from present debt burdens.
2. Drastic reduction of land values and taxes.
3. Application of science to production, harvesting and processing practices.
4. Better marketing methods.
5. Organization of producers into cooperatives or corporations.

30Annual Report 1902, p. 313.
31Annual Report 1901, p. 369.
Let us consider each of these five, in turn. The debt situation is practically hopeless. Even federal agents of the New Deal which have been trying to do so much of late toward extricating improvident farmers from debt declare that they see little or no prospect of relief for our coffee growers in Kona. Their debts are so large from long accumulation that neither current nor prospective earnings are adequate to liquidate them, and federal aid is not available because the farmers do not own the land on which they operate. Either the majority of present producers will have to be closed out and the farms taken over by the creditors in settlement of the debts, or the debts will have to be greatly scaled down and some long term plan adopted for the liquidation of the remainder. Of the two alternatives, the latter would seem the more sensible.

Second is the matter of land values. Considered over a long period of years, with short ups and long downs in market prices, coffee in Hawaii has yielded small returns, by no means justifying the usual rental rates. Since taxation is correlated to rental rates, it, also, is higher than the industry can stand. As was necessary in the great farming areas of the mainland a few years ago, a drastic downward revision of land values is in order in the coffee districts of Hawaii.

The third item of need has already been touched upon. The Experiment Station is beginning to do that which ought to have been done long ago—to make production, harvesting, and processing practices as efficient as science can make them, at a minimum of cost. Compared with the sugar and pineapple industries, coffee production is still in a primitive state of development.

The fourth item, marketing, needs reorganization. Most of the coffee produced in Hawaii is sold in “parchment” form, delivered by the farmer to a neighborhood storekeeper in partial payment of a long standing debt for food.

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32The largest single item in the total costs in the coffee industry is the harvesting. It costs more to pick the coffee than to raise it; picking represents about 58 per cent of the total cost of production. It will be impossible to reduce this item materially, so long as present harvesting methods are used, because picking is done by hand and wage rates are much higher in Hawaii than in other coffee producing countries. If all the crop were harvested in one or two pickings by mass methods, or if machine harvesting were possible, the cost could be considerably reduced.
and other supplies purchased by the farmer; the price paid for it is subject to much bargaining, with the advantage usually on the side of the storekeeper, for he is the creditor. Some (perhaps ten per cent of the crop) is "bootlegged": a producer under contract to deliver all his crop to a creditor may seize upon an opportunity to sell part of his coffee secretly to an itinerant agent, for in this way he obtains real cash instead of mere credit on an old account. This bootlegging tends to depress current prices, for the lure of cash money offsets a price cut and most producers are willing to bargain on that basis at prices below market.

There are too many middlemen, each making a living from the coffee as it goes by on the way to market. And, finally, the coffee, although admittedly superior and capable of commanding a relatively high price when sold on its own merits, is sold to general brokers for blending with other and inferior coffees from other parts of the world. If sugar cane and pineapple producers had to sell their harvest in the raw to a neighborhood storekeeper who in turn would sell it to a wholesaler who in turn would sell to a mill with several more middlemen waiting their turn to handle the product, there would be no great sugar and pineapple industries in Hawaii today. No more is coffee able to carry its present millstone and survive.

The fifth item is cooperation. Without it, the small farmer is at the mercy of ravening wolves on all sides. With it, he and his neighbors can reduce their costs both of purchasing supplies and of producing their crops and they can get more nearly the maximum returns possible from available markets for their product. The sugar and pineapple producers have gone even a step further into corporations which represent the pooling of efforts of many individuals as stockholders. Then, with cooperation between the corporations the maximum achievement becomes a reality.

If these five things could be achieved by the coffee industry it could perhaps develop into major proportions among the industries of these Islands, for the slopes on the lee side of our high mountains are better than any other place on earth for the production of coffee. This
is an assertion by many who are in position to know, among them being a federal expert who was recently assigned to Porto Rico to solve their problems and came here first to see what Hawaii's position is in regard to coffee. There are many more thousands of good acres which could be used for this industry, if it had any prospect of success along the five lines suggested above.

It is probable, however, that these five things will not be achieved, and the industry will continue to be a minor feature in our economic structure. Returns from this crop vary greatly because of fluctuations both in market prices and in annual yields. Prices of green coffee since 1900, for example, have varied from $0.105 to $0.272 per pound.

The fluctuations in Hawaii's annual coffee crops is shown in the following table of exports to the mainland:

*Annual Coffee Exports to Mainland*

(1845 to 1935)

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<thead>
<tr>
<th>Year</th>
<th>Pounds</th>
<th>Year</th>
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<tr>
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<td>1867</td>
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<td>1846</td>
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<td>78,373</td>
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<td>28,231</td>
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<td>46,926</td>
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<td>208,428</td>
<td>1872</td>
<td>39,276</td>
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<td>127,963</td>
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<td>311,807</td>
<td>1879</td>
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<td>82,528</td>
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<td>48,966</td>
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<td>93,682</td>
<td>1888</td>
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</table>

33Col. Francis J. Behr.

34Compiled from Thrum's Annual and other sources; these figures do not represent the total crop, for a considerable amount is consumed within the Territory and during the past decade the exports to foreign countries have steadily increased from a few hundred thousand pounds to over 2,500,000 pounds in 1935. The total crop in 1935 was 9,828,140 pounds, according to figures compiled by the U. H. Agricultural Extension Service.
<table>
<thead>
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<td>2,128,968</td>
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</table>


COIR See “Coconut.”

COLLARDS Collards (Brassica oleracea acephala), related to the cabbage, are produced in Hawaii only to a very small extent, occurring occasionally in market gardens.

See also “Truck Crops.”

COPRA See “Coconut.”

CORIANDER This delicate plant (Coriandrum sativum) is produced in Hawaii in small quantities for use in seasoning vegetables and other dishes and sometimes for garnishing. The demand is mostly from the Oriental
peoples here, notwithstanding the fact that the plant is of European origin.

See also "Truck Crops."

CORN Corn (*Zea Mays*), a peculiarly American crop, found its way into the Hawaiian Islands soon after the discovery voyage of Captain Cook. The Hawaiian people, however, did not seem to value it as food and for many years therefore the only place where one would have found it growing was in the gardens of some foreigners. Letters of the early missionaries sometimes mentioned corn as one of the common garden crops,35 and not infrequently the mention was occasioned by wrath at the havoc of insect pests. Yields were often very disappointing, due to the ravages of caterpillars and aphid; the corn leaf-hopper and mosaic disease seem to have come in later.

Production of corn was not limited for long to the home garden, however, for there were some early attempts to make it a field crop for horses and cattle; in 1853, for example, an area of 25 acres was planted to corn on Kauai, with rather poor results, while at about the same time other trials in the cooler uplands of Maui and Hawaii met with better success. It was only in such sections that corn became an important crop, and by the end of the century the total area devoted to it had increased to fully 7,000 acres, the chief centers being the Kula district of Maui and the upper portions of the Parker Ranch on Hawaii.

The maximum planting of corn was in 1919 and 1920 when the total area increased to about 10,000 acres, surpassing rice and becoming the third most extensive field crop in the Islands, surpassed only by sugar cane and pineapples. This was stimulated by the unusually high post-war prices and, of course, was a temporary situation; after the boom burst, prices came down and the acreage diminished very greatly.

The Hawaii Experiment Station began in 1903 to turn its attention to corn as a potential crop for the diversification of Hawaiian agriculture. It was Director Smith’s idea36 that by the introduction of new varieties and better

35See, for example, Miss Damon's "Koamalu" in which many references to garden corn occur in letters.
36See Hawaii Experiment Station Report for 1903, pp. 392-4.
methods of cultivation it might be possible to expand this industry which in the higher areas was already about 50 years old. A few new varieties were given a trial, but other demands on the new station crowded corn off the stage for several years.

It reappeared in 1913, when the Hawaii Station reported an increasing interest in this crop on some of the sugar plantations where experience was showing that plantings in fall and winter would yield from 40 to 60 bushels per acre in the lowlands, and that was enough to more than equalize the cost of the imported product, especially as prices were again on the upswing. They did not figure on the corn leaf-hopper, however, which had gained entrance to the Islands and was becoming a very serious pest. Spraying with insecticides was too expensive and of doubtful efficacy, and parasites introduced in 1917 by the Board of Agriculture and Forestry reduced the pest only to a degree. It still continued to be ruinous in all lowland areas, but affected the higher lands very little.

Mosaic disease, also, had come in and was causing much havoc by dwarfing and stunting the growth and reducing the yield sometimes to nothing.

For a decade or more, beginning in 1917, efforts were made both by the Hawaii Experiment Station (then federal) and the University (then the College of Hawaii) to find a variety which would be resistant to the leaf-hopper and mosaic disease and would do well in the lowland areas. A large number of varieties were brought in from all over the world, but none showed any promise of success except two—a white variety from Guam and a red type from Cuba. Both stations devoted a good deal of effort to improving these and adapting them to Hawaiian needs. The local demand was for a yellow or red corn, but the white Guam prospered best here, so that crossing was resorted to in the hope of developing the perfect corn for Hawaii. Gradually, however, these efforts diminished, and finally were abandoned about 1928. Prof. Henke, who had been the leader in this field, reported in 1928 that "corn has never been grown on the University farm with any degree of success," while Prof.

Krauss complained that yields were much less then than those of ten years earlier. Almost simultaneously, both stations practically abandoned further consideration of corn as a lowland crop.

Notwithstanding this, corn is grown to a limited extent here and there in the lowlands, very sporadically, and sometimes a moderately good crop is harvested. By far the best results, however, are obtained at elevations above 4,000 feet, but the total acreage today is far less than in 1920; a recent survey by the University's Agricultural Extension Service showed only about 1,700 acres in field corn in 1936, most of this on the Parker Ranch and the rest on Maui.

The experience of a century seems to indicate that corn is not a profitable crop for Hawaii and should not be attempted except when market prices are high or when an emergency cuts off normal food and feed shipments from the mainland. At elevations above 4,000 feet it may be grown successfully, provided the rainfall is adequate; in about two years out of five it is not adequate, and the crop fails.

_Sweet corn_, for table use, is of equally difficult culture in the lowland regions near Honolulu. However, a variety recently introduced from Porto Rico has done well during the past two years in experimental plantings at the Hawaii Experiment Station. The plants are vigorous, moderately free from mosaic; of the product the Station's annual report (1936, p. 25) states, "quality good, ears large, kernels sweet."


**COTTON** King Cotton made two noteworthy attempts to establish himself in Hawaii, but without success.

The earliest efforts at growing cotton here were in the

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38There are several species of cotton; the one most commonly grown in Hawaii is _Gossypium barbadense maratima_.

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first years of the nineteenth century, but it was on a very small scale, with nothing of a commercial nature ventured until about the time of the American Civil War. Then, because the normal intercourse with the southern states was interrupted by war operations, the northern states turned to these Islands as a possible source of cotton. An industry flourished for a few years (1863 to 1874), then languished and died when the old trade lines were reopened between the northern and southern states after the War. The maximum exports were in 1866 when a total of 22,289 pounds were shipped to the United States.

Here and there in yards and small volunteer patches some cotton continued to grow, but there was no industry. An effort was made in 1894 to 1898 to revive the industry, but with no immediate results. At the turn of the century, however, the price of cotton began to move upward and a new wave of popular interest in this crop plant began to spread through the newly annexed Territory.

In 1902 the Hawaii Experiment Station reported a widespread desire for information about cotton culture and a considerable demand for seed. The Station imported many varieties for trial, as well as reviving the Sea Island variety that had furnished the basis of the Hawaiian industry during the Civil War years.

The Orient, both Japan and China, was beginning to use large quantities of raw cotton and the buying was chiefly from the United States. People here reasoned that it would be relatively easy for Hawaii to capture as much of the Orient business as could be met by our production capacity, for freight from the southern states to the Orient cost much more than from Hawaii, and our production costs would not be higher and might be lower.

In 1906 some samples of our various kinds of cotton fiber were sent to the U. S. Department of Agriculture for testing. Aside from the variability of the samples, which was not surprising at that stage of the development of the industry, the report came back that in tensile strength, curliness, length of fiber, and amount of lint on the seed the

Hawaiian product showed some remarkable possibilities. The best types seemed to be the Sea Island and the Caravonica, both growing as perennials in Hawaii, although it was not their habit in most other places. It was found that the best localities here for producing cotton were the protected areas on the leeward side of the Islands, from sea level to 700 or 800 feet elevation, where rainfall was moderate and ranged from 20 to 60 inches per year.

By 1909 commercial planting had begun, about 100 acres then being under production and relatively large plans reported to be in the offing.

In 1910 the acreage of cotton was about 500 acres, the largest single planting being a field of 80 acres. One of the early pioneers was the late E. C. Smith, who later became a leader in the honey industry. Leeward Oahu (Kunia, Waipahu, etc.), Makaweli on Kauai and the Kona district of Hawaii were being tried out commercially for this crop. Kona seemed finally to prove itself the best cotton district. In 1911 a Japanese hui had 500 acres, mostly of Caravonica, in Kona.

Commercial shipments of cotton began\(^4^1\) in 1911 and continued for a few years, but only on a small scale, for the industry did not expand beyond the plantings mentioned above. The following tabulation of cotton exports shows the limited extent of this industry:

<table>
<thead>
<tr>
<th>Year</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1911</td>
<td>$2,753</td>
</tr>
<tr>
<td>1912</td>
<td>979</td>
</tr>
<tr>
<td>1913</td>
<td>4,048</td>
</tr>
<tr>
<td>1914</td>
<td>1,333</td>
</tr>
<tr>
<td>1915</td>
<td>764</td>
</tr>
<tr>
<td>1916</td>
<td>none</td>
</tr>
<tr>
<td>1917</td>
<td>1,843</td>
</tr>
</tbody>
</table>

The Experiment Station, meanwhile, was continuing its work on this crop, the 1912 Report of the Director stating that it was receiving more attention than any other crop on their list, doubtless because he saw the potential importance of establishing an additional industry to stabilize the economic structure of Hawaii. In addition to variety tests, the Station was developing a technique for propagating cotton plants from cuttings, for seed propa-

\(^4^1\)It would be more accurate to say resumed, for some shipments had been made in the 1860's, as stated above.
igation was too uncertain in the quantity of yield at harvest. E. C. Smith, a pioneer grower, had discovered that Caravonica cotton could be budded very easily, and that seemed to offer some interesting possibilities. Average yields were about a bale per acre, which was good in comparison with other cotton countries.

Pruning, also, came in for much attention, for cotton was a perennial plant here and had to be pruned to be prevented from sprawling all over and becoming unproductive. Very successful schemes for pruning were evolved.

Insect pests of several kinds were known to attack cotton, no matter what variety was grown. Cut worms, aphids and mealy bugs were always on hand, but the worst of all pests was the pink boll worm, a caterpillar which lived inside the young bolls and destroyed the fiber.

In 1910 and 1911 it was believed by Station authorities that the pink boll worm could be controlled by the simple expedient of pruning the bushes after the harvest and burning the trash, thus destroying most of the caterpillars and cocoons so that the pest would be slow in making its appearance before the next crop came on. When some planters reported that this method was not effective, the Station explained that they must prune an entire field at one time and burn the trash; if one part were cleared first and a few weeks later another part was treated, the first would become infested from the other, and so the pest would be carried along almost in full strength.

A year later, however, the Station authorities announced that the clean culture method of controlling the pink boll worm was not effective, after all. In fact, they showed a great deal of discouragement in the 1913 Report when the Agronomist said, “The pink boll worm continues its ravages, and there is little hope of any cotton industry in Hawaii until some remedy has been found for this pest. The cotton areas in the Islands are growing less instead of greater. The 50-acre field at Makaweli, on Kauai, has been uprooted since no profitable crop has been obtained in three seasons, owing to dry conditions and the boll worm. There remains still on Kauai perhaps 50 acres of cotton, in the Kona region of Hawaii per-
haps 75 acres, in the Kaneohe district of Oahu about 80 acres, and in the Waianae district possibly 30 acres.42

New horticultural quarantine orders issued by the U.S. Department of Agriculture in 1913 included cotton in countries harboring the pink boll worm. This closed the American market to us, leaving only the Orient and any possible demand which could be developed within the Territory.

After 1913, the Hawaii Experiment Station seems to have given no further attention to cotton, but a few growers in Kona persisted, nevertheless, in their efforts to develop the industry. As they were all Japanese, they were not much worried about the closing of the American market, for they could sell in Japan all that they could produce, and at a fairly good price. One group is today growing Caravonica cotton in Kona on a total area of about 100 acres.

On these fields the boll worm seems to be no great problem. Parasites kill many, and the once discarded method of burning all trash after a general pruning seems to be sufficiently effective so that the present Kona growers are able to harvest good crops most every year. One of them remarked to this writer a few years ago that he would plant 500 acres if he could obtain financial assistance.

For the small farmer this crop seems to offer some possibilities, in spite of the admittedly dismal history through which this industry has passed in the last hundred years in Hawaii. There is a considerable market within Hawaii for cotton to be used in stuffing mattresses, pillows and other similar uses. For any surplus above local needs the Orient offers a good market and it seems to be possible to produce a worth while crop, even against certain known obstacles.

It is not a highly remunerative crop. At present prices, probably $50 to $100 per acre would be an average return, provided proper methods are used in production. It probably is not well suited to the corporation method of large scale production, but for the small farmers operating in the lower coastal belt of Kona it might be a

moderately profitable crop. At any rate, it will bear careful consideration before being discarded because of past failures.


COWPEA The cowpea (*Vigna sinensis*) is a native of Asia but has been under cultivation in the Occident for many years. First introduced into Hawaii by the Chinese for use as a food for themselves, it later was tried as a livestock feed and, also, as a soiling crop.

During a period of nearly fifteen years (1917 to 1930) the University Farm made experimental plantings of many varieties of the cowpea, in the effort to establish this crop in Hawaii. The most serious obstacle to this was the extreme susceptibility of the plant to an insect pest known as aphids, or plant louse. To control this insect by the use of sprays is too expensive in proportion to the value of the crop. Test plantings in which the aphids was eliminated, showed excellent results in producing as much as 10 to 12 tons of green fodder per acre in about two months. The plants are succulent and nutritious and much relished by livestock. But for the aphids, the cowpea might be the leading crop for dairymen in Hawaii. Of some 20 varieties tested, the Victor and Brahman proved to be the best for these Islands.

The Chinese use the green pods in the preparation of certain vegetable dishes, in much the same way as green string beans are used (see Haw. Exp. Sta. Bul. 60, p. 35).


CRABGRASS Crabgrass, or kukaipuaa, is a name used for three different species of *Digitaria* which are widely distributed throughout the Territory and have moderately good value for pasturage.


The name properly belongs to *Digitaria pruriens*.  

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13The name properly belongs to *Digitaria pruriens*.  

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CROWFOOT  Crowfoot (Eleusine indica\textsuperscript{44}), also known as goose-grass, has been in the Islands since 1902, is well distributed, and provides good pasturage.


CUCUMBER  Cucumbers (Cucumis sativus) of several types are grown extensively in Hawaii, practically all the local demand for the fresh product being met by our commercial and home gardeners. Pickled cucumbers are imported in considerable quantities.

To protect against the attacks of the melon fly each cucumber, when very small, must be covered by a paper bag, which adds materially to the cost of production. In spite of this and other handicaps a very good quality of cucumber is grown here, and a moderately large industry has developed with over 100 acres devoted to the crop.

A special type is grown for the Oriental trade, the “Oriental preserving melon.” This cucumber is especially prized by the Chinese in the preparation of certain vegetable dishes.

See also “Melons,” and “Truck Crops.”


CUSTARD APPLE  The custard apple (Annona reticulata) is a tropical fruit found only rarely in Hawaii, although it deserves much more attention from our horticulturists. Both in appearance and flavor it is exotic and one must cultivate a liking for it before appreciating its full merit.

Closely related fruits which are similar in appearance but differ markedly in flavor are the cherimoya, sour sop and sweet sop.

DAHLIA  The tuberous roots of certain species of Dahlia, as variabilis, et al., yield levulose, an uncommon and high priced form of sugar. On the mainland there is some commercial interest in the production of this sugar, but in Hawaii no serious effort has been made to develop an industry on this plant. Dahlias of several species grow

\textsuperscript{44}St. John gives Dactyloctenium aegyptium as the name of this grass.