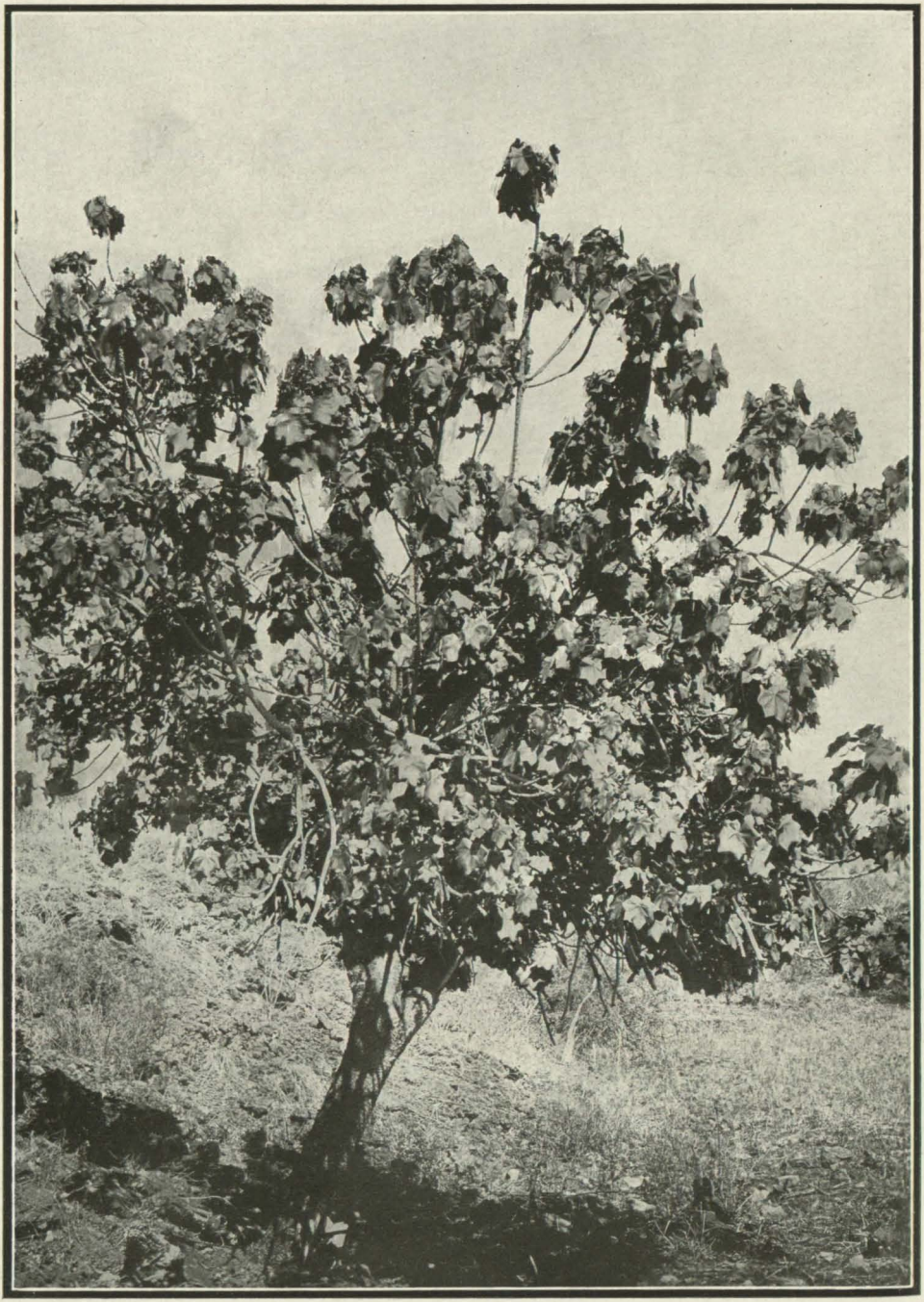
PLATE I. (Frontispiece)



KOKIA ROCKII Lewton
Kokio tree.
Growing on the lava flows of Puuanahulu, Kona, Hawaii; elevation 2500 feet.

BOTANICAL BULLETIN No. 6. JUNE, 1919

Territory of Hawaii
BOARD OF AGRICULTURE AND FORESTRY

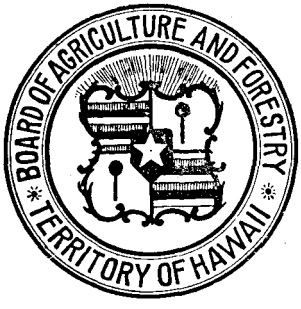
DIVISION OF FORESTRY
C. S. JUDD, *Superintendent*

The Hawaiian Genus Kokia

A RELATIVE OF THE COTTON

BY

JOSEPH F. ROCK
Consulting Botanist



ISSUED JUNE 9, 1919
HONOLULU, HAWAII

LETTER OF TRANSMITTAL

HONOLULU, HAWAII, May 3, 1919.

Board of Commissioners of Agriculture and Forestry,
Honolulu, Hawaii.

GENTLEMEN:

I have the honor to transmit herewith the manuscript of a paper entitled "The Hawaiian Genus *Kokia,* a Relative of the Cotton," by Mr. Joseph F. Rock, *Consulting Botanist of the Division of Forestry* and also *Botanist of the College of Hawaii,* and to recommend that it be published as Botanical Bulletin No. 6 of the Division of Forestry.

The paper treats of the very rare members of this most interesting genus of which one species has already become extinct, and it is hoped that its publication will arouse interest in the preservation and cultivation of these rare species.

Very respectfully,

C. S. JUDD,
Superintendent of Forestry.

Approved:
Board of Commissioners of Agriculture and Forestry,
May 5, 1919.

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ILLUSTRATIONS

THE GENUS *KOKIA* IN THE HAWAIIAN ISLANDS.

In the year 1912 Fredrick L. Lewton* established the genus *Kokia,* based on material furnished him by the writer of a species of a tree belonging to the family *Malvaceae.*

The genus as understood by Lewton consists of three species, viz: *Kokia Rockii,* the type of the genus; *Kokia drynarioides,* and *Kokia lanceolata.*

Kokia Rockii was first discovered by the writer in June, 1909, although the tree was well known to the old natives of the island of Hawaii and particularly to the natives of North Kona, to which locality the species is peculiar. When the species was first found by the writer he thought it to be identical with a closely related species occurring on the dry, west end of Molokai, where a species of that genus was first collected by Nelson, the companion of Captain Cook. The specimens collected at that time were quite fragmentary and were described by the celebrated botanist Berthold Seeman in the genus *Gossypium* under the specific name *drynarioides.*

To Dr. Hillebrand belongs the credit of finding another species, but not so recognized by him, on the eastern end of the island of Oahu. The specimens in existence are extremely meagre and fragmentary. It was listed in his famous work on the "Flora of the Hawaiian Islands" as a variety β of *Gossypium drynarioides* Seem. Prof. Lewton, whom the writer furnished with material of two species, the Hawaii and Molokai species, correctly recognized the species as not belonging to the genus *Gossypium,* but to a new genus "*Kokia,*" closely related to *Gossypium.*

The genus was then only known from Oahu, Molokai and Hawaii.

On April 2, 1919, Mr. Augustus F. Knudsen of Kekaha, Kauai, an ardent naturalist like his father Valdemar Knudsen, from whom Dr. William Hillebrand received all his Kauai botanical material, addressed a letter to the writer, and enclosed some

* Lewton, Frederick L. Kokia. A new genus of Hawaiian Trees. Smithsonian Misc. Coll., Vol. 60, part 5, Oct. 22, 1912.

fragmentary specimens with the request to identify the same. He stated: "It is the only tree of its kind known to me on Kauai." The specimen sent was immediately recognized as belonging to the genus *Kokia*. The enthusiasm of a botanist may be imagined at the finding of such a rare and beautiful species of the genus *Kokia*. The writer immediately sent a wireless stating that he would appear on Kauai by the next boat. The specimen sent by mail was too fragmentary to permit the identification with any of the three known species.

The occurrence of a species of *Kokia* on Kauai confirms the belief that the genus was spread over the whole group and was probably also present on Maui and Lanai and perhaps Niihau and Kahoolawe. The *Kokia* trees have numerous enemies, the worst being cattle, which feed on the succulent leaves and fleshy branches, while the natives stripped off their bark for the sake of a dye which they extracted for the preservation of their fish nets.

The writer, accompanied by Mr. A. F. Knudsen and his brother, Mr. Eric A. Knudsen, immediately on arrival mounted horses in search of the tree. The tree could not be located by anyone not familiar with the country, no matter how detailed a description of the locality might be given. The party climbed the cliffs of Mana, the extreme western end of Kauai, composed of barren volcanic cliffs, the main vegetation of which is composed of the *pili* grass, *Andropogon contortus*. After a ride of several hours, crossing gulch after gulch, the party arrived at the canyon of Koaloha, in which is located the only *Kokia* tree now known from Kauai. It grows in company with the *Kukui, Aleurites moluccana,* whose leaves the *Kokia* greatly resemble, making it very difficult to distinguish the tree from the *Kukui,* especially at a distance.

The Kauai *Kokia*, which is a tree about 30 feet in height, owes its survival to a cliff about 15 feet in height on the edge of which it grows, the trunk and crown inclining over the cliff so that cattle can not reach it.

Mr. Knudsen informed the writer that he saw the identical tree 20 years ago, but that he could not locate it again until he stumbled onto it in a recent cattle drive.

The tree was full of flower buds, none of which had opened,

but one was just about to open. Specimens were collected and the ground was searched for a whole hour in an effort to find mature seeds. Seven seeds were found in all, including a perfectly mature capsule.

Mr. Knudsen states that he has seen the tree loaded with flowers, about 2000 flowers being observed at one time, each individual flower being from seven to nine inches across. The flowers are of a brilliant red, and when the tree is in full bloom it is an object of great beauty.

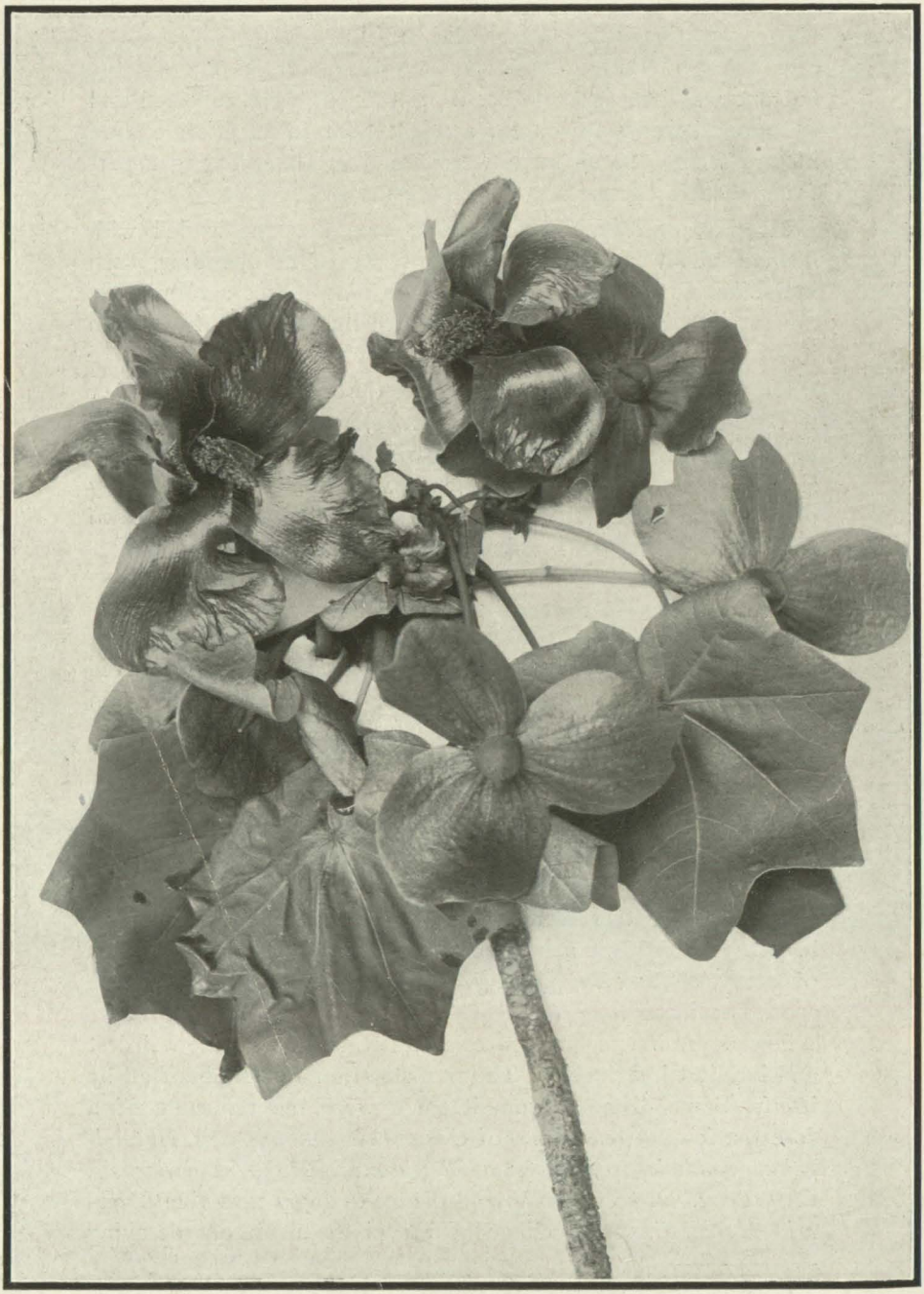
On examination it was found that the tree is related neither to the Molokai nor to the Oahu species, but is exceedingly close to *Kokia Rockii* of Hawaii, from which it differs sufficiently in size of flowers, leaves, pubescence, capsule, etc., to make it worthy of a varietal rank. It is therefore here named as *Kokia Rockii Kauaiensis.*

History of the Old Species.

As has already been stated, *Kokia drynarioides* was discovered by Nelson, the companion of the great circumnavigator Captain Cook, and was described by Seeman* very briefly in his "Flora Vitiensis." Dr. William Hillebrand received specimens of this species from a Mr. R. Meyer, an old resident of Molokai, who discovered three trees which could not be located again by Dr. Hillebrand. In April, 1910, the writer found a single tree of that species in a lonely, dry canyon at the extreme west end of Molokai back of Mahana. It was a small, stunted tree about 10 feet in height. Although it was full of fruit and leaves, it showed signs of decay, so that the passing of a year or so would find the species extinct.

The region in which this rare species grew is one of the weirdest and loneliest imaginable. The tree stood on a rocky bluff all by itself. Some distance from it there were the remnants of a forest, a few scattered trees of *Osmanthus sandwicensis, Nototrichium sandwicense, Xylosma Hillebrandii, Maba sandwicensis, Chrysophyllum polynesicum* and the exceedingly rare vine *Brewceria Menziesii,* which clinged for support to an old decaying

* Seeman in Fl. Vit. 22. 1865.



KOKIA ROCKII Lewton
Kokio.
Flowering branch, flowers bright red of silky texture. About one-third natural size.

KOKIA ROCKII Lewton

Fruiting specimen pinned against trunk of tree.

Maba tree. All the trees were windswept, the crowns extending in oblong outline in one direction. On the ground lay scattered old trunks of once glorious trees, and among them a small dead tree of *Kokia drynarioides,* probably one of the original three trees discovered by R. Meyer, and perhaps the very same from which Nelson collected his fragmentary specimens.

In June, 1915, the writer made another visit to the then only living tree of *Kokia drynarioides.* It was nearly dead, only one or two branches still bearing foliage. There were neither flowers nor fruit on the tree. A search on the ground rewarded the writer with a few seeds, some of which were grown in Honolulu, and one of which was planted on Molokai by Mr. C. C. Conradt, at Pukoo. The rest were forwarded to Mr. David Fairchild, Agricultural Explorer of the Bureau of Plant Industry at Washington, D. C.* Unfortunately, the seedlings grown in Honolulu died on account of the excessive rains during the winter of 1915-16.

While on Molokai in 1918 the writer visited the tree again, but it had died; only the worm-eaten, barkless trunk and branches remained of the last of its race.

There are now two living trees in cultivation on Molokai. One is at the residence of Mr. C. C. Conradt, at Pukoo, where the tree has already flowered and fruited for the first time this spring (1919), four years after planting from seed. The other is at the residential grounds of Mr. Geo. P. Cooke. This latter tree is older than the Pukoo tree, but is now beginning to flower for the first time. It grows at an elevation of about 2000 feet.

A few seeds secured from the Pukoo tree have been planted in Honolulu with the hope of getting it established here. Two seeds were sent to Mr. Fairchild.

Kokia lanceolata Lewton

No living specimens of this species are in existence. While in Europe in 1914, the writer worked on the Hillebrand collection at Dahlem, and through the kindness of Prof. Engler secured many duplicates from Hillebrand's herbarium, among them a

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* In a letter dated April 23, 1919, Mr. Fairchild writes: "You will be interested to know that we have a plant about five feet tall growing vigorously at our garden at Buena Vista, near Miami, Florida."

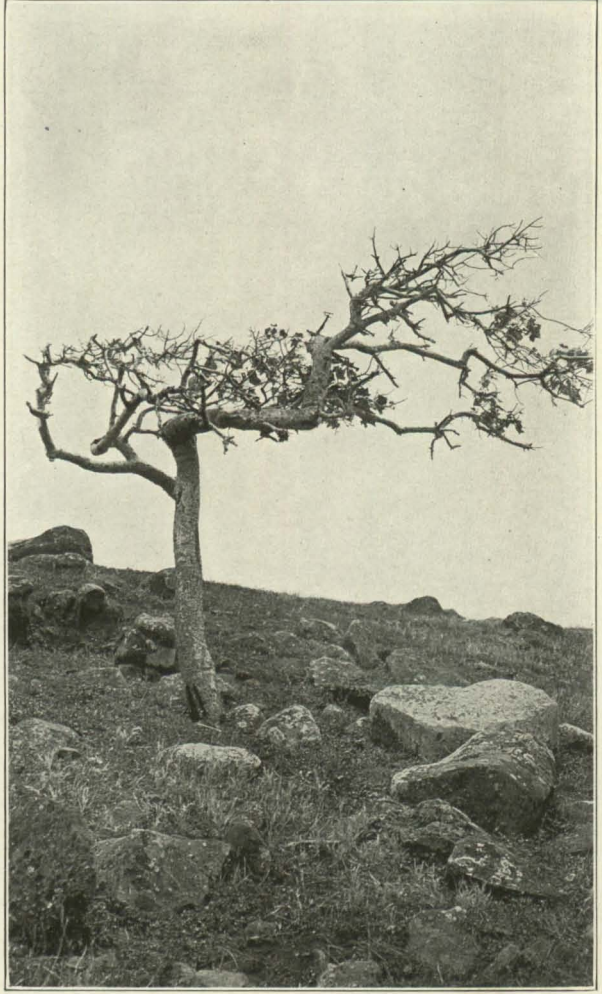


Fig. 1. **KOKIA DRYNARIOIDES** Lewt.

The last of the Molokai Red Cotton as it appeared in 1915. It is now a thing of the past.

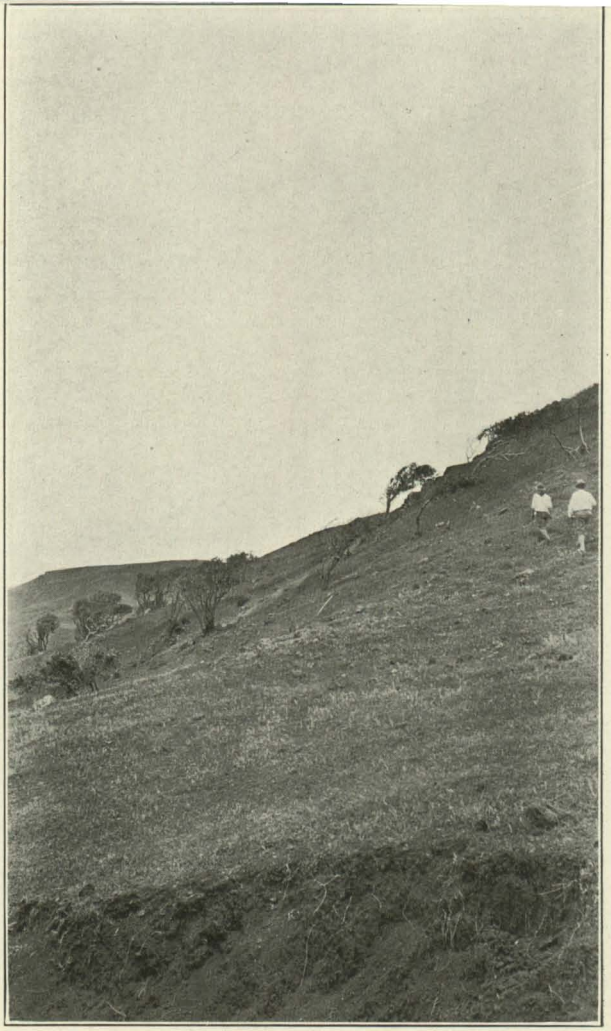


Fig. 2. The region on the west end of Molokai (Mahana) where the Red Cotton grew.

specimen of *Kokia lanceolata*. While the specimen is fragmentary, it is practically the best in existence. It was collected by Hillebrand on the island of Oahu in the valley of Wailupe, at the eastern end of the island. The writer searched Wailupe to find the species again, but without avail.

The leaves of *Kokia lanceolata* differ considerably from those of *Kokia Rockii* and the other species and variety. They are not cordate, but subtruncate at the base and without a sinus. The bracts are narrow, lanceolate. No flowers or fruits are extant of this species.

Kokia Rockii Lewton

A number of trees of this species are still in existence. They grow in the dry district of Puuwaawaa, North Kona, Hawaii, on rough *aa* lava flows.

Mr. Robert A. Young and Mr. Paul Popenoe published an article on "Saving the *Kokio* Tree" in the Journal of Heredity of January, 1916.*

The writer regrets to relate that the protective measures undertaken or supposedly undertaken to save that species were never thoroughly carried out, due to lack of interest on the part of the owners or lessee of the land and the Government in general. It is true that a few walls of lava rock were erected around a couple of trees or so, but so close to the trunk that the inner margin of the wall was not more than a foot distant from the trunk. Since then the walls have fallen down, due to the rummaging of cattle and goats, and the trees are as unprotected as ever.

One tree of this species has been planted on the College of Hawaii grounds, where it has reached the height of six feet, and seems well established. Others are being grown to be planted out at the College arboretum.

Kokia Rockii **Kauaiensis** *Rock* n. var.

An erect tree about 10 m. high, with ascending branches; leaves

* Saving the Kokio Tree. Robert A. Young and the Editor "The Journal of Heredity," Vol. 7, No. 1, January, 1916.

in whorls at the ends of the branches, somewhat fleshy of a deep green color, palmately 10-nerved; the leaves orbicular in outline with broad deltoid obtuse lobes 8 to 10 in number, the intervening sinuses very shallow, the leaf bases overlapping dextrorsely and sinistrorsely, 15 to 25 cm. in diameter, covered with a transparent areolar network and punctate throughout with blackish dots, glabrous above and beneath, but hirsute on both sides, with yellowish brown hair at the place of attachment of petioles; petiole fleshy thickly punctate with black dots, 5 to 8.5 cm. long; flowers single in the axils of the leaves; peduncle stout, 3 to 4 cm. long, bracteolate below the middle; the three bracteoles persistent, sessile broadly ovate sinuate, chartaceous, greenish red in color, more or less prominently nerved, glabrous above, hirsute with scattered yellowish hair beneath, especially along the middle of the bract, 15 cm. long, 13 cm. wide, each bract free to the base, the broad bases overlapping; calyx densely hirsute with yellowish hair, the ring of stiff brownish hair at the base of the calyx tube missing; flowers up to 22 cm. in diameter (teste A. Knudsen), bright red, the petals densely silky pubescent outside with yellow hair; capsule larger than in *Kokia Rockii,* ovoid, 3.75 cm. high, woody, acuminate; seeds broadly angular, larger than in the species, lint longer.

KAUAI: Koaloha Canyon, region of Mana, in company with *Aleurites moluccana, Nototrichium viride, Osmanthus sandwicensis,* etc., flowering and fruiting April 12, 1919, Rock and Knudsen no. 16037, type, in herbarium, College of Hawaii.

This variety differs from the species in the larger leaves and flowers, the larger ovoid-oblong capsule, the densely hirsute calyx and in the absence of the ring of stiff brownish hair at the base of the calyx tube.

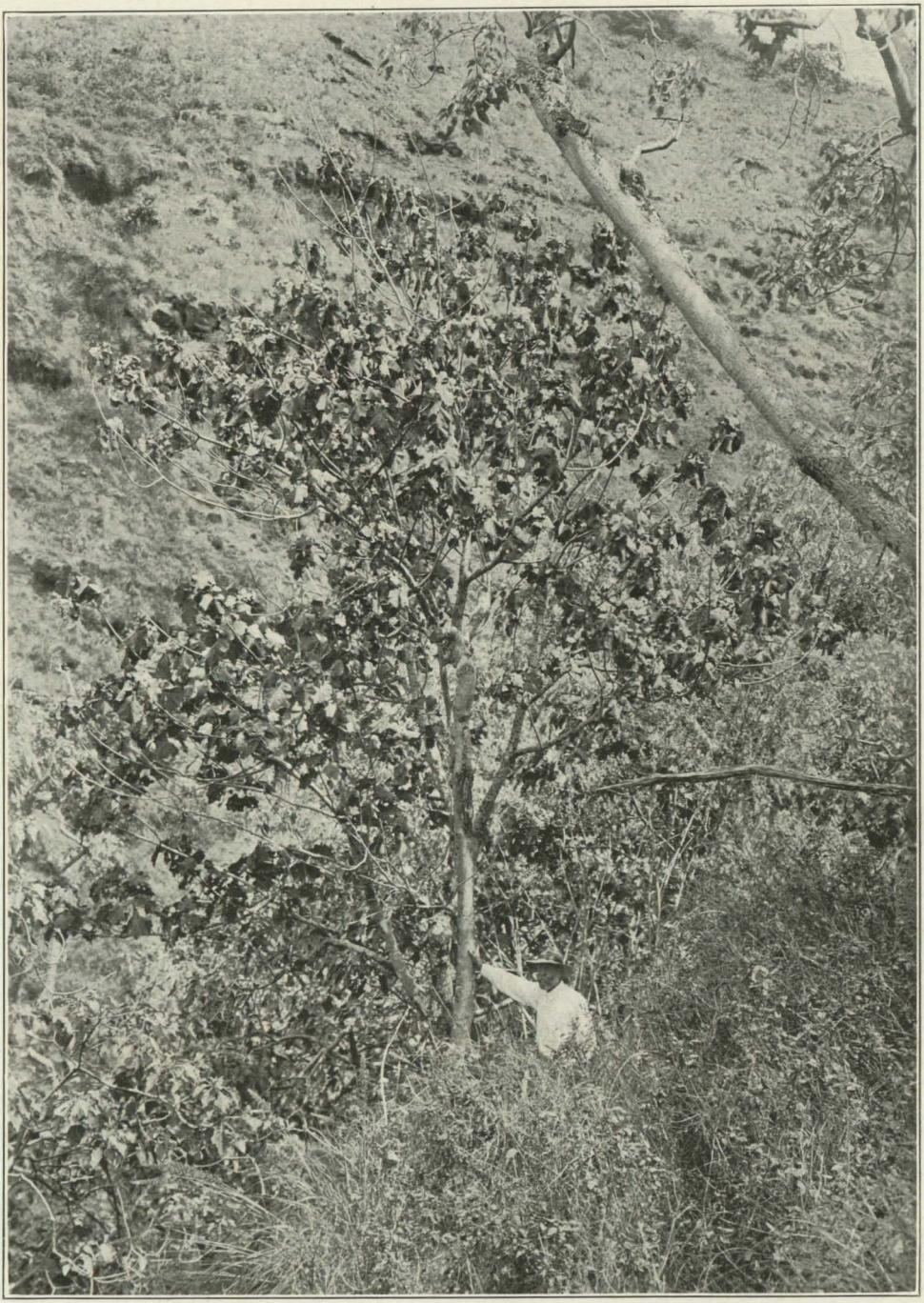
Kokia lanceolata Lewt.

Gossypium drynarioides var. β Hillebr. Flora Haw. Isl. 51. 1888.

Kokia drynarioides lanceolata (Lewt.) Rock Indig. Trees Haw. Isl. 307. 1913.

Leaves much smaller than in the other species, 12.5 cm. wide, 7.5 cm. long, deeply sinuate, the middle lobes 3.75 cm. long, the lower lobes diminishing in size towards the base, the last lobes

KOKIA ROCKII KAUAIENSIS Rock
(Reduced.)



KOKIA ROCKII KAUAIENSIS Rock, with its discoverer, A. F. Knudsen.
The tree, the only one known from Kauai, grows in the dry canyon of Koaloha in the Mana region of Kauai.

widely separated by a broad sinus, (base subtruncate) instead of overlapping as in the other species; petiole 13.75 cm. long; peduncle less than 5 cm. long, bracteate below the middle, the three bracts below the calyx tube, lanceolate, 3.75 cm. long, 12.5 mm. wide, glabrous above, pubescent beneath, several nerved, the veins parallel; calyx tube broadly campanulate, glabrous, shining, but with scattered black warts as in the other species; flower bud, densely hairy with yellowish silky hair outside.

OAHU: Wailupe Valley, Hillebrand in Herbarium Berlin and College of Hawaii Herbarium no. 16041.

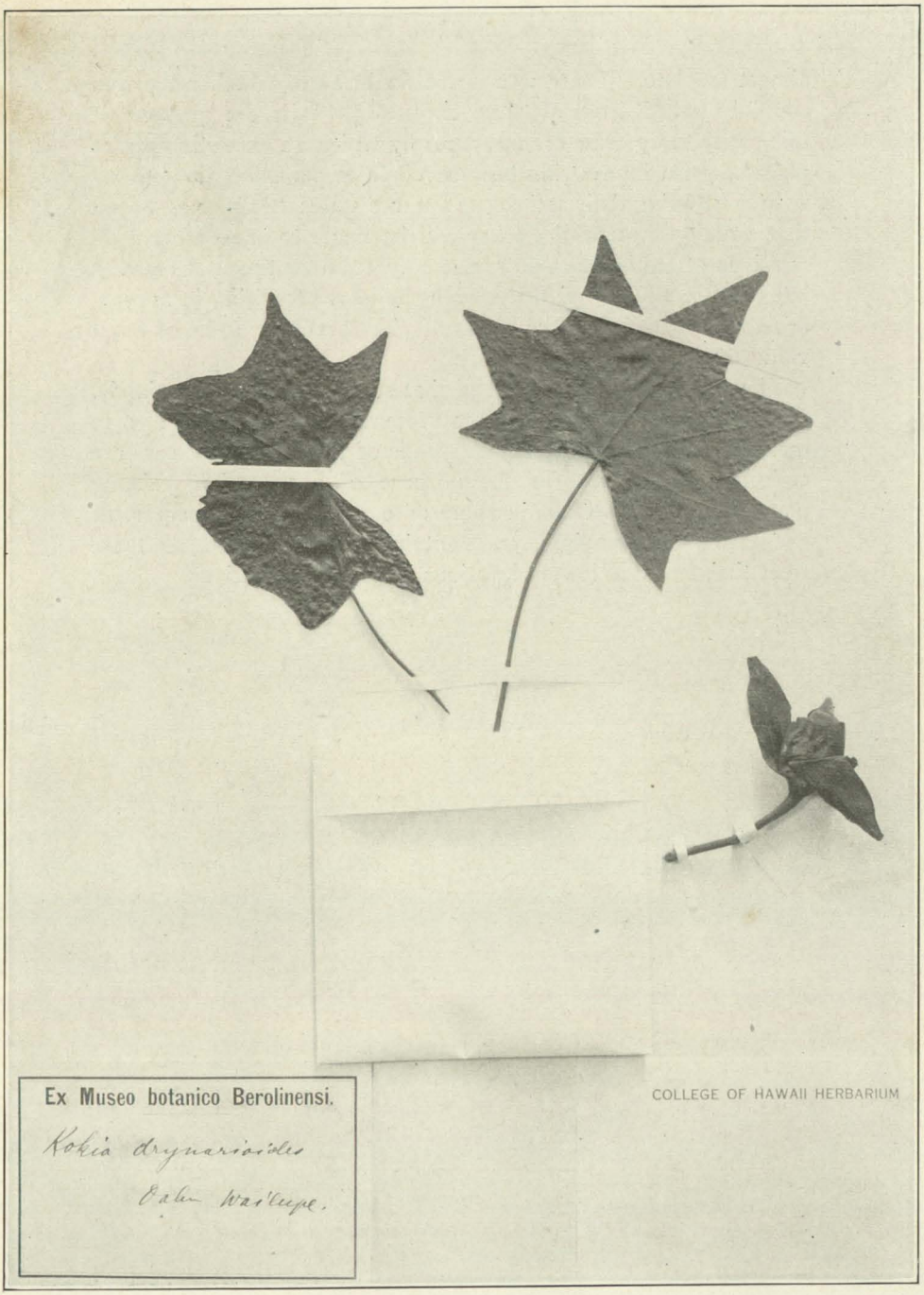
Hillebrand, who collected this rare species, reports it from the eastern end of Oahu on the hills of Makaku and Koko Head. Two trees were seen by him. The specimen in the Berlin Herbarium is labeled as coming from Wailupe Valley. There is no doubt that this interesting species has become extinct, as a careful search of the eastern part of Oahu, including Wailupe Valley, was without success.

Hillebrand himself expressed the fear that this rare tree was doomed to extinction owing to its being accessible to cattle.

CONCLUSION.

It is remarkable that the Hawaiian Islands should have contributed two endemic genera to the not very large family *Malvaceae*. One is the present genus *Kokia*, the other the genus *Hibiscadelphus*.

Of other *Malvaceae* the Islands possess a number of endemic species, the most interesting being the various species of *Hibiscus*. The most noteworthy genus next to *Hibiscadelphus* is the genus *Kokia*, and perhaps more so, since the members of the genus *Kokia* may prove to be of economic importance. In the article on "Saving the *Kokio Tree*," by Young and Popenoe, these authors state: "In itself it appears to have no economic importance; but since the rise of the science of genetics has given breeders such a keen realization of the value of the wild relatives of important cultivated plants, it was possible that this wild cotton should escape consideration as of possible value in hybridization with the low-growing species commonly cultivated. But when the attempt was made to get this tree-cotton it was found to be



KOKIA LANCEOLATA Lewton

almost too late. There was grave doubt as to whether the tree could be saved from absolute extinction. It is the purpose of this paper to describe the measures by which an exceedingly rare plant of great interest has been saved from perishing altogether."

In concluding their article the authors state: "It is to be hoped that equally successful efforts will be made to save other wild relatives of cultivated plants, not only from sentimental reasons, but because any one of them, even the least promising in appearance, may turn out, in the hands of plant breeders, to be of great value to the world's agriculture."

The writer would recommend that steps be taken immediately, not only to protect properly the present living trees, but also to make arrangements whereby the seeds of these valuable trees are collected every year for the purpose of propagation. Young plants should be set out in some of our dry forest reserves, or even back of Honolulu, on Tantalus or Punchbowl, as these trees thrive well at lower elevations in hot, dry situations.