THE OLONA, HAWAII'S UNEXCELLED FIBER-PLANT

The Hawaiian people formerly made use of a considerable range of fiber plants. Some of these were brought by the natives from the South Pacific, others were discovered in the new island home. The paper mulberry, *Broussonettia papyrifera,* is an excellent example of a fiber-plant widespread in the Pacific region. From its copious bast was made the typical *kapa* or bark-cloth of Polynesia. The *olona* (*o-lo-na*) *Touchardia latifolia* Gaud., on the other hand, is wholly confined to the Hawaiian Islands; the genus is monotypic and endemic. The ancient Hawaiians undoubtedly discovered the valuable fiber of this plant at a very early time. They were intimately familiar with the local flora and its economic utilization. The *olona* is mentioned in many of the old songs and legends.

Special interest is attached to the *olona* fiber as it is generally recognized *to be the strongest and most durable fiber in the world.* No other fiber is recorded to exceed it in these two important characteristics. So far as is known to the writer, the present paper is the first and only extant concise and comprehensive account of the *olona.*

The urticaceous genus *Touchardia* was named and described by Charles Gaudichaud-Beaupre, generally known as Gaudichaud. He was botanist for the great French expedition under Freycinet, 1817–1820, and for "La Bonite" during its circumnavigation of the globe, 1836–37. The botany of the latter voyage, in which *Touchardia* is described, was published under the title "*Botanique du Voyage autour du Monde . . . sur la Bonite.*" The salient features of the genus are as follows: Flowers dicœcious, on globose receptacles. Male perigone 5-parted, the segments imbricate in the depressed bud. Stamens 5. Female perigone subcampanulate, 4-lobed or toothed. Ovary straight, almost as long as the perigone. Ovule oblique, ascending. Stigma spathulate, with one face and the margins papillose-ciliate. Achene smooth, compressed, oval, invested by the rather fleshy adherent perigone. Albumen very scanty. Cotyledons ovate, subcordate, conduplicate, and twice as long as the thick radicle.

The single species *latifolia* was named with reference to the large, broad leaves, which form a conspicuous feature of the plant. It is an erect woody shrub, 4–10 ft. high, and sparingly dividing into stout branches. It is from the thick bark of these wand-like erect shoots that the highly prized fiber is obtained. The youngest shoots are hispid, but soon glabrate; the colorless latex is viscid and not plentiful.

The leaves are alternate, large, and with petioles of 3–10 inches. The upper leaves have short petioles, the lower leaves have greatly elongated petioles. The leaf-blade is 9–16 inches long by 5–10 inches broad, ovate, with acute or acuminate apex and rounded base. The margin is obtusely crenate. The blade is chartaceous, dark-green on both faces, and glabrous, excepting a few small hairs along the veins. Unlike many urticaceous plants, the leaves are not armed with stinging hairs. The veins are conspicuously tripli-venate at the base of the leaf, the lateral veins not reaching the middle of the margin; toward the apex it is pinnate, with rectangular areoles. The stipules are large, 2 inches long, axillary, entire and acute. They form one of the easily recognized characters of the plant. The midribs, petioles, stipules, etc., are often dark red.

The flowers are pedicellate and bracteolate. The globose glomerules are generally arranged in repeatedly forking cymes, with one branch suppressed and the middle glomerule sessile. The male cymes are longer (3–5 in.) and broader (5–6 in.) than the female cymes, which are also more crowded. The male glomerules are 6–8 lines in diameter, with a perigone of 1½–2 lines, the lanceolate segments hooded and obtuse or tuberculate below the apex. The stamens are shortly exerted; anthers large, white. The rudiment of the pistil is glabrous. The female glomerules are 4–5 lines in diameter; perigone 1 line diameter, orange-colored upon maturity; style as long as the achene. Like many of the plants of the rain-forest the *olona* is quite variable as to its flowering period; flowering plants may be obtained at any season of the year.

The natural habitat of the *olona* is the lower and middle forest zone, lying on the mountains between elevations of 800–1,800 feet. It is strongly hygrophytic and shade-loving; it never occurs naturally in the open or in dry sections. The favorite habitats are deep, cool, gloomy ravines, or moist slopes that are well screened by forest cover. The *olona* belongs to that ecologic section of the Hawaiian flora that luxuriates in the dense moist shade of the montane forests. The zonal limitations of *olona* are clean-cut; it does not occur on the lowlands, nor at the higher levels. It inhabits all of the larger islands of the archipelago. Representative regions are the rain-forests of Wai-ale-ale, Kauai, Waianae and Koolau Ranges, Oahu; East Molokai; West Maui and Hale-a-ka-la; and the extensive forests on the island of Hawaii. It occurs in little patches or thickets here and there in the forest, but is nowhere abundant. It does not form continuous stands; reproduction is not vegetative but apparently always from seed. In any one spot the collector is not likely to find more than a few score individual plants.

The Hawaiians formerly cultivated the *olona* in a primitive manner. They did not prepare the land or plant seed, but merely searched out good patches of the wild plants. Such a patch was cleared of any obstructing vegetation, not disturbing, however, the large trees which shaded the plants. If the *olona* plants were too crowded they were thinned out. The old plants were pruned so as to give a number of young, straight shoots.

At irregular intervals, as convenience or necessity dictated, the grove was visited and the crop harvested. This process consisted in cutting all the long, straight shoots that had reached a diameter of about one inch. The bark of such shoots was rich in bast fibers, and these were of maximum length. Six feet was an average length. The bark was carefully stripped from the wands, in one or more pieces, packed into rolls or bundles, and carried down to the settlements on the lowlands, where the final operations were performed.

A suitable situation was found along a stream or irrigation ditch. The bundles of bark were opened and spread out in the shallow running water, where they were allowed to partially macerate. This required several days; then the long strips were removed from the water and the remaining pulpy matter was scraped from them while still wet. The scraping was performed on a long, narrow, hardwood board, specially devised for this purpose and known as "*la-au kahi olona.*" The scraper was made of pearl shell (*Margaritifera fimbriate*) or turtle-shell plate (*Chelone mydas*), and was called "*uhi kahi olona kau honu.*" The prepared fiber was carefully dried and rolled into cordage of various sizes.

In ancient Hawaii the *olona* was venerated as a sort of deity or lesser god. Before spinning the fibers the natives made libations, and offered sacrifices of hogs, fowls, etc. The following excerpt of an old chant—the *mele* of Kawelo—vividly describes the preparation of the *olona* fish-net:

I, as chief, willingly
Cast my net of *olona;*
The *olona* springs up, it grows,
It branches and is cut down.
(The paddles of the chief beat the sea.)
Stripped off is the bark of the *olona,*
Peeled is the bark of the yellow *moki.*
The fire exhales a sweet odor;
The sacrifice is ready.
The bark is peeled, the board is made ready,
The *olona* is carded
And laid on the board.
White is the cord.
The cord is twisted on the thigh,
Finished is the net!
Cast it into the sea,
Into the Sea of Papa; let him fall,
Let him fall, that I may strangle the neck
Of Uhumakaikii.

Uhumakaikii was a legendary sea-monster, who could raise great waves and capsize canoes.

Formerly every chief had in the mountains one or more plantations of *olona,* which were tended by his dependents and which supplied him with sufficient quantities of this valuable product. Taxes were not infrequently paid with *olona,* as the fiber was nowhere so abundant as to depreciate its exchange value.

Among the Hawaiians it was put to a great

variety of uses. All fishing lines and nets of the best quality were invariably made of *olona,* because of its high resistance to the action of salt water. *Olona* lines and nets which have been in more or less constant use for over a century are almost as good as new, and are handed down from generation to generation as precious objects. Most of the natives are very unwilling to part with any of their fishing gear that is made of olona. The very serviceable carrying-nets, *koko,* in which the wooden calabashes and other objects were borne, were commonly made of *olona* fiber. *Olona* was not used for making the bark-cloth or *kapa* itself. but threads and cords of *olona* were used for sewing the *kapa.* A stout cord of *olona* was usually attached to the wooden war-clubs and dagger-like swords, for suspending the weapon from the wrist. This prevented the loss of the weapon during the fray. For fastening the stone adz, *oo,* to its wooden handle, *olona* was always the preferred fiber.

It was used for the very fine and pliable netting which served as a groundwork for the feathers, in the construction of the splendid garments and insignia of the ancient royalty and *alii.* The brilliant scarlet and yellow feathers were skillfully woven by the women upon the imperishable framework of *olona.*

Mr. William Weinrich, manager of the Hawaiian Sisal Company's extensive plantation, has made an exhaustive study of fibers in the Hawaiian Islands, and has kindly prepared for the writer the following statement concerning *olona:*

> This fiber not only partakes of all the best characteristics of this genus, but is superior to any of its members, producing the best of all fibers known at the present time. The three dominant features are
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> First—the great tensile strength. I estimate that the strength of *olona* is about three times the strength of commercial Manila. The statement is made that *olona* is about eight times as strong as the hemp, *Cannabis sativa.* So far as I can gather, this great strength is due to the unusual length of the cell in proportion to its width.
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> Second—its great resistance to deterioration in salt water. I once examined a ball of *olona* fish-line, the Hawaiian owner of which stated that it had been in their family, and in constant use, for over fifty years. At the time I saw it, the fiber was in an excellent state of preservation.
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> Third—its pliability, and thus its adaptability for spinning by hand. Fishing lines and nets made from this fiber by expert Hawaiians present an appearance of so uniform a caliber and twist that it would lead one to believe that the fiber had been made by the most intricate machinery.
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> It was the writer's pleasure, some years ago, to send samples of the *olona* fiber to the manufacturers in the East. To my surprise, the fiber was found to be absolutely unknown in that market.
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> A fiber with these characteristics should be exploited to the fullest measure. The extraction of this fiber is not a difficult process. In the history of Hawaii we find references to this fiber as having been grown on a large scale as a source of revenue; but, like many other things Hawaiian, its usefulness has been lost sight of during the progress of civilization.
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> The key to the situation lies in transforming this plant from its wild state to a cultural form. When this is done, the world will be in possession of a new fiber, having a greater tensile strength, weight for weight, than any other fiber known.

Vaughan MacCaughey
College of Hawaii,
Honolulu

THE BARBADOS-ANTIGUA EXPEDITION FROM THE STATE UNIVERSITY OF IOWA

The Barbados-Antigua Expedition from the State University of Iowa returned to New York on August 1, with all its members in good health and without mishap of any kind.

There were nineteen persons in the party, nearly all of them instructors or graduate students from the State University of Iowa. Their object was not only to secure collections in marine zoology, entomology and geology from a region in which little work had hitherto been done; but also to study the living forms in and around the islands visited and thus supplement the future more intensive work based on the collections secured.

In both Barbados and Antigua the colonial authorities provided excellent quarters for the party and adequate laboratory facilities in government buildings, and both officials and