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Coconut[1]

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COCONUT

LATIN	*Cocos nucifera* L.
SPANISH	Coco
FRENCH	Coco
GERMAN	Kokosnuss
SWEDISH	Kokosnöt
ARABIC	Jauz Al-Hind
DUTCH	Kokosnoot
ITALIAN	Cocco
PORTUGUESE	Coco
RUSSIAN	Kokós
JAPANESE	Kokonatto
CHINESE	Yeh Tzu

The coconut palm is an alluring symbol of the tropics. Its mention conjures up the image of a picturesque tropical isle—a curving beach lined with tall, stately palm trees leaning gracefully toward the sea. This plant is one of nature's most useful gifts to man, indispensable in the daily existence of millions of the inhabitants of the tropics, where the palm is a primary source of food, drink and shelter.

Every part of the coconut is utilized for some human need: its white nutmeat may be eaten raw, or shredded and dried, in which form it is known as desiccated coconut. The dried meat of the kernel is called copra, and when crushed is the source of coconut oil; its husk yields short, coarse, elastic fibers known as coir, which is widely used to make rope, cables, upholstery and coarse textiles; its large leaves, when interwoven, provide an excellent thatch roofing material for houses and may be fasioned into hats, curtains and baskets; the midribs of the leaves are used for fencing, brooms, canes, pins and needles; thin strips of the fronds are woven into clothing. The hard, fine-grained coconut shell is a useful domestic utensil—half a shell makes a good cup, while carved shells can become spoons, buttons, ashtrays, saucers or teapots. An excellent charcoal is produced from the shells, employed not only as a cooking fuel but also in the production of gas masks and air filters. A sugary sap known as *toddy* is obtained by cutting the unopened inflorescences to extract a sweet juice which may be consumed fresh, or fermented and distilled to make a strong liquor. The outer part of the trunk of the coconut palm furnishes a construction lumber for houses and furniture, which has an attractive grain and dark color. The swollen base of the trunk, when hollowed, can be turned into a food storage container. At the top of the tree, the tender terminal bud (the palm heart) can be used in salads. One could live almost endlessly on the coconut's products.

The coconut was not known to classical writers. It is first mentioned in 545 A.D. by Cosmos Indicopleustes, an Egyptian monk who visited western India and Ceylon. In his *Topographia Christiana*, Cosmos described it as the "great nut of India."

A remarkable Buddhist temple called Boroboedoer (Fig. 1) was built of volcanic lava on a hillside in central Java about 900 A.D. Among the ruins of this time-worn shrine there are numerous, splendid bas-relief carvings, several of which depict

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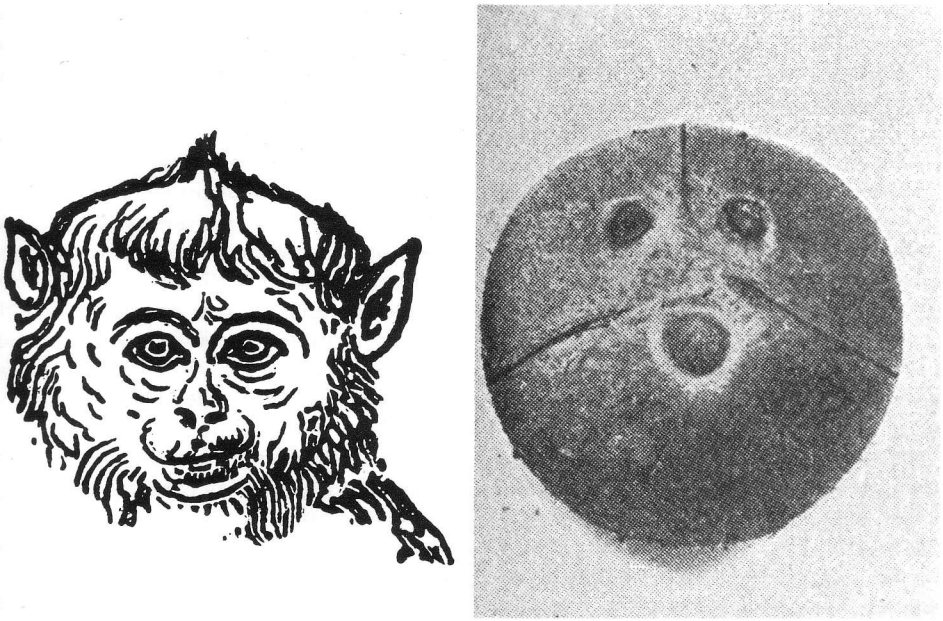
1. Ancient Indonesian sculpture depicting coconuts. Among the ruins of a Buddhist temple called Boroboedoer on a hillside in central Java, dating from about A.D. 900. Credits: *COCOS NUCIFERA*. F. W. T. Hunger. Amsterdam: Scheltema & Holkema's Boekhandel, 1920.



2. The origin of the word "coconut." Sixteenth-century Spanish and Portuguese explorers noticed that the three scars on the base of the shell resembled a monkey's face—two of the germinating holes representing the eyes, the third the nose. So they called the nut "coco," which was the Spanish slang word for "monkey face." Credits: Left, *De Kokospalm of Klapperboom.* L. Th. Maijer. Batavia, Java, 1917; Right, *La Noix de Coco.* Octave-J.-A. Collet. Paris, 1913.

the coconut palm. This is undoubtedly one of the oldest known illustrative portrayals of the coconut. In 1280 Marco Polo described coconut growing in Sumatra, as well as in Madras and Malabar in India, calling it *nux indica*, the Indian nut.

The generic name "Cocos" and the popular name "coconut" apparently are derived from the Spanish word "coco" meaning "monkey face." Sixteenth-century Spanish and Portuguese explorers gave this name to the coconut because the three scars or markings on the base of the shell resemble a monkey's face—two of the germinating holes representing the eyes, the third the nose (Fig. 2). By the end of the sixteenth century the word "coconut" became established in the English language.

Although coconut palms tend to lean away from each other in order to get more sunlight when growing close together, they generally grow straight. Those near the shore lean toward the ocean because in that direction there are no other palms to shade them. Atop the unbranching trunk is a radiating crown of thirty or more arching, featherlike leaves measuring up to twenty feet in length. New leaves emerge as spearlike structures from the top-most point of the trunk and slowly unfold and open to take their place in the crown. A normal palm can produce a new leaf every month. After two and one-half to three years the leaf dies and detaches from the tree, leaving behind a distinctive ridged scar which gives the trunk its rough surface. The tough, fibrous, but pliable trunk is capable of bending and is very resistant to strong winds. The coconut is a single-stemmed tree; the tall varieties may reach a height of eighty feet or more.

A thick growth of thousands of string-like roots spreads horizontally twenty to

thirty feet from the trunk to cover an area greater than the diameter of the crown. Although it has no tap root, the small roots and rootlets are so solidly anchored in the soil that they are seldom uprooted, even during hurricanes. Without such a strong root system, the coconut palm would not be able to lean and grow in such an inclined manner in windy and seaside locations, where it usually leans into the prevailing wind.

At maturity, roughly six to twelve years in tall varieties, the tree begins to produce green inflorescence buds in the leaf base of each new leaf. The developing inflorescence on its first appearance is two to three feet long, enveloped in a sheath called the spathe. As the bud swells it bursts the sheath, revealing the inflorescence. The flowers are pale and straw-colored. The coconut palm is monoecious, producing both male and female flowers on the same inflorescence. The smaller male flowers are produced on the end of the inflorescence, away from the trunk. The inflorescence can be either self- or cross-pollinated. The tall varieties are nearly always cross-pollinated because the female flowers mature first and are no longer receptive when the male flowers shed their pollen. Although many female flowers are pollinated and set fruit, more than fifty per cent fall during the first two months, leaving a cluster of young coconuts to develop.

After 120 days, the shell becomes filled with a clear, sweet, refreshing liquid called "coconut water," rich in sugar, minerals and vitamins. Coconut water is a refreshing drink, popular in producing areas as well as with tourists in the tropics, who sip it directly from the nut through a straw.

As the fruit ripens, this watery juice thickens. After 160 days the nut attains its full size, and the meat (endosperm) begins to form around the inside of the shell as a thin, white, jellylike layer. The shell begins to harden when the nut is about 220 days old, and full maturity is reached at eleven to twelve months when most of the coconut liquid has solidified into nut meat, leaving an air space within the nut. Shaking the coconut to slosh the liquid is a test of its maturity. The average ripe fruit is ovoid, about eight to fifteen inches long, six to eight inches in diameter and weighs around seven to eight pounds. A smooth outside skin covers the thick, fibrous husk. The following figures indicate the approximate percentages of the components of the whole, ripe coconut: shell 12 per cent; husk 35 per cent; meat 28 per cent; and water 25 per cent.

Cocos nucifera is the Latin name or binomial for the coconut. At one time scientists recognized as many as sixty other species under the genus *Cocos*, but it is now generally accepted that the coconut palm stands by itself and is monotypic—meaning that within the genus *Cocos* only one species, *nucifera*, is recognized. Consequently, every coconut palm in the world is taxonomically the same species, which probably makes it the most abundant single food tree in existence. Since a number of other palms were once classified as very closely related to the coconut, a plethora of scientific and popular names has confused its history.

Two major classes of coconuts are typically recognized on the basis of stature: tall and dwarf. Most commonly planted for commercial purposes are the tall varieties, which are slow to mature and first flower six to ten years after planting. They produce medium- to large-size nuts and have a productive life of sixty to seventy years. Dwarf varieties probably originated as mutations of tall types. They grow to a height of twenty-five to thirty feet and begin to flower after three years, when only about three feet tall. Their productive life, however, is only about thirty years. Although more difficult to grow, the dwarf varieties are valued because they bear early and are resistant to lethal yellowing disease.

As a result of the world-wide distribu-

tion of the coconut in tropical areas a considerable number of named varieties—over eighty, including tall and dwarf—have been described. For the most part, each major coconut-growing region has its own dominant tall variety: for example, Ceylon Tall, Indian Tall, Jamaica Tall, Malayan Tall, and Java Tall. The San Ramon variety in the Philippines produces especially large nuts, while the Macapuno is a tall type, the nuts of which have a jellylike flesh considered a delicacy, which can be eaten with a spoon. The San Blas from Central America has an unusually high yield of coconut milk. There are also many dwarf varieties: the best known is the Malayan Dwarf. Others include the Dwarf Green and Dwarf Orange from India.

The principal coconut-growing regions of the world are located geographically within about twenty-two degrees north and south of the Equator—roughly as far north as Hawaii and as far south as Madagascar. Its native habitat lies in the humid tropics where it is frequently a pioneer plant on ocean beaches. As a plant capable of "escaping" from cultivation and growing spontaneously, it may be one of the first water-borne plants to arrive and grow on newly elevated land or reefs.

Growing naturally along the beach in a narrow band, often only a few feet wide, the coconut habitually borders an island's vegetation. The outermost trees usually lean toward the sea, seeking sun and wind. Away from this coastal fringe the coconut cannot compete successfully with inland vegetation without human assistance.

As it grows so near the ocean, the coconut may give the impression that it thrives on brackish or salt water. Apart from being able to withstand occasional brief salt water flooding, it needs a regular supply of fresh water to survive—which it derives from a lens of fresh water, which literally floats above the denser salt water, present in the soil under the beach. Originating from inland rainfall, this layer of fresh water furnishes the coconut palm with some of its nutrients, since the sandy beach soils are infertile.

Natural dispersal of the coconut palm takes place when ripe nuts drop into the sea from leaning palms, float on ocean currents, and are deposited in new sites. Considerable distances may be traversed, for a ripe coconut can float for three to four months in salt water and still germinate. Cast onto the beach by waves, the palm is able to establish itself and then expand its range along the shore.

Scientists are generally in agreement with respect to the character of the native habitat of the coconut, but not on the particular geographic location where the palm originated. Its exact origin is lost in antiquity because of its wide natural distribution. Theories about the origin of the coconut can be divided conveniently into New World and Old World centers. A New World origin is supported by the historical fact that stands of coconut palms were found on the Pacific Coast of Panama by the first Spanish explorers and by taxonomic affinities between the coconut and various South American palms. Assuming a New World origin, it has been argued that coconuts floated across the Pacific Ocean and thence to the Asian mainland where they spread westward to India and beyond. Opponents of this theory point out that recent plant research casts doubt on the theory of New World origin, and that coconuts were not being used by the natives of Panama when the Spanish arrived in the early sixteenth century. It is not disputed that the stands of coconut palms existed in Panama in pre-Colombian times. But had the coconuts been there before they appeared in Southeast Asia, the inhabitants would undoubtedly have been using coconut products at least as much as they were exploited in the Old World.

A much more plausible theory is that the coconut originated in the Old World, probably somewhere in the western Pacific

or eastern Indian Ocean. Supporting biological evidence consists of fossilized coconuts found on North Island, New Zealand, dating from the late Tertiary period. In addition, the great number of parasites specific to the coconut which exist in Southeast Asia would seem to indicate that area was their original home. The longer a plant grows in a given area the greater the chances are that it might acquire natural enemies. Cultural and historical evidence is likewise convincing. The occurrence of the coconut in India dates back three thousand years. In the Indo-Pacific region there are countless names for the coconut and its products, deeply imbedded in the native folklore.

If the coconut originated in the Indo-Pacific region, dispersal both east and west can be postulated. Doubtless, many of the Pacific islands received the coconut through human agency, for it was a custom of Polynesian voyagers to carry nuts with them for food and drink and to plant them on new islands. Study of ocean currents indicates that coconuts could have floated from the South Sea Islands towards South America and that the Pacific Coast of Panama would have been a logical place for them to become established.

Westward dispersal is evidenced by the many uninhabited islands in the Indian Ocean which already had wild stands of coconut palms when first visited by sixteenth and seventeenth century explorers. The coconut had reached East Africa prior to Vasco da Gama's visit in 1498, for he found it in Mozambique, where it may have been introduced by Arab spice traders. It is generally agreed that the coconut was not to be found in the Atlantic Ocean basin until the Portuguese brought it there after 1500, when they introduced the palm to West Africa and Brazil. In the early sixteenth century, the Spanish carried it to the Caribbean. Through human efforts, the coconut was rapidly disseminated throughout the Caribbean and South America wherever the habitat was suitable, since its products were so highly appreciated. Thus, by means of flotation and later through human assistance, the coconut extended its range until its distribution was pantropical.

Today the coconut is the most widely cultivated of all palms, grown in more than eighty countries in the tropics. It can be found in most of the islands and coasts of the tropical realm and with some minor extensions into the subtropics, as in the southern tip of Florida. Although some coconuts were growing in Florida in the middle of the nineteenth century, plantings of the palm were given an unexpected boost on January 9, 1878, when the sailing vessel *Providencia*, fully-laden with coconuts from the South Pacific, was shipwrecked on a beach near Lake Worth. By 1900 more than 300,000 coconuts were growing in Florida, propagated mostly from coconuts imported from Trinidad, but supplemented by coconuts salvaged from the wreckage of the *Providencia*.

World production figures provide a picture of where coconuts are most important as a commercial crop. The table below shows that the Indo-Pacific region accounts for about eighty per cent of the world's coconuts. During the past few years, Indonesia and the Philippines have been the leading world coconut producers. Mozambique is the largest producer in Africa, while Mexico is foremost in Latin America.

COCONUT PRODUCTION 1983
(metric tons)

Indonesia	11,100,000
Philippines	9,200,000
India	3,900,000
Sri Lanka	2,300,000
Malaysia	1,200,000
All Others	7,190,000
World	34,890,000

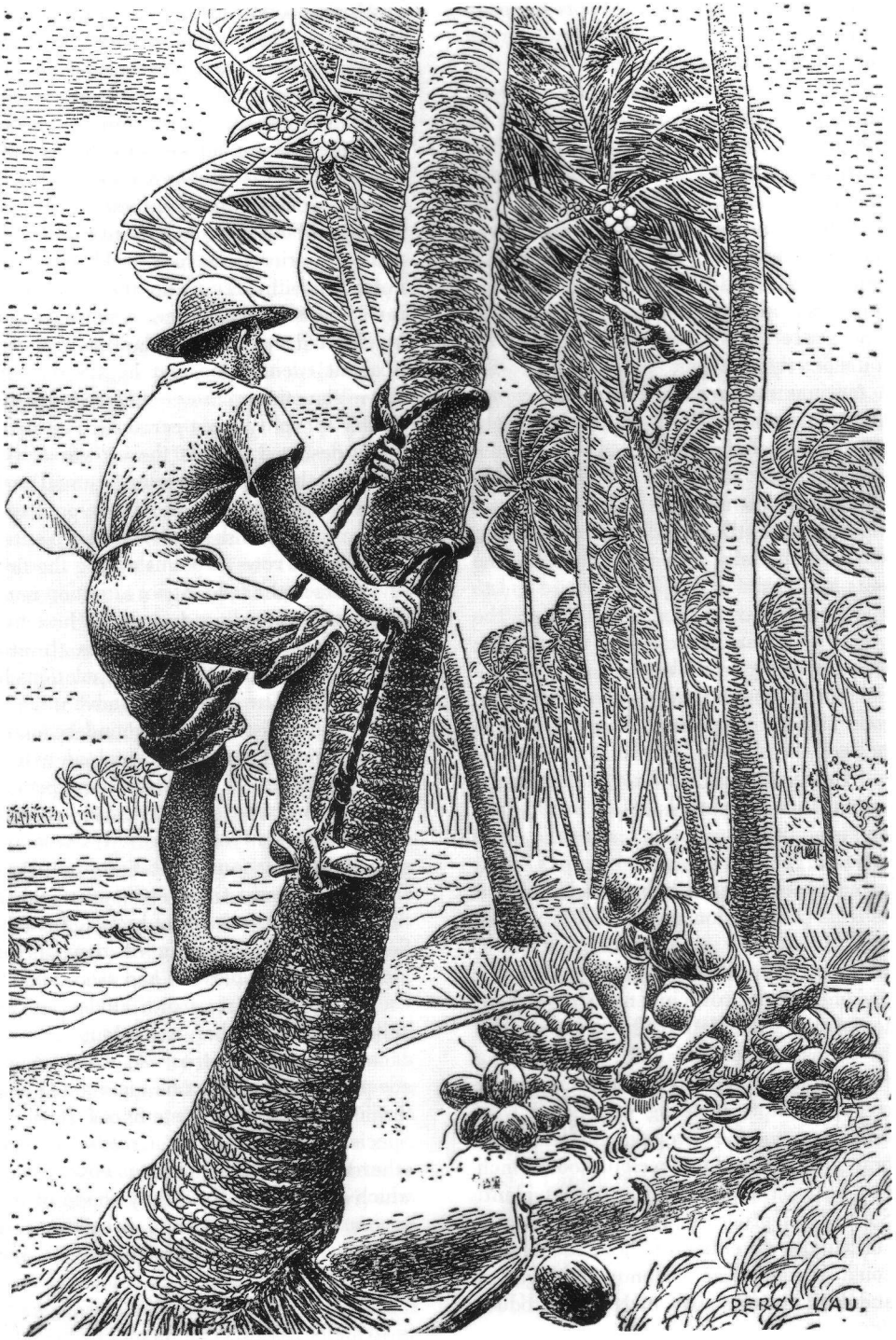
SOURCE: *FAO Production Yearbook 1983.*

The coconut is propagated only by seed. Unlike the date and some other palms, the coconut does not produce offshoots at the base of the trunk. Thus asexual or vegetative propagation is extremely difficult at the present time. Each nut normally contains a single embryo. Germination is slow: about four months are required for the leaf shoot to emerge from the husk. During germination, part of the embryo enlarges within the shell to form the coconut "apple," which persists until root emergence. Fresh nuts may be planted immediately after harvesting, or stored for a few months in a cool, dry, well-ventilated enclosure. Under plantation conditions, the seed nuts are collected from parent trees exhibiting such desirable characteristics as high nut production, vigorous growth and disease resistance. Sown in specially prepared seedbeds, the nuts are buried in deep, rich, loose soil to about two thirds of their depth. When the young plants are six to twelve months old, they are either transplanted directly to the field, or to a nursery for two to three years more before being set out in final field position.

Since cross-pollination is common in the coconut, consistent results of seed selection are not assured. Because of the great advantage of vegetative propagation, extensive research is being carried out on asexual propagation techniques. One avenue of research involves tissue culture, whereby plant tissue containing actively dividing cells is grown in a nutrient medium to develop a plantlet which can eventually be transplanted into soil. Encouraging results have been reported. Another research effort is being conducted with reference to the propagation of floral branches, induced to develop shoots which can be separated from the parent plant. Successful progress toward large-scale cultivation via either of these techniques could revolutionize coconut propagation and lead to markedly increased production.

Most coconuts are grown on small holdings in Southeast Asia. To establish new plantations land must be cleared, since the coconut cannot compete successfully with other vegetation. Sites with good soil drainage and annual well-distributed rainfall of 40 to 120 inches are preferable. A mature coconut palm produces on the average about fifty to seventy nuts per year. Superior trees may yield over 100 nuts, while the record in the Philippines is 470 nuts from one tree. A normal spacing for tall varieties in plantation groves is about twenty-nine feet by twenty-nine feet—sometimes closer—to give a density of fifty to eighty trees per acre. The spacing is designed so that the crowns of the mature palms do not overlap. Annual cash crops such as cassava, sweet potatoes, peanuts, corn or soybeans can be planted between the rows of palms during the first few years in the field. Strict attention must be given to weeding during the first five or six years. Coconut plantations are also utilized as pastures by local populations in some areas. The principal disadvantage of cattle-grazing is that the ground becomes packed around the trees to such an extent that soil aeration is seriously impeded. Furthermore, the livestock may trample and damage the young trees. If cattle are grazed on a coconut plantation, the palms should be at least six to eight years old so that their leaves are out of browsing reach. Sometimes intercropping of bananas or pineapples is employed, and occasionally coconut palms are grown under mixed cultivation with other tree crops such as cacao, cashew or citrus—in which event adequate spacing must be maintained and fertilizer applied to sustain soil fertility. Species of *Indigofera*, *Crotalaria* and other tall-growing leguminous cover crops which can endure the heavy shade of the coconut palms are useful in preventing erosion, controlling weed growth and improving soils.

Multiple use of the land under coconuts is virtually essential for small holders who


PERCY LAU.

need to generate some income and provide foodstuffs for the first eight to ten years before coconut production begins in quantity. On large estates, catch (or supplementary) crops are also utilized to generate income during the early years.

Harvesting coconuts is carried out in different ways, depending upon the size of the grove and the products desired. The simplest method is to wait until the nuts fall to the ground and then gather them up. Such is the practice in plantings where the crop is not highly commercialized and the nuts are collected for direct consumption. On commercial plantations, nuts are usually gathered every two months to reduce labor costs. For copra production, which requires fully ripe nuts, free-fall harvesting assures maturity. The disadvantages of this method are that nuts are frequently lost where there is a thick cover crop under the trees and that impact damage to the nuts may occur.

Nuts for copra production may be picked when twelve months old. Picking on low trees is done with a knife or with a long bamboo pole about sixteen feet long, with a curved knife attached to its end. Ripe nuts are selectively cut from the trees and collected from the ground immediately. The dwarf varieties are, of course, the easiest to harvest.

In countries such as India where coir fiber from the husk is also a key product, nuts are picked at about eleven months, when the fiber is of highest quality.

When tall varieties grow to a height beyond the reach of a cutting pole, the trees must be climbed to harvest nuts—an arduous and dangerous undertaking (Fig. 3). A number of climbing methods have been developed, but most make use of some type of rope harness which encircles the trunk and permits the climber to move it up and down. Climbing is facilitated by the ridgelike leaf scars on the trunk and is generally done barefoot. When the climber reaches the crown, he grasps leaf stalks for support and cuts loose the ripe nuts. In addition to the considerable danger of falling from the top of the palm, the climber risks encountering bee or hornet nests, rats and even poisonous snakes which may nest in the crown. Since this work is so exhausting, a climber can harvest only about eighteen trees in a day. Climbing is the most expensive method of harvesting coconuts. In Malaysia, Thailand and Indonesia efforts have been made to reduce harvesting costs by training pig-tailed monkeys to climb the palms and throw down the ripe nuts. The obedient apes, wearing a collar at the end of a long rope, are guided by signals from a keen-eyed handler on the ground (Fig. 4).

Copra, derived from the Hindi word "khopra," is dried coconut meat from which coconut oil is expressed; it is the chief commercial product of the palm. To prepare copra, the harvested nuts are first processed to remove the thick, fibrous husk. Ordinarily this manual task is carried out in the field by impaling the nut on an upright iron spike fixed in the ground and tearing off the husk with three or four vigorous twists (Fig. 5). The work is hard, but an experienced worker can dehusk about 2,000 coconuts per day. The husked nuts are transported to the copra processing area where they are split in two by means of a chopping knife or hatchet. In industrialized operations, the released coconut water is collected and made into vinegar. The shell segments with adhering coconut meat are immediately set out to dry in the sun on racks or concrete patios or dried in heated kilns, since any delay results in deterioration. Sun-drying requires sixty to eighty hours of sunshine;

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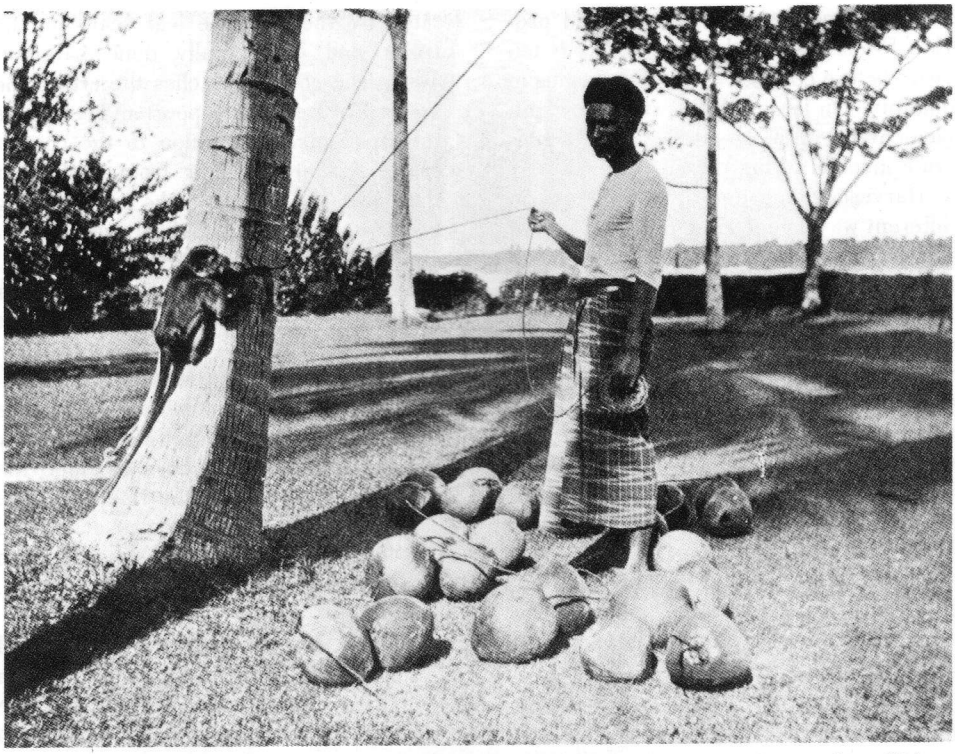
3. Harvesting of coconuts in Brazil. A dangerous and exhausting job. Credit: *Tipos e Aspectos do Brasil.* Illustration by Percy Lau. Rio de Janeiro: I.B.G.E., 1975.



4. Labor saving. In some regions of Indonesia, Malaysia, and Thailand, tame monkeys such as *Pithecus nemestrinus* are trained to climb the coconut palms and loosen the ripe nuts. Credit: *A Practical Guide to Coco-nut Planting.* R. W. Munro and L. C. Brown. London: John Bale, Sons & Danielsson, Ltd., 1920.

the copra is covered at night and during periods of sudden rains. The meat is removed from the shells after two or three days to accelerate the drying process. In kilns, drying can be accomplished in four to five days. About ninety per cent of copra production comes from small holders, so sun-drying or the use of kilns of limited size is most common.

Drying reduces the moisture content of coconut meat from fifty to fifty-five per cent down to five to six per cent. Properly cured copra can be stored for extended periods with minimal deterioration or loss from insects or fungi. Before being marketed, copra is graded into about six classes in order of quality, then bagged for export.

Copra comes mainly from the same five countries which lead in coconut production. The leading copra producer is the Philippines.

COPRA PRODUCTION 1983
(metric tons)

Philippines	1,930,000
Indonesia	1,070,000
India	350,000
Malaysia	204,000
Sri Lanka	145,000
All Others	849,000
World	4,548,000

SOURCE: *FAO Production Yearbook 1983.*

Copra yields vary considerably depending upon environmental conditions, age of

5. Husking the coconut, 1884. A century later, the same method is used to remove husks: the coconut is impaled on a sharp spike set in the ground. Credit: *The Prince of Palms.* W. P. Treloar. London, 1884.

the palms, methods of cultivation and the varieties grown. In tall varieties, about 5,000 nuts will yield one metric ton of copra; among dwarf varieties, from 6,000 to 8,000 nuts are required.

The value of copra is based on its oil content, and with a content of about sixty-five per cent it is one of the richest for vegetable oil extraction. Coconut oil is obtained by direct processing of wet kernels or through crushing of good quality copra. The oil is even more important in the country of origin than in importing nations; about sixty per cent usually goes into domestic use, while the remaining forty per cent is exported. After extraction from copra, coconut oil is refined into a clear liquid which has neither the taste nor the odor of the coconut. It is a fluid in warm tropical climates but at temperatures below 76 degrees Fahrenheit changes to a solid fat with the consistency of butter.

Coconut oil gained international economic stature in the middle of the nineteenth century as an ingredient for soap in Europe. It is one of the finest oils for that purpose; rich in glycerins, it lathers freely in hard or salt water. Following its use in soap-making, coconut oil became a major ingredient in margarine and remained the most important vegetable oil in the world trade, until surpassed by soybean oil about twenty years ago. Coconut oil now constitutes about eleven per cent of the total fats and oils entering world markets; it is one of the most digestible of the vegetable oils, universally popular as an ingredient in cooking and in the preparation of countless tropical dishes. New

uses are constantly being discovered for it. The popular cream substitutes for coffee and tea are a good example.

A versatile commodity, coconut oil has many food and non-food uses. In food, in addition to margarine, it is employed in shortening, confectionery, baked products, ice cream, frozen desserts and whip toppings. Hindus in India prepare a highly important, vegetarian butter from coconut oil called *ghee*.

Coconut oil's non-food uses include the manufacture of toilet soaps, shaving creams, shampoos, toothpastes and cosmetics such as lipsticks, hair dressings and lotions. The charcoal industry employs it in the production of glycerine, fatty acids, synthetic rubber, plastics and paints; while in pharmaceuticals it is utilized as a solvent for vitamins and hormones, and as an ointment base because of its ready penetration into the skin and water-absorption properties.

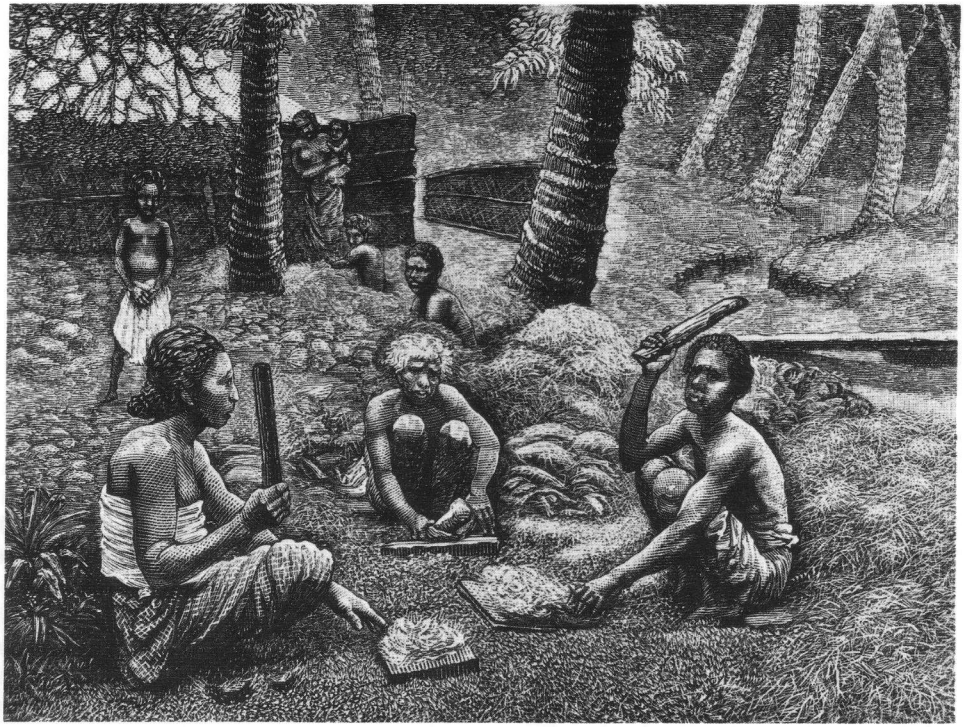
According to the United States Department of Agriculture, an estimated 3,017,000 metric tons of coconut oil were produced in the world in 1980, with a market value of between $568 and $836 per metric ton.

After expression of the oil from copra, the remaining residue is a by-product known as coconut cake, copra cake or "poonac," which when used in limited quantities is a valuable cattle and poultry feed, rich in proteins and fats.

Desiccated coconut is fresh coconut meat which is shredded and dried; it has a moisture content of less than three per cent and an oil content of about sixty-eight per cent. Currently this product is processed to a large extent in the Philippines (for the United States market) and in Sri Lanka (for Europe). Following shelling, the reddish brown skin is pared off the outside surface of the white meat; the meat is then washed, pasteurized, blanched, shredded, dried and graded into extra fine, fine, medium and coarse qualities. A significant, hygienic pasteurizing process has been developed in the Philippines for desiccated coconut. This product is exported in kraft sacks lined with polyethylene film; it is packaged in fancy cuts—strips, chips, slices and threads—and in recent years has become a familiar and popular ingredient in the confectionery and baking industries. It may be further processed by sweetening and toasting. At retail, the product is commonly called "shredded coconut," and is sold in plastic bags or cans. Coconut chips, a popular snack food, are sliced strips of desiccated coconut which have been roasted, salted and vacuum-packed in cans. This snack item is popular among tourists in Hawaii and the Caribbean islands.

The adaptability of the coconut is shown in other food products: coconut gelatin, a dessert made of coconut water, sugar, acetic acid and a bacterial pineapple culture; colored coconut, used mainly for topping in confectionery and baking, and prepared by mixing desiccated coconut with a certified food coloring and anhydrous corn sugar; coconut milk, made by squeezing fresh, grated coconut meat through a sieve, often serves as a substitute for cow's milk in Asia where it is fed to infants; coconut cream, a concentrate of coconut milk; coconut spread, a mixture of coconut cream with eggs and sugar; coconut juice, a diluted noncarbonated soft drink, and carbonated coconut soda, both prepared from coconut milk. The juice, milk and cream are consumed at the retail level as the ingredients of the pineapple-coconut-alcoholic beverage known as *piña colada*. Coconut sport or macapuno is an unusual product from a coconut variety in which the ripe fruit contains no water but is filled instead with a thick curd. This delicacy is eaten fresh, or cut into strips and cooked in syrup.

These coconut products, imported for the most part from the Philippines, Thailand, Singapore and Puerto Rico, are processed foods which can be found in jars



6. Beating coconut fibers to produce coir in Ceylon, 1884. Credit: as Fig. 5.

or cans in food markets in the United States.

Another edible delicacy, well liked in the Far East, is the coconut "apple" which develops in the shell as the nut germinates. A refreshing drink known as coconut lemonade, popular in India, is prepared by boiling coconut water, sugar and lemon juice. Coconut flour, produced from partially defatted edible coconut gratings, is utilized in India and the Philippines in nutrition feeding programs in schools.

Toddy is the sugary sap obtained by tapping the tender, unopened inflorescence of the coconut palm. This sweet liquid can be drunk fresh or boiled down (like maple sap) to make a palm sugar called *jaggery*. Distillation of fermented toddy yields a liquor called *arrack*. Fermentation of toddy (matured by aging in closed casks) also produces coconut vinegar. In India this vinegar is sometimes flavored with spices such as black pepper, nutmeg and cinnamon.

Coir, an important industrial product in India and Sri Lanka, is the stiff, elastic fiber extracted from the husk of the coconut. Its name comes from the Tamil word "kayiru," meaning rope. The short, wiry elastic fibers of the husk are durable and resistant to water. Winning the fiber requires time and much hand labor (Fig. 6). The husks must be retted in water before the fiber can be extracted. The longest and finest white fiber, obtained from the husks of unripe coconuts, may be spun into yarn for making ropes, cables, twine for lobster pots, rugs and acoustic insulation; a coarser, brown coir produces brush bristles, while the shortest fibers are utilized for stuffing mattresses and upholstery. The husks of approximately 1,000

coconuts are required to produce 180 pounds of coir. Coir dust, a by-product of coir processing, serves as an excellent rooting material and nursery mulch.

Virtually every part of the coconut palm has some reputed medicinal application. The liquid of the unripe coconut has been prescribed traditionally in India as a medicine to treat fevers, cholera and urinary disorders, as well as an anthelmintic to destroy and expel intestinal worms. Coconut meat is recommended in India as a cure for constipation and to relieve the build-up of gas in the stomach. Coconut oil has been found to soothe and help heal cuts, scratches and burns of the skin, including sunburn. Coconut milk is prescribed in Hindu medicine to help cases of sore throat and to calm stomach ulcers. In the Far East it is believed that ash from burned coconut shells can quell stomach pains; coconut roots may be used as tooth picks.

Because of its multifarious and diversified uses, the coconut palm has been given the names "tree of life" and "tree of heaven" in the Orient. Myth and ritual are involved with the palm in its Indo-Pacific homeland. In New Guinea, a native belief holds that the coconut originated by sprouting from the head of the first man to die. Thousands of miles away in Northern India, the coconut is considered a sacred fruit, linked to prosperity. It is likewise a symbol of fertility: shrines often keep a supply of coconuts to be given by priests to women who wish to conceive.

Coconuts themselves have served as primitive money. On the Nicobar Islands in the Indian Ocean, whole coconuts comprised the local currency, and the value of goods was reckoned in coconuts until the early twentieth century. Discs carved from coconut shells formed part of the shell-money strings which served as currency on some islands in the Carolines and in the Bismarck Archipelago in the South Pacific.

The importance of coconuts in human nutrition in the Indo-Pacific region is reflected in the estimated per capita consumption of 140 nuts per year in Sri Lanka; this figure is probably even higher in some Pacific Islands.

Nutritionally, coconut products contain protein, fat and carbohydrates—all three of the major food constituents. Analysis of the products reveals the percentages as shown in Table 1 below.

Probably all plants suffer from insect pests and disease. The coconut palm is no exception. More than 100 species of insects afflict it. The large rhinoceros beetle is the most serious, because it penetrates the terminal bud, causing damage to unopened leaves and occasionally death to young palms. This beetle can be controlled by destruction of its breeding sites in decaying vegetable material. Palm weevils are another major pest. They lay eggs in the crown of the tree and the burrowing larvae damage the trunk. Chemical control is usually effective, but in severe infestations the tree must be felled and burned.

A dozen or more serious diseases affect the coconut palm. Of recent prominence in the New World is lethal yellowing dis-

Table 1.

Product	Water	Protein	Fat	Carbohydrates	Fiber	Minerals
Coconut water	95.4	0.1	0.1	4.0	—	0.4
Coconut meat	36.3	4.5	41.6	13.0	3.6	1.0
Copra	6.8	7.6	63.7	16.1	3.8	2.0
Coconut cake	11.0	19.8	6.0	45.3	12.2	5.7

Source: K. P. V. Menon and K. M. Pandalai. *The Coconut Palm.* Ernakulam, India, 1957.

ease which first appeared in the Caribbean in 1870, spread among the islands, and has been devastating coconuts and nearly thirty other species of palms in mainland Florida since it first turned up in Key West in 1955. First symptoms of the disease are dropping of immature nuts and yellowing leaves. Death usually follows in a matter of months. Most of the estimated 500,000 coconut palms in South Florida are the Jamaica Tall variety which is highly susceptible to the disease. The vector has recently been identified as a leaf hopper which transmits the mycoplasmalike organism that causes the disease. Fortunately, dwarf varieties of coconut are resistant to lethal yellowing: Malayan Dwarf and the newly developed Maypan hybrid are being planted to replace the more susceptible tall coconut varieties. At least three-fourths of the tall coconut trees of Jamaica have died due to lethal yellowing. In Florida, widespread injections of oxytetracycline (also known as tetramycin in garden shops) have been carried out to control the disease temporarily. These treatments must be repeated at four month intervals. Lethal yellowing, recently reported in the Rio Grande Valley in Texas, looms as a very real threat to Mexico's coconut palms and could spread throughout Latin America. Plant diseases are seldom confined to a limited area despite governmental control programs, and in the years to come there may have to be a wholesale shift to dwarf varieties in the New World.

Planting dwarf varieties leads to earlier production in three or four years, but the nuts are smaller and the trees have a shorter productive life than the tall varieties. Should lethal yellowing reach the Old World, there might be little choice but to shift to dwarf varieties or dwarf hybrids. The brightest hope for coconut growers may be the development of simple and inexpensive vegetative propagation techniques which could be applied to reproduce selected, high-yielding, disease-resistant varieties on a large scale. This could bring about a sharp increase in production and strengthen the competitive position of the coconut in world vegetable oil markets.

Within producing countries, wide and varied utilization and long-standing cultural traditions assure that coconuts will always be important. Industrialization of coconut products over the past decades has brought about changes. Whereas raw copra used to be the major export, extraction of coconut oil and its export is increasing steadily at the present time. A similar pattern is seen in the shift from exporting coconuts in the shell to exporting desiccated coconut. Both of these changes have benefited the countries of origin by creating additional employment in those tropical, developing areas of the third world.

It is estimated that approximately one billion coconut palms are currently planted throughout the world on some twenty-two million acres. About thirty-three billion coconuts are used annually—roughly eight nuts for every human being. The life cycle of the coconut corresponds curiously to the human: it reaches full bearing at about twelve to fourteen, more or less the time of puberty; produces well until about sixty, when it begins to decline and ultimately dies at about eighty.

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Meeting of Palm Specialists

A satellite meeting of palm specialists will be held during the IV Congreso Latinamericano de Botanica, 29 June to 5 July, 1986 in Medellín, Colombia. The object of this meeting is to draw together botanists working on all aspects of palm biology in the New World and to exchange information about current and future research projects. No research papers will be presented during this meeting. Persons wishing to give papers are invited to do so during the Technical Sessions of the Congreso.

For information about the satellite meetings, contact: Rodrigo G Bernal, Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Apartado 7495, Bogotá, Colombia.

Error in Palmeter

Third prize in the Raffle to be held at the 1986 Biennial Meeting is a complete set of *Principes*, bound. The value should have been $700, not $187 as printed in the Palmeter, *Principes* 30(1): 192.