

HISTORY OF THE COCONUT PALM IN AMERICA.

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INTRODUCTION.

Many scientific text-books and works of reference support the popular idea that the coconut palm is specially adapted to tropical seacoasts and is confined to maritime regions. No other example of special adaptations of plants to their environments has had longer currency or more confident belief. Nevertheless, it seems that the botanical romance of the coconut, protected by its thick husk and floated from island to island in advance of human habitation, must go the way of many other pleasing traditions. What natural agencies have been supposed to do for the coconut is now to be recognized as the work of primitive man. The truth proves again to be stranger than the fiction.

The coconut exists in the lowland tropics only as a product of cultivation. It does not plant or maintain or distribute itself on tropical seacoasts, and would entirely disappear from maritime localities if human care were withdrawn. The habits of the palm from the botanical standpoint, its significance in human history, and even its agricultural possibilities are misunderstood unless we are able to lay aside the maritime tradition.

An outline of the evidence for the American origin of the coconut palm and of its distribution by human agencies has been published in a previous number of the Contributions.^a The present study carries the subject further in two principal directions. It brings additional facts to show that the coconut palm was already widely distributed in the New World before the arrival of the Europeans, and that it is not naturally a maritime or humid tropical species, but a native of drier and more temperate plateau regions in South America. A comparison of the habits of germination of the coconut with those of other related American palms shows other and very different uses

^aThe Origin and Distribution of the Cocoa Palm, Contributions from the National Herbarium, vol. 7, pp. 257-293. (1901.)

for the characters that have been looked upon as special adaptations for maritime dissemination.

The huge seed with its immense store of food materials and its thick fibrous husk make it possible for the coconut to propagate itself in the relatively dry interior localities where it appears to have originated. The inability of the palm to withstand shade explains why it has been unable to establish itself as a wild plant on any tropical seacoast. The application of these facts to cultural problems shows that the possibilities of an extratropical extension of the coconut palm are not to be realized on seacoasts, but in interior desert regions where larger amounts of heat and sunlight are to be obtained.

Though the biological evidence of the American origin of the coconut palm appears complete and adequate, recent years have brought to light several additional facts which may be of use to those whose training and habits of thought lead them to attach great weight to the historical arguments of De Candolle and other writers who believed in the Old World origin of this palm and its dissemination by the sea. The reader is impressed by De Candolle's references to many old and rare books, and will naturally remain loth to believe that so eminent an authority could have come to an erroneous conclusion, unless all the foundations of his opinions are carefully reexamined.

It is important to trace and clear away any mistakes or false deductions which obscure the early history of cultivated plants. Misconceptions regarding the origin and dissemination of any important economic species tend to distort human history as well as to mislead botanical and agricultural investigation. It is only when we view the past with the right perspective that we gain correct ideas of the factors which control our present interests and our future progress. Civilization itself is based on cultivated plants, and history may be written with as much propriety from the agricultural standpoint as from the military, political, or commercial.

Many of the plants valued by primitive man have found no place in our civilization, but have gone more or less completely out of use, either because other species of better quality or more abundant yield have taken their places, or because their uses have been outgrown. The coconut does not belong among the plants of waning importance. Its cultivation is being extended in many parts of the Tropics, and its products are rapidly gaining places in the domestic economy of the most civilized nations of Europe and America. The probability is great that the coconut palm will be recognized eventually as a food plant of the first rank, not merely by the natives of the Malayan and Polynesian islands, but by the whole civilized world.

Coconuts are an important product in Porto Rico, Hawaii, and the Philippines. A coconut industry has been established in southern

Florida, and is now beginning to attain considerable proportions. One of the Florida coconut planters is recently reported to have sold the crop of a single season for \$15,000. There is also a possibility, still entirely untried, that hardy varieties of the coconut palm can be obtained in South America which can be cultivated in southern California and Arizona, or even in a few spots in southern Texas where flowing artesian wells of warm water may make it possible to protect small areas from frost.

ALLEGED INTRODUCTION OF THE COCONUT PALM BY EUROPEAN COLONISTS.

De Candolle held the opinion that the coconut palm was introduced into South America and the West Indies by European settlers, and that it existed in pre-Spanish America only on the Pacific coast of the Panama region. The presence of even these coconuts in America was supposed to represent a recent arrival by sea from the Pacific islands. He says:

The cocoa-nut abounds on the littoral of the warm regions of Asia, of the islands to the south of this continent, and in analogous regions of Africa and America; but it may be asserted that it dates in Brazil, the West Indies, and the west coast of Africa from an introduction which took place about three centuries ago. . . .

The inhabitants of the islands of Asia were far bolder navigators than the American Indians. It is very possible that canoes from the Asiatic islands, containing a provision of cocoa-nuts, were thrown by tempests or false manoeuvres on to the islands or the west coast of America. The converse is highly improbable.

The area for three centuries has been much vaster in Asia than in America, and the difference was yet more considerable before that epoch, for we know that the cocoa-nut has not long existed in the east of tropical America.^a

This supposed limitation of the range of the coconut palm in ancient America, while not necessarily disproving its origin on this continent, might stand in the way of any full confidence in the American nativity of the species. But if it can be shown that there is adequate historical evidence of the existence and wide distribution of the coconut in tropical America at the time of the discovery, we gain a different idea of the status of the palm among the natives of America. De Candolle was able to entertain the opinion that the coconut did not exist on the eastern side of the American Continent before the Spanish discovery because he overlooked several important early references and because he relied upon the theory of an early Spanish introduction to explain the historical facts with which he was acquainted.

No direct evidence of such an introduction has been produced, nor does a canvass of the references to the early accounts of America cited by De Candolle reveal any facts which support the assertion, even indirectly. There were no coconuts in the Mediterranean region

^a De Candolle, A., *Origin of Cultivated Plants*, ed. 2, pp. 430, 433. (London, 1886.)

which the Spaniards could bring to America, and they had no facilities for securing coconuts from the East Indies. And even if they had been able to arrange such an importation through their jealous competitors, the Portuguese, the time required in those days for the necessary sea voyages would have been too long.

A motive for such an introduction was lacking, as well as an opportunity. It does not appear that any of the early discoverers or historians were familiar with the coconut before coming to America, and they evidently did not become acquainted with it here as an important article of food or as having any other value that would lead them to give it their active attention and care. The agricultural activities of the Spanish colonists took the direction of introducing European plants into America, in the hope of being able to supply themselves with their accustomed foods. The appreciation of the new foods and other products of the agricultural plants that were natives of America and the introduction of American plants into Europe went on only slowly and casually.

There is nothing to show that tobacco or potatoes reached Europe until after the middle of the sixteenth century. Indian corn and capsicum pepper were known in Germany by 1543, as described by Fuchs, but in both these cases it is possible to doubt whether the plants were post-Columbian introductions from America or pre-Columbian arrivals from the Orient, as indicated by the early histories and by their earliest European names.^a Columbus himself began the introduction of European plants into America, but the only tropical types introduced during the period of the early discoveries appear to have been the varieties of bananas and sugar cane brought over from the Canary Islands.

The Malayan and Polynesian islands, where the coconut is a plant of the first rank, were still undiscovered by Europeans, who had only vague rumors of the medicinal virtues of the *Nux Indica*, as it was termed in the medieval pharmacopœia. Even in parts of the East Indies where the coconut palm undoubtedly existed some of the early writers make little or no mention of it. Thus in the extended

^aThe history of the early introduction of American plants into Europe has been summarized by Dr. Seb. Killermann, in the *Naturwissenschaftliche Wochenschrift*, vol. 24, p. 193. (March 28, 1909.)

Doctor Killermann finds that four American plants were known in Europe before 1543, the Indian corn, the capsicum pepper, the squash (*Cucurbita maxima*), and the French marigold (*Tagetes patula*). By about the middle of the sixteenth century five other American plants had been recorded, two species of tobacco (*Nicotiana tabacum* and *N. rustica*), the prickly pear (*Opuntia*), the century plant (*Agave*), and the tomato. From the second half of the century there are accounts of the bean (*Phaseolus vulgaris* and *P. coccineus*), the peanut, the Jerusalem artichoke (*Helianthus tuberosus*), the spiderwort (*Tradescantia*), the nasturtium (*Tropaeolum*), and the potato. The sweet potato does not appear in this list. The first reference to its existence in Europe given by De Candolle is that of Clusius in 1601.

account of Cochin China by an early Jesuit missionary, Borri, which follows the early discoveries of America in Churchill's Voyages, there is no mention of coconuts, though other plants and their products are treated in detail.

The first practical acquaintance of the Spanish with the coconut was gained in America, and we may believe that if they had undertaken to introduce the palm into the West Indies they would have brought the nuts from Panama instead of from the East Indies. But even this would have been quite outside of the objects and operations that are recorded in elaborate detail by the early historians. Any such undertaking on the part of any intelligent leader would almost certainly have become a matter of record. We find, however, no sign of interest in the plant which would render such an effort on the part of the Spaniards in any way probable.

In thus alleging an early Spanish introduction of the coconut in America De Candolle seems to have depended entirely on an inference not really warranted by facts. He argues that unless the palm were wild and indigenous it must have been introduced by Europeans, a deduction certainly unwarranted in view of the fact that numerous other species of native cultivated plants, such as Indian corn, sweet potato, cotton, capsicum, peanut, cassava, sour-sop, avocado, anatto, and cacao (chocolate) had been widely distributed through tropical America in pre-Columbian times. Like the coconut palm, most of these plants are still unknown in the wild state. They testify to the very great antiquity of agriculture in tropical America, and show the propriety of considering the coconut as one of many American plants that had been domesticated in America before the arrival of the Spaniards.

EARLY ACCOUNTS OF THE COCONUT PALM IN AMERICA.

PETER MARTYR'S ALLUSIONS TO THE COCONUT.

The only suggestion of historical warrant that De Candolle gives us for the idea of the introduction of the coconut by Europeans is contained in this statement:

Sloane says it is an exotic in the West Indies. An old author of the sixteenth century, Martyr, whom he quotes, speaks of its introduction. This probably took place a few years after the discovery of America, for Joseph Acosta saw the cocoa-nut palm at Porto Rico in the sixteenth century.^a

In reality Sloane does not express any such opinion as his own; he gives a very casual mention of an idea which he ascribes to Peter Martyr, the representative of the Pope at the court of Spain, who wrote letters about the Spanish discoveries to his friends in Italy,

^a De Candolle, A., *Origin of Cultivated Plants*, ed. 2, p. 430. (1886.)

based on information collected from the explorers and the reports they sent home. Sloane says:

Martyr says this Fruit was brought to the American Isles, but, that many were found naturally in Peru, it may be doubted whether they were not brought thither by the natural Currents of the Sea.^a

Sloane does not tell us where such a statement is to be found in Martyr's writings, nor does De Candolle appear to have considered it necessary to verify the reference for himself. A search through the English version of Martyr's Decades used by Sloane might have lessened confidence in the idea that the palm was introduced by the Spaniards.

The name "coco" was not mentioned by Martyr in his accounts of America, though there were many references to palms, which the early English translator turned into "date trees," the date being the only palm well known in Europe at the time. Even in the last century we find English travelers referring to Brazilian species of *Cocos* as "dates," as in the following instance:

Still we were skirting palm-trees, among which the grass grew to a great height. One of the things we had from the Indians yesterday was the date-palm. Its fruit grows in clusters, looking like a colossal bunch of grapes; the outer shell is thin, and contains a sweet, yellowish substance, of which the Indians are very fond, covering a nut like a filbert, with the flavour of the coconut, containing the kernel from which the oil is extracted.^b

In addition to the fact that both are fruits of palms, there is a notable external resemblance between dates and coconuts as they hang in large clusters among the bases of the leaves. The only striking difference is that of size, which is commonly disregarded in popular comparisons. Indeed, Martyr himself was familiar with the idea that the products of America often exceeded those of Europe in size.^c

^a Sloane, Hans, *A Voyage to the Islands Madera, Barbados, etc.*, vol. 2, p. 9. (1725.)

^b Mulhall, M. G., *Between the Amazon and Andes*, pp. 183, 184. (London, 1881.)

^c Martyr did not understand that the Indian corn of America was a different plant from the cereals of Europe, and hence found it difficult to credit the report that the wheat in Santo Domingo produced ears thicker than a man's arm.

. . . The lyke encrease commeth of wheate if it be sowen vppon the mountaynes where the colde is of some strength: but not in the playnes, by reason of to much fatnes and rankenes of the grownde. It is in maner incredible to heare, that an eare of wheate shuld bee bygger then a mans arme in the brawne, and more then a spanne in length, bearynge also more then a thousande graynes as they all confesse with one voyce, and earnestly affirme the same with othes. Yet they say the bread of the Ilande (cauled) *Cazabbi* made of the roote of *Iucca*, to bee more holsome, because it is of easyer digestion, and is cultured with lesse labour and greater increase. The residue of the tyme which they spende not in settinge and plantynge, they bestowe in gatheringe of golde.—Martire, Pietro, *The Decades of the Newe Worlde or West India* (1516), trans. by Richard Eden (1553), in Arber, E., *The First Three English Books on America*, p. 168. (Birmingham, 1885.)

While most of Peter Martyr's allusions to dates give no details that afford a botanical identification of the palm, it must be remembered that there is no other palm in the West Indian region that is more similar to the date or any other that has economic importance enough to bring it to the attention of men like Martyr and his English translator, Eden, and lead them to reckon it among the economic products of the New World. Eden seems to have been more keenly interested in such matters than Martyr and occasionally adds information from other sources to his translation of Martyr, as in the following instance:

. . . In these Ilandes they founde no trees knowen vnto them, but pyne app[l]e trees, and date trees: And those of maruelous heyght and exceding harde, by reason of the greate moystnesse and fatnesse of the grounde, with continuall and temperate heate of the sonne, whiche endureth so all the hole yere.^a

There is no corresponding statement in the complete Latin text of Martyr's "Decades" published at Paris in 1587, under the title "De Orbe Novo." The interest of the passage is not destroyed by the fact that it was an interpolation, for Eden was a contemporary of Martyr and published his translation of the first three of Martyr's "Decades" before the complete edition was issued. That Eden understood Martyr's passages about palms to refer to the coconut can hardly be doubted, and there is no reason to claim that he was mistaken in such instances as the following:

This fortresse, he cauled saynt Dominikes towre. Into this hauen, runneth a ryuer of holsome water, replenished with sundrye kyndes of good fysshes. They affyrme this ryuer to haue many benefytes of nature. For, where so euer it runneth all thynges are excedynge pleasaunte and fruitfull: hauynge on euery syde, groues of date trees, and dyuers other of the Ilande frutes so plentyfully, that as they sayled alonge by the shore, often tymes the branches therof laden with flowres and frutes, hunge soo ouer theyr heades, that they mighte plucke them with theyr handes.^b

The phrase "groves of date trees" is justified by Martyr's Latin word *palmeta*, which also carries an implication that the groves were artificial, and not mere forests of wild palms. In another passage wild palms that grow "of themselves" are mentioned in direct contrast with those that bear "dates" larger than those of Europe, thus implying again that the latter were cultivated.

. . . They haue also abundance of nuttes of pynetrees, and great plentie of date trees, whiche beare frutes bygger then the dates that are knowen to vs: but they are not apte to bee eaten for theyr to much sowernes. Wylde and baren date trees, growe of them selues in sundry places, the branches wherof they use for biesommes, and eate also the buddes of the same.^c

The words *nucibus pineis* of the Latin original indicate that Martyr, as well as his translator, confused pines and pineapples. It does not

^a Martire in Arber, op. cit., p. 67.

^b Martire in Arber, op. cit., p. 82.

^c Martire in Arber, op. cit., p. 131.

appear that there are any pine trees in the Veragua district of Panama, to which this statement pertains, or that there are any pines with edible nuts in the whole Central American region. There are many pine forests in Mexico, Guatemala, and Honduras, but they are not known to extend farther south than the latitude of Matagalpa, Nicaragua. The botanical explorations of Professor Pittier in Costa Rica and Panama afford conclusive evidence that there are no pines in those countries. Professor Pittier also states that ineffectual attempts have been made to introduce pines into the central plateau of Costa Rica.

The word translated by Eden as "date trees" simply means palms (*palmarum*), and might possibly refer to the fruits of one of the *Attalea* palms or to those of *Elaeis melanococca*, though neither of these could be expected to have received much consideration from the standpoint of utility as food, or to have been planted by the Indians. The coconut, though hardly distinguished for sourness (*ob austeritatem*), would certainly be a disappointment as a food in comparison with the sweet fruits of the true date. Coconuts are very seldom eaten in the Tropics in a raw state except by children; as an exclusive diet they were considered very unwholesome, especially by the weakened, half-starved men of the Spanish expeditions.

OVIEDO'S ACCOUNT OF THE COCONUT.

The source of Eden's information regarding the American "dates" need not be sought further than in the extensive accounts by Oviedo, also translated by Eden and published in the same book with Martyr's "Decades."^a There can be no possible doubt that Oviedo was acquainted with the coconut palm. He described it at length in a two-page chapter of his quaint Spanish, which Eden rendered into contemporary English as follows:

There is bothe in the firme lande and the Ilandes a certeyne tree cauled *Cocus*, beinge a kynd of date trees and hauynge theyr leaues of the self same greatnesse as haue the date trees which beare dates, but dyffer much in their growynge. For the leaues of this *Cocus* grow owte of the trunkes of the tree as doo the fyngers owt of the hande, wreathyng them selues one within an other and so spreadynge abrode. These trees are hygh: and are founde in great plentie in the coaste of the sea of *Sur*, in the prouince of *Cacique Chiman*. These date trees brynge furth a frute after this sorte. Beinge altogyther vnite as it groweth on the tree, it is of greater circumference then the heade of a man. . . . Whyle this *Cocus* is yet freshe and newly taken from the tree, they vse not to eate of the sayde carnofitie and frute: But fyrste beatynge it

^a Oviedo's original publication was an abridgment entitled, *Oviedo dela natural hystoria de las Indias*. (Toledo, 1526.) This was translated by Richard Eden under the title, *The natural history of the West Indies*, and published in Arber, E., the first three English books on America. (Birmingham, 1885.) The complete work was first issued at Madrid in 1851. (See footnote, p. 295.) Books 1-19 and 10 chapters of book 50 were published in Seville, 1535, as *La historia general delas Indias*.

very much, and then straynyng it, they drawe a mylke thereof, much better and sweeter then is the mylke of beastes, and of much substaunce: The which the Christian men of those regions put in the tortes or cakes which they make of the grayne of *Maizium* wherof they make theyr breade, or in other breade as we put breade in porrage: So that by reason of the sayde mylke of *Cocus*, the tortes are more excellent to be eaten withowt offence to the stomake. They are so pleasaunte to the taste, and leaue it aswell satisfied as thowghe it had byn delyted with many delycate dysshes. . . . This frute was cauled *Cocus* for this cause, that when it is taken from the place where it cleaueth faste to the tree, there are scene two holes, and aboue them two other naturall holes, which altogyther, doo represente the giesture and fygure of the cattes cauled *Mammone*, that is, munkeys, when they crye: whiche crye the Indians caule *Coca*.^a

Eden's version of Oviedo also affords a clue to the mystery of Sloane's statement regarding the introduction of the coconut into America, upon which De Candolle appears to have placed so much reliance. It was Oviedo, instead of Peter Martyr, who reported the planting of dates in Santo Domingo, but these were not coconuts, but true dates from Spain, as the context shows:

Suche frutes as are brought owt of Spayne, into this Ilande, prosper maruelously and waxe rype all tymes of the yeare: as herbes of all sortes very good and pleasaunt to bee eaten. Also many pomegranates of the best kynde, and oranges bothe sweete and sower. Lykewyse many fayre Lymones and cedars: and a great quantitie of all such as are of sharpe, sowre, and bytter taste. There are also many fygge trees whiche brynge furth theyr frute all the hole yeare. Lykewyse those kynd of date trees that beare dates: and dyuers other trees and plantes which were brought owt of Spayne thither.^b

The substitution by Sloane of Peru for Panama, in the passage already quoted on page 276, may have been a mere slip of the pen, or a typographical error, for it does not appear that coconuts have ever thriven in Peru, in ancient times or modern, or that Sloane had any warrant of fact for his statement. Finally, we have the evidence of the passage just quoted, to show that Sloane confused the coconuts that were already in America with the true dates that were brought by the Spaniards from Spain. The only indication of historical warrant given by De Candolle for his theory of the Spanish introduction of the coconut into America proves to be entirely without foundation.

REPORT BY COLUMBUS OF COCONUTS IN CUBA.

Eden's version of Oviedo definitely asserts the existence of the coconut palm in the West Indies, as well as on the continent, and Oviedo's larger history includes the coconut in an account of the numerous native species found in the island of Santo Domingo, but De Candolle seems to have noticed only the mention of the special abundance of the coconut palms on the Pacific coast of Central America, which he

^a Oviedo in Arber, op. cit., p. 225.

^b Oviedo in Arber, op. cit., p. 239

contrasted with their supposed absence on the Atlantic coasts and islands. De Candolle alludes to Oviedo only in the following passage:

Oviedo, writing in 1526, in the first years of the conquest of Mexico, says that the cocoa-nut palm was abundant on the coast of the Pacific in the province of the Cacique Chimán, and he clearly describes the species. This does not prove the tree to be wild. In southern Asia, especially in the islands, the cocoa-nut is both wild and cultivated. The smaller the islands, and the lower and the more subject to the influence of the sea air, the more the cocoa-nut predominates and attracts the attention of travelers.^a

Oviedo's statement is not the only one that has to be explained if we are to deny the existence of the coconut palm in the West Indies when the Spaniards arrived. Columbus himself recorded the finding of coconuts on the north coast of Cuba, near Puerto Principe, only a little over a month after his first landing in the Bahamas.

The Admiral got into the boat, and went to visit the islands he had not yet seen to the S. W. He saw many more very fertile and pleasant islands, with a great depth between them. Some of them had springs of fresh water, and he believed that the water of those streams came from some sources at the summits of the mountains. He went on, and found a beach bordering on very sweet water, which was very cold. There was a beautiful meadow, and many very tall palms. They found a large nut of the kind belonging to India, great rats, and enormous crabs. He saw many birds, and there was a strong smell of musk, which made him think it must be there. This day the two eldest of the six youths brought from the *Rio de Mares*, who were on board the caravel *Niña*, made their escape.^b

The coconut was known to mediæval Europe only as *Nux Indica*, or Indian Nut, the name "coconut," though stated in dictionaries to be derived from Latin and Greek words meaning nut or seed, seems not to have been applied to the coconut till after the discovery of America. Other lexicographers have undertaken to derive coco from Spanish or Portuguese words meaning ape or ogre, an application which is explained by allusion to the three pits or eyes of the coconut which afford a grotesque suggestion of the face of a man or a monkey. It is quite possible, however, that the Spaniards adopted the word coco from the natives of the West Indies as they did many other names of agricultural plants, such as "mais" (Indian corn), "aji" (capsicum), "achiote" (anatto), "platano" (banana), "mani" (peanut), etc. In the case of the banana it is evident that a native word, closely resembling platano led the early explorers to suppose that the banana was the actual platano or plane tree of which the Spaniards of that time knew only the name as it occurs in the Bible. The histories written by Oviedo and Acosta both contain chapters explaining that the plane tree of Scripture was not the same as the "platano" of the West Indies.

^a De Candolle, A., *Origin of Cultivated Plants*, ed. 2, p. 431. (1886.)

^b *Journal of the first voyage of Columbus*, trans. by C. R. Markham, p. 80. (Hakluyt Society, 1893.)

Markham's translation of the clause relating to the coconuts in Cuba is not altogether satisfactory. The Spanish version says that large nuts (*nueces grandes*) were found, rather than a single nut. The statement that the nuts were of the kind belonging to India (*nueces grandes de las de India*) is followed by a parenthetical idiomatic expression (*creo que dice*), as though to remind the reader that this was the opinion of Columbus, for which the editor of the journal, Las Casas, did not wish to be considered responsible. Las Casas added a footnote (*Hutias debian de ser*, "They must have been agoutis") to indicate that the animals taken for rats by Columbus were agoutis, the large tailless rodents of Cuba. Having learned that the agoutis were not rats, the identity of the nuts might also be questioned, but no other nut has been found in Cuba large enough to be mistaken for a coconut. Knowing that Columbus had not in reality reached the East Indies, Las Casas was inclined to pass lightly over the evidences that had deceived the Admiral.

We are left with no positive assurance that the large nuts came from the very tall palms, but botanical science affords us no ground for refusing to believe that the statement relates to the coconut, as Colmeiro has declared in opposition to a Spanish historian who considered the large nuts as walnuts.^a

Markham's translation also omits a statement regarding the palms, that they were taller than any that Columbus had seen thus far, which may have reference to a previous mention of great numbers of palms (*infinitas palmas*) three days before at a location identified by Markham as Puerto de Taxamo, Cuba. If we include these emendations, the reference to the large nuts and its immediate context may be translated as follows:

There was a very beautiful meadow, and many very tall palms, taller than those seen before; he found large Indian nuts, as he would say, and large rats, also like those of India, and very large crabs.^b

Though the presence of natives is not stated, the mention of the meadow indicates that the place had been cleared by human inhabitants. It appears unlikely that the native palms, even if they had

^a Vió Colón "muchas y altísimas palmas," así como algunos pinos (*Pinus occidentalis Sw. et. P. cubensis Griseb.*), y después de aquéllas mencionó las "nueces grandes de las de India," que no es admisible perteneciesen á un nogal, como presumió el historiador Muñoz, siendo lo creible que fuesen cocos, porque no es improbable que el cocotero (*Cocos nucifera L.*) existiese en las regiones intertropicales del Nuevo Mundo antes de su descubrimiento, y así parece demostrarlo tan significativa indicación.—Colmeiro, Miguel, Primeras Noticias acerca de la Vegetacion Americana, p. 13. (Madrid, 1892.)

^b The Spanish text of Navarrete is as follows:

"... habia un prado muy lindo y palmas muchas y altísimas mas que las que habia visto: halló nueces grandes de las de India, creo que dice, y ratones grandes de los de India tambien, y cangrejos grandísimos. (Navarrete, Coleccion de los Viages y Descubrimientos, etc., p. 60, Madrid, 1825.)

existed in the forest, would have attracted the attention of the explorer.

Ferdinand Columbus states that his father found "palm trees of several sorts," and mentions on a previous occasion that some had "the trunk green and smooth," which may refer to the Cuban royal palm (*Roystonea regia*).^a This could have no connection with the large nuts, for the mature fruits are only about the size of a small cherry.

One of Peter Martyr's passages relating to "dates" evidently has reference to the same incident of exploration of the north coast of Cuba by Columbus:

And when they had at the lengthe escaped these strayghtes, and were nowe come into a mayne and large sea, and had sayled theron for the space of foure score myles, they espyed an other excedinge hygh mountayne, whyther the Admirall resorted to store his shyppes with fresshe water and fuel. Heare amonge certeyne wooddes of date trees, and pyneable trees of excedyng height he fownd two natie sprynges of fresshe water.^b

The fantastic idea of tall "pyneable trees" arose from the failure of Europeans not familiar with America to distinguish between pine trees and pineapples. True pine trees were found in abundance in Cuba and Santo Domingo, as well as in Central America. European readers who progressed far enough to learn that pineapples had no relation to pine trees often went to the other extreme of supposing that all the early references to pines related to pineapples. Pine trees are mentioned in the Journal of Columbus in the same district with the "very tall palms" and the large "nuts of India."

If the statement of the Journal of Columbus stood alone we might well hesitate to base any general conclusion upon it, but there is certainly no reason to deny it a place among the many other statements that can be reasonably interpreted only by recognizing their relation to the coconut. As soon as we appreciate the fact that the Spaniards were not acquainted with the coconut, either in nature or in name, before their arrival in America, it becomes apparent that the statement of Columbus is as direct a piece of evidence as we could hope to get, under the existing circumstances. It is not unreasonable to believe that he knew something of the Indian nut, and of the palms that produced it, considering that he spent many years of his life in the active quest of geographical knowledge, with especial reference to the Indies, which he hoped to reach by sailing west. The most remarkable thing about this statement of Columbus is that it should have been so completely overlooked by De Candolle and other writers interested in the history of the coconut palm. Even Pickering failed to include it in his immense collection of similar facts,

^a Churchill's Collection of Voyages and Travels, vol. 2, pp. 534, 535. (London, 1732.)

^b Martire, in Arber, op. cit., p. 77. (See footnote c, p. 276.)

though he refers to the finding of coconuts by Columbus during the fourth voyage, when the coast of Central America was explored.^a

In this case an error appears to have been made, which has been copied into some of our works of reference. The only passage that it seems likely to have been interpreted in this way relates to the seeds of the cacao tree from which chocolate is made, not to the nuts of the coconut palm.^b

ABUNDANCE OF COCONUT PALMS IN PORTO RICO.

The earliest record of the coco palm in the West Indies given by De Candolle was that of Acosta, who visited America in the latter half of the sixteenth century and saw coco palms at San Juan, Porto Rico, from which De Candolle infers that the alleged introduction "probably took place a few years after the discovery of America." The context of Acosta's allusion to the coconut at San Juan does not, however, support such a conjecture, since it is apparent that Acosta, who was a learned and careful historian, was describing the coconut as a notable product of the "Indies," after spending seventeen years in America. The coconuts at San Juan, if brought by the Spaniards, even from Panama, could not have been there for many decades, so that Acosta's mention of them is better evidence against a Spanish introduction than for it.

Acosta does not say how many coco palms he saw at San Juan, but the chaplain of the Duke of Cumberland, who visited Porto Rico in 1598 gives us an account of the coconut palms of that island which would not be inapplicable at the present day, and which precludes all reasonable doubt that at the end of the sixteenth century the coco palm existed in Porto Rico in such size and in such numbers as to render incredible any recent introduction, subsequent to the arrival of the Spaniards.

The body of them is but slender, no where so bigge as a man's middle, and upwards growing proportionably lesse, till they are risen some thirtie or fortie foot high without sprig or bough, then breake out their boughs all at once, euery one whereof is iust like a goodly Ostridge feather; their leaues are so cunningly set together, euery one whereof

^a "... Eastward from the Polynesian Islands, nuts were seen by Columbus on his fourth voyage, in Central America (Churchill Collections)."—Pickering, Charles, Chronological History of Plants, p. 428.

^b For their provision they had such roots and grain as they in *Hispaniola* eat, and a sort of liquor made of *Maiz*, like the *English* beer; and abundance of *Cacao* nuts, which in *New Spain* pass for money, which they seemed to value very much; for when they were brought aboard among their other goods, I observ'd that when any of these nuts fell, they all stoop'd to take it up, as if it had been a thing of great consequence: yet at that time they seem'd to be in a manner besides themselves, being brought prisoners out of their canoe aboard the ship, among such strange and fierce people, as we are to them, but so prevalent is avarice in man, that we ought not to wonder that it would prevail upon the *Indians* above the apprehension of the danger they were in.—Churchill's Collection of Voyages and Travels, vol. 2, p. 606. (London, 1732.)

alone is something like a Sedge or the leafe of a wilde Lilly. Under this bush which is the head of the tree, doe the Coker-nuts grow, some fortie on a tree round about the Bole, some yard downward from where the branches breake out. These trees are a very great grace to the Citie of Puerto Rico, [San Juan] and very many there were found in it.^a

Samuel Champlain, the subsequent explorer of Canada, also visited Porto Rico in 1599, shortly after the English expedition had sailed away from the island. The Spanish expedition that Champlain accompanied also "remained at Porto Rico about a month," and came to the same conclusions as the English chaplain regarding the island and its palms.

The said Island of Porto-rico is pretty agreeable, although it is a little mountainous, as the following figure shows. It is filled with quantities of fine trees, such as cedars, palms, firs, palmettoes, and another kind of tree which is called sombrade. . . .^b

We might remain in doubt of what palms were intended if it were not for a later passage in which Champlain clearly distinguishes between the true palm or coconut and the cabbage or royal palms which he calls "palmiste," but not "palm."

As I have spoken of the palm, although it is a tree sufficiently common, I will here represent it. It is one of the highest and straightest trees that can be seen; its fruit, which is called "Indian nut," grows quite on the top of the tree, and is as large as the head of a man; and there is a thick green bark on the said nut, which bark being removed, the nut is found, about the size of two fists; that which is inside is very good to eat, and has the taste of young walnuts; there comes from it a water, which serves as a cosmetic for the ladies.^c

FIRST ACCOUNT OF THE COCONUT IN BRAZIL.

De Candolle knew from the writings of Piso and Marcgrave that the coconut existed in Brazil at an early date, but he did not admit that the palm was present before the European settlements were made. He treated his evidence regarding Brazil in the same way as that relating to Porto Rico, to support his assumption of an introduction by Europeans. But if we go back to the original of the earliest statement we find nothing of this implication that the coconuts had been imported by the colonists. We learn only that the palms were cultivated in Brazil, as everywhere else. De Candolle's inference from such statements is that Piso and Marcgrave "seem to admit that the species is foreign to Brazil, without saying so positively," but these authors certainly give no intimation of any idea that it was introduced into Brazil by the Portuguese. On the contrary, they both record the native Indian names, *inaiaguacuiba* for the tree and *inaiaguacu* for the fruit, and state that the fruit of

^aEarl of Cumberland, *Voyage to the West Indies, Purchas His Pilgrims*, vol. 4, p. 1173. (London, 1625.)

^bChamplain, *Samuel, West Indies and Mexico*, trans. by Alice Wilmere, p. 10. (Hakluyt Society, 1859.)

^cOp. cit., p. 31.

another species of *Cocos* native in Brazil is called *inaia mira*, or small coconut. No suspicion is betrayed that coconuts were not one of the genuine products of the country, instead of a recent importation from abroad. The statements of later writers on Brazil and Guiana, such as Aublet, Martius, Spruce, Burton, and Wallace, are in entire accord with that of Piso and Marcgrave. They do not claim that the coconut is native in eastern South America, but find it widely distributed in cultivation.

Piso's is not, however, the first reference to the coconut in Brazil, as De Candolle seems to have supposed. More direct and conclusive evidence was published nearly a quarter of a century before from a Portuguese friar who had resided in Brazil for the last three decades of the sixteenth century.^a This writing has also a direct bearing on the question of introduction by Europeans, since it contains a special enumeration of the plants brought to Brazil by the Portuguese. The coconut does not occur in this list, but is included among the native cultivated plants.

In this *Brasill* are many coco-nuts, excellent like those of *India*; these are ordinarily set, and growe not in the Woods, but in Gardens, and in their Farms. And there are more than twentie kindes of Palme trees, and almost all doe beare fruit, but not so good as the *Cocos*: with some of these Palme trees they couer their houses.^b

Exactly the same might have been written of the peach palm (*Guilielma*), the other indigenous palm widely cultivated in prehistoric times by the Indians of South America. But since the peach palm did not attain a world-wide distribution no question of its South American nativity has ever been raised, though it has never been found in the wild state.

The statements of the early historians that the coconut palms did not grow wild in the forest, but only where they had been planted, instead of supporting the idea of an introduction by the Portuguese colonists is better evidence to the contrary, for it becomes highly improbable that such a piece of history would have been omitted from the record. This consideration is even more conclusive in the case of Brazil than in that of Porto Rico, for in that island it might have been possible to raise the palms if the colonists had introduced them early and propagated them with care and diligence. But in Brazil there was actually no time for any multiplication and dissemination of the palms to have taken place, for the colonization of Brazil by the Portuguese did not begin till after the middle of the sixteenth century, or less than twenty years before the arrival of the writer who states their abundance.

^aThe manuscript of this unknown author was captured by an English sailor in 1601, and an English translation was published in 1625 in Purchas His Pilgrims, vol. 4, p. 1289. Piso's account of the coconut in Brazil was not issued until 1648.

^bPurchas His Pilgrims, vol. 4, p. 1307.

The Portuguese are also supposed by Martius and De Candolle to have planted the coconut in their West African settlements, but for this purpose they are more likely to have brought seed from Brazil than from the East Indies.^a The slave trade brought about early and frequent communication between Angola and Brazil, and several travelers visited and described both countries. Martius, though he does not give his authorities, states that the coco palm was planted in the Portuguese settlements in West Africa. This does not prove, of course, that the coconut was unknown in West Africa before Portuguese times; nor on the other hand does the record by Maregrave of native Congo names afford sufficient proof that the natives knew the palm before the time of the Portuguese settlements.

The coco palm continues to be planted at the European settlements and trading stations on the West Coast of Africa, but seems not to have extended itself spontaneously nor to have been adopted in cultivation, perhaps because very few of the agricultural natives live on the coast. The Kroo people of Liberia, who have maritime habits, were reported by Doctor Vogel to have superstitious fear of planting coconut palms.^b This belief seems still to prevail, for the very large Kroo town at Monrovia, though built along the beach, is shaded by no coco palms.

EARLY NOTICES OF THE COCONUT PALM IN COLOMBIA.

The presence of coconut palms in the interior of Colombia, as reported by Humboldt and more recent writers, was also recorded by Cieza de Leon, who accompanied the first overland expedition through Colombia. Cieza de Leon came to America in 1532 as a boy of 14, and after passing in military camps and marauding explorations the years that lads usually spend in school he began, at the age of 22, the writing of a history, "because others of more learning were too much occupied in the wars to write." Nevertheless, the writings of Cieza give us a clearer picture of the condition of the country and the people than do those of any of the learned historians

^a Cassava and Indian corn, capsicum, peanuts, alligator pears, pineapples, and doubtless other American plants, including American types of cotton, appear to have been introduced into West Africa by the Portuguese at very early dates, and are now widely distributed in that continent. The coconut has remained of little importance in Africa, not being utilized as a source of oil, that of the oil palm (*Elaeis*) being of better quality and more easily obtainable.

^b "The inhabitants [of Cape Palmas] believe, that whoever plants a Cocoa-palm will die, before it produces fruit (i. e., in about seven years). The Chief of the fishermen yielded at last to the entreaties of the American Governor, and put some Cocoa-nuts on the ground: he then drove cattle over the spot, that he might not incur the consequences of planting and covering them with earth!"—Hooker, *W. J., Niger Flora*, p. 37. (London, 1849.)

like Oviedo, Acosta, and Hernandez, and merit the high commendations bestowed by Clements R. Markham, who translated Cieza's writings.^a

The statement of Cieza de Leon regarding coconuts is as follows:

. . . The site is twenty-three leagues from the city of Cartago, twelve from the town of Anzerma, and one from the great river, on a plain between two small rivers, and is surrounded by great palm trees, which are different from those I have already described, though more useful, for very savoury *palmitos* are taken from them, and their fruit is also savoury, for when it is broken with stones, milk flows out, and they even make a kind of cream and butter from it, which they use for lighting lamps. I have seen that which I now relate, and it all comes within my own experience. The site of this town is considered rather unhealthy, but the land is very fertile.^b

Velasco, in writing of the palms of the same region over two hundred years later, identifies Cieza's reference and applies it to the variety of coconut called *vira chonta* or "butter palm." It may be doubted whether this is the true coconut palm or a distinct species which has been called *Cocos butyracea*.

To treat *butyracea* as a distinct species does not render it any less interesting, either from the botanical or the agricultural side. If the interior of Colombia affords other species of *Cocos* that are distinct from *Cocos nucifera* and yet closely related to it the question of origin will be still more definitely answered, and the diversity of types available for introduction to other parts of the world will appear still greater. It is evident, however, that Velasco considered his *vira chonta* only as a variety of the coconut palm, since he includes it with three other varieties. Velasco's account of the coconut palms of Colombia, written about 1789, but not published till 1844, appears to contain more original information than any other statement on the subject. It is evident that he took special interest in the palms as a group, since he describes numerous species in detail, with their native names and uses. The parts relating to the coconut palms may be translated as follows:

There are more than fifty different species of palms, all with the generic name *Chonta*. . . . The fruit, in the language of Peru is called *ruru* and in that of Quito *lulum*, which means *egg*; accordingly the fruit of any sort of palm is called *chontaruro*.

^a "The work of Pedro de Cieza de Leon is, in many respects, one of the most remarkable literary productions of the age of Spanish conquest in America. Written by a man who had passed his life in the camp from early boyhood, it is conceived on a plan which would have done credit to the most thoughtful scholar, and is executed with care, judgment, and fidelity. . . . In arrangement, in trustworthiness, in accuracy, and in the value of his observations, the work of Cieza de Leon stands higher than that of any contemporary chronicler: and these qualities in his book are enhanced by the romantic life and noble disposition of its author."—The Travels of Pedro de Cieza de Leon, trans. by C. R. Markham, pp. 1, LVII of the introduction. (Hakluyt Society, 1864.)

^b Op. cit., p. 68.

Hatum chonta, that is, the largest of all palms. Its nut (*coco*) is commonly as large as the head of a man, covered with a tow which is the best kind for gun wads. The white marrow is very good, thick as a finger, and from it, by pressure, is extracted a very rich and sweet oil. The milky liquid is also sweet, refreshing, and good to drink, and from the nuts are made large vessels to hold liquors and for other purposes.

Suni chonta is the palm with the long nut, slightly smaller than the preceding. It has the same properties and the tree is a little smaller.

Vira chonta, the palm with buttery fruit. It is as high as the preceding, but much more slender and with narrow leaves. The fruit is somewhat smaller, almost spherical, with little or no firm marrow, and the milk so thick that after a little beating it coagulates into a very rich butter for eating or lighting. It is peculiar to the River Cauca, on the confines of the province of Popayan, where the Spaniards first discovered it in 1545, one of them, the historian Chieca de Leon, describing it. It is thus seen how lightly a thousand falsehoods are written by some, like Francisco Hernandez, native of Mexico, who in his Latin history asserts that *cocos* were brought by the Spaniards from the East Indies to the West. At their first entrance into South America they found very old palms full of fruit, which never occurs until after the age of 16-20 years with these large kinds of *cocos*.

Yurac chonta, the palm which yields the white *coco*, not only the marrow but all the shell being white, and this, being very thick, is made into cups for chocolate with embossed work. The meat is not very good and the tree rather small. * * *

Almost all of these palms are from the province of Maynas, and some of them from Guayaquil and Popayan.^a

Velasco does not give any definite citation of the books of Hernandez, and may not have known them at first hand. In reality, Hernandez does not seem to have said that coconuts were brought from the East Indies. He states that coconuts were not found in New Spain (Mexico), but he reports at the same time that they were abundant in the West Indies as well as in the East, so that the idea of an introduction by the Spaniards is rather denied than affirmed.

Velasco's reference to the use of the small shells of the *yurac chonta* for embossed work may have interest in connection with the photograph of the carved shell of a small coconut shown in plate 53, figure 1. The specimen from which this photograph was taken was presented to the writer, some years ago by Gen. E. A. Lever, of New Orleans, having been found by him in a grave in the Chiriqui district of Panama in digging for the gold ornaments and pottery that are often found in the prehistoric graves of that region.

ECONOMIC STATUS OF THE COCONUT IN TROPICAL AMERICA.

While the early records appear sufficient to establish the existence of the palm in the New World at the time of the early discoveries, they certainly do not indicate that it was a food plant of primary importance in any part of tropical America, unless it were along the Pacific coast of Panama and Costa Rica. If the coconut had had any such prominence among the Caribs and Arawacks of the West Indies as among the Polynesians and Malays of the East it is incredible

^a Velasco, J., *Historia del Reino de Quito*, vol. 1, pp. 52-54. (Quito, 1844.)

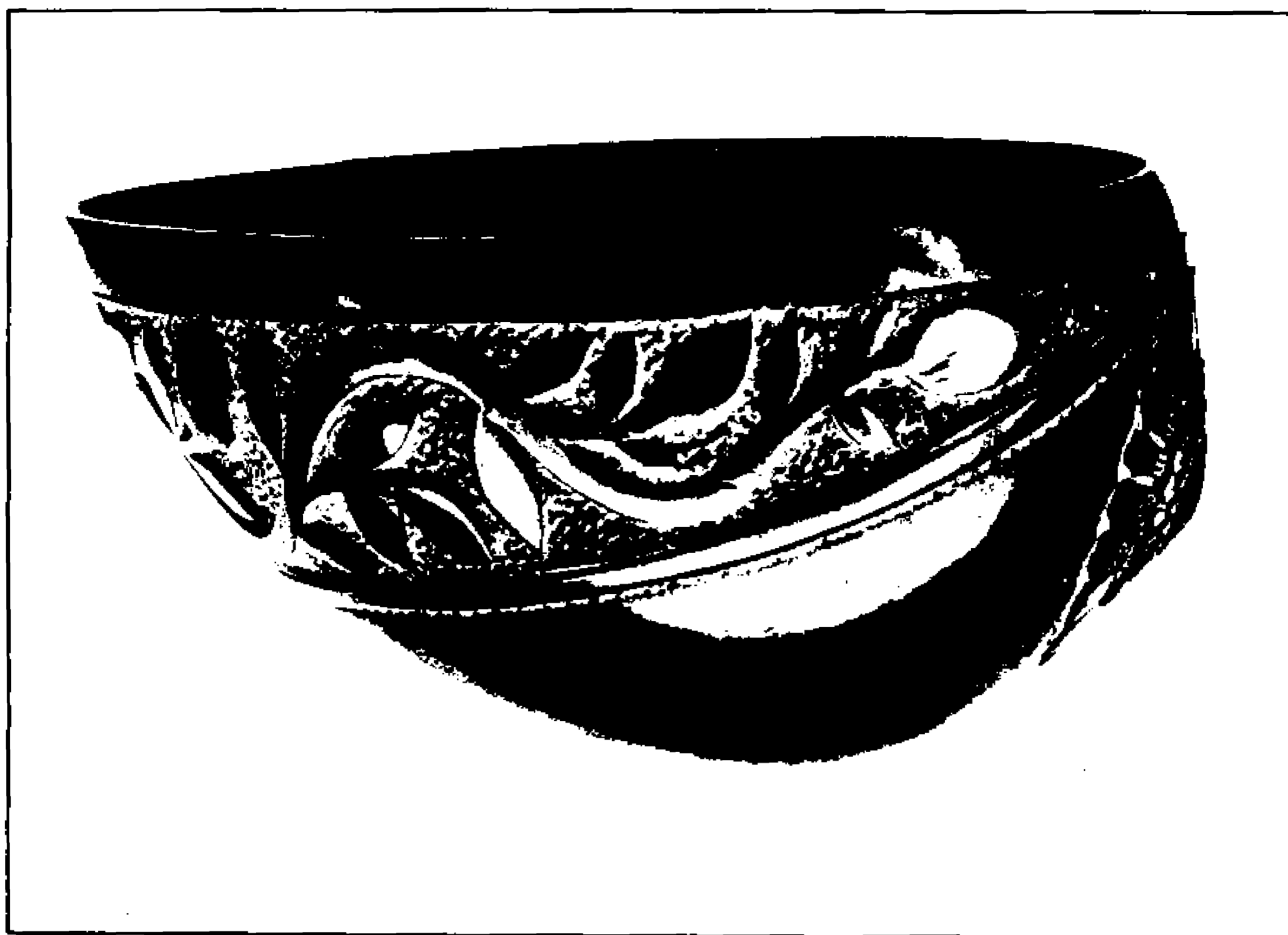


FIG. 1.—CARVED COCONUT SHELL.

From a grave in the Chiriqui district of Panama. (Natural size.)

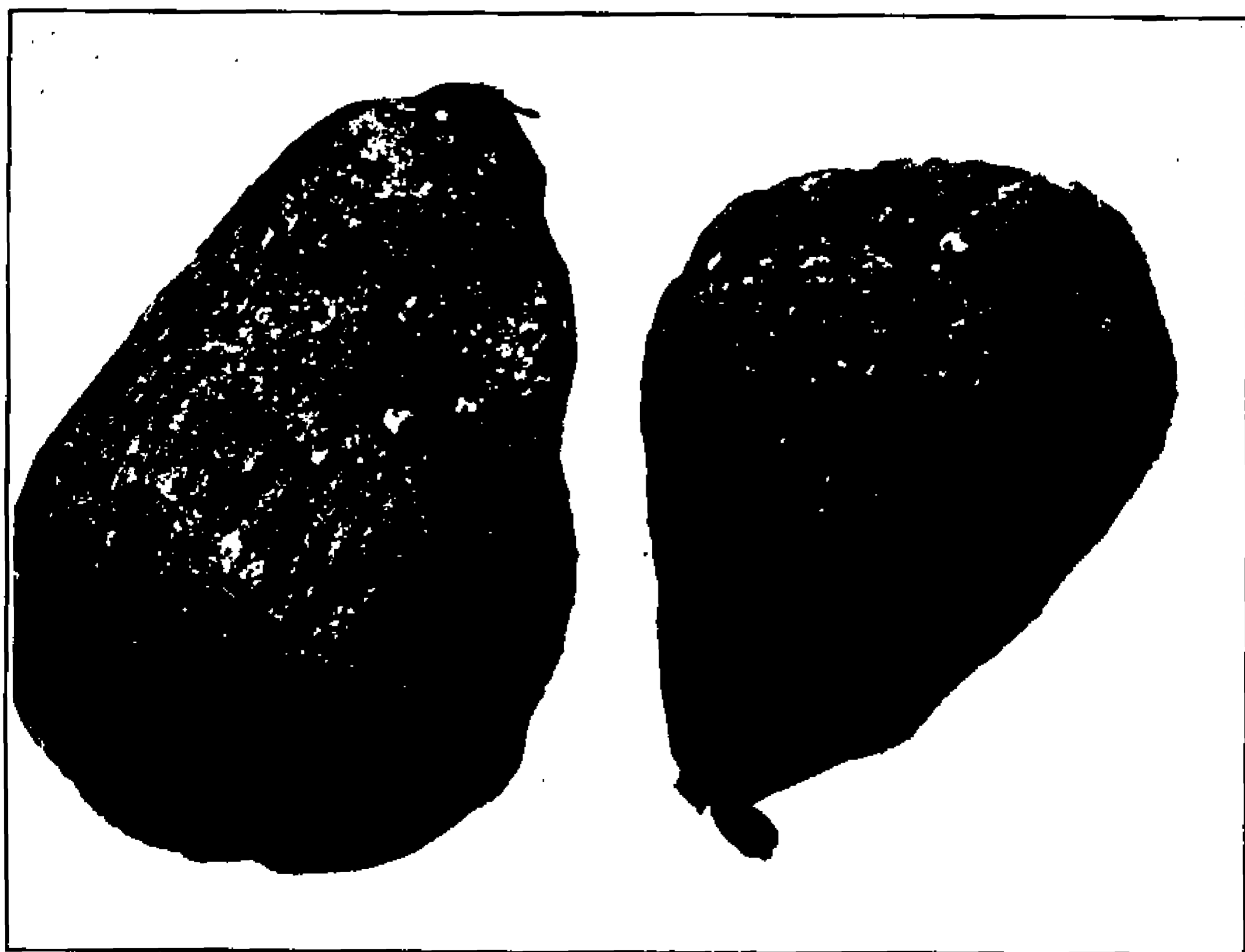


FIG. 2.—DRIED COTYLEDONS OF COCONUTS.

Brought by Dr. Edward Palmer from the region of Acapulco, where they are called "coconut apples" (manzanas de coco). (Natural size.)

that we should not have had much more numerous and extended reports of it during the period of discovery. The lack of more adequate accounts does not appear so surprising if we consider that even at the present day the coconut is not an economic plant of the first rank in tropical America; that is, it is nowhere of such cardinal importance as in the tropical islands of the Pacific.

Outside of a few districts where commercial plantations of coconuts have been established, the status of the coconut among the natives of tropical America remains to-day much the same as it appears to have been at the time of the discovery of America by Europeans. Coconut palms are found on all the coasts and principal islands, planted more or less abundantly as the inhabitants of the different regions happen to be more or less civilized.

People too backward in civilization to have settled abodes do not undertake the cultivation of long-lived tree crops like the coconut. The more primitive tribes of Indians either have no agriculture at all, or a merely nomadic form of agriculture that utilizes only annual or quick-growing crops, which are planted every year in new clearings instead of upon the same stationary farm as in the temperate regions. A reason for this nomadic system of agriculture that generally prevails in forested tropical regions of low elevation is found in the fact that it is much easier to clear a new tract of land every year by cutting and burning than to pull up the weeds that invade cleared land or to maintain the fertility of the soil under continued clearing and cropping. It is only when people have reached the next stage of agricultural development and maintain permanent clearings and gardens, as among the Polynesian and Malayan inhabitants of the islands of the Pacific and Indian oceans, that the coconut and other tree fruits become regular, staple products. Elsewhere, as among the tropical Indians of America and the natives of Africa, the coconut remains only secondary and exceptional, planted occasionally in the larger villages or towns that happen to be located near the coast, but nowhere attaining any serious or indispensable importance.

At the present time the progress of the West Indian coconut industry, if not the actual existence of the palm in this region, appears to be threatened by a serious disease, which enters the terminal bud and kills the palm. Investigations of this disease indicate that it is due to a bacterial parasite, which appears to be spreading very rapidly.^a

^a Horne, W. T., *La Enfermedad de los Cocoteros*, Boletín Oficial de la Secretaria de Agricultura, Industria y Comercio, vol. 3, p. 1. (1907.) *The Bud Rot and Some other Coconut Troubles in Cuba*, Bull. 15, Estacion Central Agronomica de Cuba. (1908.)

Johnston, J. R., *The bud rot of the coconut palm*, U. S. Department of Agriculture, Bureau of Plant Industry, Circular 36. (1909.)

The meat of the ripe nut, for which coconuts are imported into temperate countries, is not the part most valued in the tropics, but the "milk" of the unripe nut. On many of the coral islands of the Pacific, where there are no springs or other supplies of water, the natives could not survive without the milk of the coconut. In Porto Rico and elsewhere in America the coconut is also valued chiefly as the source of a beverage, but where fresh water is as abundant as in the West Indies the milk of the coconut is a luxury rather than a necessity. The unripe nuts are carried to the towns and sold as a beverage, like lemonade or soda water in temperate regions.

The meat of the coconut has little more importance in the American tropics than in the United States, being used mostly for pastry and confectionary, and not as a staple article of diet. Even the oil of the coconut which serves so many culinary and other domestic purposes in the East Indies is almost unknown in the American tropics. The extraction of the oil and its use in cooking are said to be practiced in British Honduras and in Trinidad, but by European residents rather than by the natives of the country. There are no such multitudinous applications of the shells, husks, fibers, leaves, sap, and all other parts of the palm as in the East Indies.

On the west coast of Mexico, according to Dr. Edward Palmer, use is made of the so-called "coconut apple" (*manzana de coco*), in reality the swollen cotyledon of the germinating nut. The cotyledon gradually absorbs the food materials stored in the meat of the nut, at the same time increasing in size till it fills the whole cavity of the shell. The fleshy part of the cotyledon is said to have a pleasant, sweetish taste, and to be much more delicate and more readily digestible than the meat itself. The coconut "apples" are also dried and are sold in the native markets in this condition. Plate 53, figure 2, shows a photograph of two dried cotyledons of the coconut. There is nothing to show whether the use of the cotyledon represents a native custom in Mexico or was imported from the Pacific Islands, where it also exists. The making of fermented drink called "tuba" from the sap of the palm appears to have been introduced into the vicinity of Acapulco from the Philippines, as indicated by the presence of the Filipino names.

An additional reason why the culture of the coconut palm was not flourishing in the West Indies at the time of the discovery is found in a fact of history. Columbus and other early explorers made repeated statements to the effect that the inhabitants of the islands were everywhere at war with the Caribs, the seafaring cannibals who preyed upon the more peaceable agricultural natives of the islands. The fear of the Caribs kept the natives from living near the coasts.

Even when the lands along the coast were extensively cultivated, as described by Columbus in Hayti, it was difficult to find people or houses.^a One of Peter Martyr's letters to the Pope gives an account of the Caribs and reflects the impression of the early explorers regarding the havoc wrought by them in the West Indies.

Theyr common meate, is *Ages, Iucca, Maizium, Battata*, with suche other rootes and frutes of trees, and also suche fysshe as they vse in the Ilandes and other regions of these prouinces. They eate mans fleshe but seldome, bycause they meete not oftentymes with strangiers, except they goo fourth of theyr owne dominions with a mayne armye of purpose to hunt for men, when theyr rauenyng appetite pricketh them forward. For they absteyne from them selues, and eate none but suche as they take in the warres or otherwyse by chaunce. But suerly it is a miserable thyng to heare howe many myriades of men these fylthy and vnnaturall deuourers of mans flesshe haue consumed, and lefte thousandes of moste fayre and frutfull Ilandes and regions desolate withowte menne: By reason wherof owre men founde so many Ilandes whiche for theyr fayrenes and frutefulnessse myght seeme to bee certeyne earthly Paradyses, and yet were vtterly voyde of men. Hereby yowre holynesse may consider howe pernicious a kynde of men this is.^b

With such enemies to pounce upon them from the sea it is easy to understand that the coconut palm could not be popular among the coast-dwelling natives of the West Indies after the Carib invasions began. To plant coconut palms, or even to allow them to grow where they could be seen from the sea, would only invite the attacks of the cannibals by showing them where their human prey could be found.

THE PALMS OF COCOS ISLAND.

Another piece of definite evidence regarding the habits and history of the coco palm comes from a small island in the Pacific Ocean about 300 miles to the west of Panama. The name Cocos Island was given by the early navigators because of the abundance of coconut palms found on it. Since the coming of the Spaniards, however, the island has not been inhabited and the coconut palms have almost completely disappeared. Prof. H. Pittier, who visited Cocos Island in May, 1898, and again in February, 1902, in the interest of the Costa Rican Government, reports that the palms that now abound on Cocos Island are not coconut palms, but belong to the genus *Euterpe*. Some of the American palms that have been referred to *Euterpe* have a superficial resemblance to coconut palms,

^a He believed that the villages must be at a distance from the sea, whither they went when the ships arrived; for they all took to flight, taking everything with them, and they made smoke-signals, like a people at war.—The Journal of Columbus, trans. by C. R. Markham, p. 104, Hakluyt Society, 1893.

^b Martire in Arber, op. cit., p. 159. (See footnote, p. 276, above.)

but they belong in reality to a distinct group, much more related to the Cuban royal palm than to the coconut.^a

Excepting a few planted very recently by a treasure seeker living on the island, the only coconut palms found by Professor Pittier were a small cluster near the southwestern end, on a beach so protected by rocks and breakers that landing from the sea is quite impracticable. The mountains visible from the anchorages at the other end of the island are clothed with the Euterpe palms, not with coconut palms. The treasure seeker had brought coconuts from Puntarenas, Costa Rica, and planted them at Wafer Bay, but these were found to be different from those already growing on the island. Some of the latter had also been planted recently at Chatham Bay.

De Candolle refers to Dampier as having found an abundance of coco palms on Cocos Island and looks on their presence on an uninhabited island so close to the American continent as an additional reason for believing that the shores of the New World might have been stocked by sea-borne nuts from the archipelagoes of the Pacific. It has been shown in the previous paper that Dampier did not visit this Cocos Island, and that the "island of cocos" to which Dampier referred was near the coast of Colombia. It was not, as De Candolle supposed, the Cocos Island of modern maps.^b

From the preceding facts it might be inferred that Cocos Island had been misnamed as a result of mistaking the Euterpe palms for coconuts, but there is historical evidence to justify the name. Although Dampier, as before stated, did not visit Cocos Island, we have an authentic account by Wafer of the existence of large numbers of coconuts on this island in 1685. Wafer was at one time Dampier's first officer, and his "Travels" are often bound with Dampier's "Voyages." This may explain De Candolle's citation of Dampier's statement as applying to the modern Cocos Island. Though Wafer was not a botanist, his account of the coconuts of Cocos Island is too circumstantial to permit us to doubt that coconuts existed in abundance in his day.

Our men being tolerably well recover'd, we stood away [from the Gulph of Amapalla] to the Southward, and came to the Island Cocos, in 5 Deg. 15 Min. N. Lat. 'Tis so called from its Coco-Nuts, wherewith 'tis plentifully stor'd. 'Tis but a small Island, yet a very pleasant one: For the Middle of the Island is a steep Hill, surrounded all about with a Plain, declining to the Sea. This Plain, and particularly

^a The resemblance lies in the shape and position of the leaves when seen at a little distance. The crown of leaves of the royal palm does not resemble that of the coconut, because the leaflets are inserted at different angles along the midrib, but this is not the case in the Porto Rico mountain palm (*Acrista monticola*) nor in the still more graceful *ternera* or *halaute* (*Plectis oveniana*) that adorns the summits of many limestone mountains in eastern Guatemala.

^b Contributions from the U. S. National Herbarium, vol. 7, pp. 264, 265. (1901.)

the Valley where you go ashore, is thick set with Coco-nut Trees, which flourish here very finely, it being a rich and fruitful Soil. They grow also on the Skirts of the Hilly Ground in the Middle of the Isle, and scattereing in Spots upon the Sides of it, very pleasantly.^a

So much for the number and location of the palms. That this description does not, by any chance, apply to any other palm with which the coconut could be confused, even in the seventeenth century, is shown by a further incident.

Nor did we spare the Coco-Nuts, eating what we would, and drinking the Milk, and carrying several Hundreds of them on board. Some or other of our Men went ashore every Day: And one Day among the rest, being minded to make themselves very merry, they went ashore and cut down a great many Coco-trees; from which they gather'd the Fruit, and drew about 20 Gallons of the Milk. Then they all sat down and drank Healths to the King and Queen, etc. They drank an excessive Quantity; yet it did not end in Drunkenness: But however, that Sort of Liquor had so chilled and benumb'd their Nerves, that they could neither go nor stand: Nor could they return on board the Ship, without the Help of those who had not been Partakers in the Frolick: Nor did they recover it under 4 or 5 Days Time.^a

In view of these statements the present complete, or nearly complete, extinction of the coco palm can scarcely be understood except as the result of the absence of human inhabitants from Cocos Island during the last two centuries, another example of the fact that the species can not compete with the vegetation of the coasts and islands of the humid tropics. If Cocos Island were a mere coral atoll or sand bar, the traditional possibility of sea-drifted coconuts could still be drawn upon, but it has an area of about 18 square miles and a mountainous surface, the highest peak rising about 660 meters. When the size and topography of the island are considered and the presence of a considerable native flora, Wafer's statements regarding the coconut groves on the slopes away from the sea would seem to point to clearing and planting by the hand of man though the apparent number of the palms may have been increased by confusion with the native species that grows on the mountains.

That there were no inhabitants at the time of Wafer's visit does not prove that the island had never been occupied. Even without a permanent population the coconuts may have been planted and cared for by natives of the mainland for use during fishing expeditions, a plan followed in some localities in the Malay region. The serious disturbances that followed the arrival of the Spaniards in the Panama region would naturally tend to interrupt such visits. Already in Wafer's time the palms must have been abandoned long enough to conceal the evidences of human agency in planting them, for any more direct indications that the island had been inhabited would undoubtedly have been noted.

^a Wafer's *New Voyage and Description of the Isthmus of America*, in Dampier's *Voyage*, vol. 3, pp. 379, 380. (London, 1729.)

One of the coconuts brought back by Professor Pittier from Cocos Island proved to be quite unlike the varieties grown in Costa Rica. It was less than half the size of the mainland coconuts and was nearly round, measuring 11 centimeters long by 11.5 centimeters wide. The "eyes" were unusually large, the fertile foramen measuring 1.8 centimeters across. We can hardly hope to learn whether the single cluster of small-fruited coconut palms found by Professor Pittier represented the last survivors of the multitude found by Wafer. Whether we take this view or assume that they were brought by some unknown expedition or were drifted in from the sea and planted by accident, as coconuts have been supposed to be, the fact remains that no coconut palms survived in the parts of the island that Wafer visited and described.

The island suffered from a plague of rats at the time of Professor Pittier's visit, and he suggests that these animals might have been responsible for the disappearance of the coconut palms. It is true that rats often do serious damage in plantations, making it necessary to belt the palms with tin to keep the pests from climbing up. But if the extinction of the palms is to be ascribed to the rats, they must be considered as a very general factor, since they are distributed over the whole tropical belt where coconuts are cultivated, from Porto Rico to the islands of the Pacific and Indian Oceans. They would be as likely to interfere with the perpetuation of coconuts in any abandoned place as on Cocos Island.

Ethnologists may find in this hitherto unsuspected primitive occupation of Cocos Island an additional evidence of the maritime skill of the Indians of the Pacific coast of tropical America, and thus be the more willing to consider the possibility of prehistoric communication between the shores of the American Continent and the Pacific islands. The accounts which the Peruvians gave to the Spaniards of lands in the Pacific led to the fitting out of the expeditions of Mendaña, Sarmiento, and Quiros. The Polynesians also had traditions of places farther east than any existing islands. The natives of the Marquesas Archipelago, the group that lies nearest to Cocos Island and the Isthmus of Panama, told Captain Porter that the coconut was brought from another island to the eastward.

The cocoa-nut tree, as I before remarked, was said to have been brought from Ootoopoo, an island which is supposed by the natives to be situated somewhere to the windward of La Magdalena.

None of our navigators have yet discovered an island of that name, so situated; but in examining the chart of *Tupia*, that native of the island of *Ulitea* who left there with Captain Cook on his first voyage, we find nearly in the place assigned by the native of *Noaheevah* to *Ootoopoo* an island called *Ootoo*.^a

^a Porter, D., *Journal of a Cruize made to the Pacific Ocean*, vol. 2, p. 139. (Philadelphia, 1815.)

Porter notes the further fact that a native of the Society Islands had given to Captain Cook, fifty years before, a similar name for an island supposed to be located to the eastward of the Marquesas group. Like other Polynesians, the natives of this archipelago were accustomed to sail away with their families in large canoes well provisioned with food and with cuttings of their cultivated plants, to discover and colonize new islands. An Englishman, who had lived in the Marquesas for several years, informed Porter that he had known of the departure of more than 800 people who left "in search of other lands," never to return.

As an indication that some of these expeditions from Polynesia reached the American Continent we may refer to the presence of the banana, a plant certainly native of the Old World, and also widely distributed in pre-Spanish America. Balboa found, on his first expedition across the Isthmus of Panama, a tribe of dark-skinned, heavily tattooed people with frizzled hair, which various historians have described as negroes, following a statement to that effect by Peter Martyr.

There is a region not past two dayes journey distant from *Quarequa*, in which they founde only blacke Moores: and those excedynge fierce and cruell. They suppose that in tyme paste certeyne blacke mores sayled thether owt of *Aethiopia* to robbe: and that by shippewracke or some other chaunce, they were dryuen to those mountaynes.^a

Oviedo's much more detailed account of these people makes it apparent that they were not negroes. Peter Martyr's statement is in the nature of a casual report echoed from second-hand information. Oviedo's narrative was drawn up on the Isthmus where he arrived in 1513, the year after Balboa crossed. It embodies the direct testimony of Balboa himself and other eyewitnesses of the events of his remarkable expedition.^b

It is evident enough from Oviedo's account that the black frizzle-haired people encountered by Balboa were recent intruders and not ordinary Indians, but there is not the slightest indication, expressed or implied, that they were African negroes, who were quite unable to make voyages to America, either by design or by accident. The Kroos and other maritime tribes of West Africa use only small canoes and make only short voyages along the coast, usually going ashore to sleep. The Pacific, however, was the scene of a general

^a Martire in Arber, op. cit., p. 139. (See footnote, p. 276.)

^b Oviedo, *Historia General y Natural de las Indias*, vol. 3, pp. 8, 126-129. (Madrid, 1851: see above, p. 278.) The reason why the facts given in this most extensive of the early histories of America have not received more general consideration is doubtless to be found in the fact that the work, though written in the early part of the sixteenth century, was not published until the middle of the nineteenth, except in the form of short extracts and abridgements, which gave small indication of the detailed circumstantial character of much of the information.

maritime activity, as shown not only by the Polynesians, but by the dark, frizzle-haired Melanesian people who were extending themselves to the eastward and had reached not only to Fiji and Tonga, but to Tahiti^a and the Marquesas.^b

The place where these frizzle-haired people were found by Balboa was close to the Pacific Ocean and very far from the Atlantic. Nor is it entirely impossible that additional present-day evidence is still to be obtained by careful ethnological study of the Panama region, where a rather peculiar clan of frizzle-haired, seafaring people still exists, locally called Chiricanos. They are commonly supposed to represent an intermixture of negroes and Indians, but are worthy of study as a possible remnant of Polynesian influence.

The period in which the coconut was first carried westward across the Pacific was, in all probability, so extremely remote that shore lines and land masses may easily have been different from what they are now. Other low-lying islands between Cocos and the Marquesas group may have disappeared, but the biological and historical facts do not leave us dependent on such speculations for an assurance of human contacts between the Pacific islands and the coasts of tropical America. It becomes obvious that the possibility of communication with the islands of the Pacific may have continued nearly to the time of the coming of the Spaniards, and that not by ocean currents or shipwrecks, but by deliberate voyages of maritime people, whose other exploits in the Pacific show that they were quite capable of carrying the coconut into the Pacific, and, many generations later, of bringing the banana back.

THE COCONUT PALM UNABLE TO MAINTAIN ITSELF ON SEACOASTS.

The disappearance of the coconut palms from Cocos Island is a striking example of the general fact that the coconut palm is not only unable to establish itself on seacoasts, but is unable to persist after it has been planted. The greater the emphasis laid upon the idea that the coconut can float, and can be cast up and grow on the beach, the greater appears the discrepancy between the theory of maritime distribution and the actual facts, for the palm is not known to exist except as a cultivated plant in the care of agricultural people.

That nuts are sometimes carried for long distances by the sea there can be no doubt; everything is carried that has a sufficiently low specific gravity. A striking instance of this kind has been

^a Bougainville, *A Voyage Round the World* (1766-1769), trans. by John Forster, p. 249. (London, 1772.)

^b Quiros (1595), in Dalrymple, *Historical Collection of Voyages and Discoveries*, vol. 1, p. 69. (London, 1770.)

personally communicated by Dr. W. E. Inksetter, of Alajuela, Costa Rica. A coconut, with the husk intact, was found on the beach in the island of Ronsay, in the Orkney group, to the north of Scotland, in the winter of 1892-93. Doctor Inksetter saw the nut and drank some of the milk, which was still in good condition.

But of what advantage is such transportation if the nut encounters unfavorable conditions when it lands, and thus fails to germinate or to grow to maturity and establish its seedlings in turn? We should find on some tropical coast a place where the palms thrive and multiply, where we find old palms surrounded by flourishing young ones, growing spontaneously, without the aid of man, but no such instance has been reported. Instances of floating nuts or of supposedly self-sown palms indicate the opposite of what they are sometimes thought to prove, for the failure of the palms to persist is only emphasized by showing that opportunities have been ample. There seems to be no authentic record of coco palms establishing and maintaining themselves on any tropical coast in a wild or truly spontaneous condition. A palm that is unable to maintain itself on the land has nothing to gain by having its nuts drifted about by the sea.

The complete absence of coconuts from the extensive tropical coast line of Australia until planted by European colonists has already been cited as a gigantic experiment showing that the coconut did not establish itself without human help, even in a place where it afterwards thrived in cultivation. It is known that the shores of Australia were visited yearly by many Malay fishing boats carrying large quantities of coconuts among their food supplies. Many nuts have also been found cast up on the tropical beach of Australia. The palms exist in large numbers on small islands in the Torres Straits, only 30 or 40 miles from the Australian coast. The contrast between these palm-covered islands and the palmless shores of Australia has made a strong impression upon eyewitnesses.

Murray Island is about 700 feet high at its highest point, and consists of steep broken ground. Its whole aspect is singularly different from any part of Australia, since the whole of its lower portion, and a good part even of the hills, is covered by a continuous grove of cocoa-nut trees. The entire absence of these trees from every part of Australia is a most striking fact, since it is, I believe, the only country in the world so much of which lies within the Tropics in which they have never been found. We had once or twice found cocoa-nuts on the beach, still more or less fresh; and here is an island, absolutely within the Great Barrier reef, completely covered by them, and yet neither by Flinders, King, Wickham, Stokes, or ourselves have any trees been discovered anywhere upon the mainland. We could perceive many natives on the beach of Murray Island, as also a nearly continuous line of large dome-shaped

huts, surrounded by fences of tall poles ornamented by large shells; everything shewing the natives to be a different race of beings from the Australians.^a

The explanation of the absence of coconuts in Australia has been found by all travelers in the fact that the Australian natives differ from those of all the Pacific islands in being nonagricultural. The same is true of another peculiar and very primitive people living on the Andaman Islands of the Indian Ocean. With them also the coconut palm was lacking, though their islands lie in the midst of the East Indies, where the coconut and its numerous varieties have been supposed to originate and distribute themselves by sea.^b

No other inhabited tropical coasts and islands of the Pacific and Indian oceans appear to be without coco palms, but no other peoples failed to plant and care for them. Throughout this region there is no difference of popular opinion regarding the strict dependence of the coconut upon man. The idea of wild coconuts planting themselves on tropical seacoasts is strictly the product of the imagination of authors who have written books about the Tropics without visiting such regions, or at least without taking into account the opinions of those who have first-hand familiarity with the habits of the palm.

Throughout the South Sea islands coco-nut palms abound, and oil may be obtained in various places. Some of the uninhabited islands are covered with dense groves, and the ungathered nuts, which have fallen year after year, lie upon the ground in incredible quantities. Two or three men, provided with the necessary apparatus for pressing out the oil, will, in the course of a week or two, obtain enough to load one of the large sea canoes. . . .

The coco-nut is essentially a maritime plant, and is always one of the first to make its appearance on coral and other new islands in tropical seas, the nut being floated to them, and rather benefiting than otherwise by its immersion in the salt water.^c

The authority of Simmonds might seem to give weight to these statements, but no such ideas are found in the account of the coconut palm in that author's subsequent manual of Tropical Agriculture. The islands where the coconuts established themselves and accumulated in "incredible quantities" were never specified.^d

^a Jukes, *Voyage of the Fly to the Eastern Archipelago*, 1842, vol. 1, p. 132. (London, 1847.)

^b It is interesting to note that with the exception of a few spots, evidently planted by the early colonists, cocoa-nuts do not occur in the Andamans, and this is especially remarkable from the fact that the conditions are favorable for their propagation.—Safford, W. E., *The Abbott Collection from the Andaman Islands*, Smithsonian Institution, Ann. Rep., 1901, pp. 477-492. (1902.)

^c Simmonds, P. L., *The Commercial Products of the Vegetable Kingdom*, pp. 549, 550. (London, 1854.)

^d If anything further is needed to show that Simmonds had no direct knowledge of the coconut palm when the earlier work was written, his fanciful statement regarding the germination and growth of the palms will certainly suffice. Almost every line contains a fresh error.

"The coco-nut is usually planted as follows: Selecting a suitable place, you drop into the ground a fully ripe nut, and leave it. In a few days a thin lance-like shoot



FIG. 1.—COCONUT PALMS OVERHANGING THE SURF AT HIGH TIDE, PUERTO BARRIOS, GUATEMALA.



FIG. 2.—COCONUT PALMS OVERHANGING THE SEA, LIVINGSTON, GUATEMALA.
The trunks lean very strongly toward the sea as a result of competition with other vegetation.

The conclusions of those who have considered the subject from the tropical standpoint and with the advantage of actual contact with tropical conditions, have been canvassed in the previous paper, but a few of their statements may be repeated. Pickering testifies:

. . . *C. nucifera* throughout the Pacific occurs only on those islands to which it has been carried by the natives, a fact well known to traders; was observed by myself only under cultivation throughout the islands of the Pacific and the Malayan Archipelago.^a

. . . So invariably is its presence attributable to human operations that it has become a guide to the traders in seeking for natives.

Notwithstanding that the fruit is well adapted for floating uninjured over a wide expanse, I have never met with an instance of a cocoa palm having spontaneously extended itself from island to island.^b

Other testimonies are the following:

. . . It is to be emphasized that all coconuts are *planted*; the idea of a wild palm being as strange in Funafuti as that of a wild peach might be in England. . . . I doubt whether, despite popular opinion to the contrary, a wild coconut palm is to be found throughout the breadth of the Pacific.^c

. . . From repeated observation, [in the Solomon group] I am convinced that the coco-nut palms will rarely grow, and certainly will not bear fruit, unless attended to and kept clear of overgrowing trees.^d

. . . The Cingalese have a saying that Cocoa-nut trees do not thrive unless "you walk and talk among them," indicating that trees thrive the best when carefully attended to.^e

THE COCONUT PALM NOT TOLERANT OF SHADE.

When the traveler who lands for the first time on a tropical coast looks up along the shore and sees the coconut palms leaning out toward the strand or actually overhanging the water, he is at once reminded of and confirmed in the idea of maritime distribution. (Pl. 54, figs. 1 and 2.) But if he looks further into the facts he will learn

forces itself through a minute hole in the shell, pierces the husk, and soon unfolds three pale-green leaves in the air, while, originating in the same soft white sponge which now completely fills the nut, a pair of fibrous roots pushing away the stoppers which close two holes in an opposite direction, penetrate the shell, and strike vertically into the ground. A day or two more, and the shell and husk, which in the last and germinating stage of the nut are so hard that a knife will scarcely make any impression, spontaneously burst by some force within; and, henceforth, the hardy young plant thrives apace, and needing no culture, pruning, or attention of any sort, rapidly arrives at maturity."—Simmonds, *op. cit.*, p. 555.

The rapidity of germination and growth are entirely misconceived; only one leaf is produced at a time, and the first leaves are simple, not three-parted; roots do not come out of the holes, but grow from the young plant; the shell does not burst; the young palms do not thrive without care.

^a Pickering, Charles, *Chronological History of Plants*, p. 428. (Boston, 1879.)

^b Pickering, Charles, *The Races of Men*, pp. 54, 323. (London, 1851.)

^c Hedley, *Memoir III*, Australian Museum, Sydney, p. 22. (1896.)

^d Woodford, *A Naturalist Among the Head Hunters*, p. 194. (London, 1890.)

^e Seemann, B., *Popular History of the Palms and their Allies*, p. 158. (London, 1856.)

that coconuts do not grow toward the sea in order to be able to drop their fruits into the waves, but because this side is bare to the sun. The trunks of the palms reach out toward the sea for the same reason that house plants turn toward the window. Many writers overlook this fact, but there are exceptions, as the following statement will show:

. . . We must also give up the poetic fancy that the coconut tree stretches out towards the sea because it loves the briny breeze. The truth is, that the tree is a lover of light, and will bend in any direction to reach it; and as there is no obstruction on the sea shore it naturally bends in that direction and would do the same if the open space were inland. So sensitive is it to shade of the lightest that it instinctively bends away from it, and instances may be seen where the tree has grown almost horizontally till outside the influence of the shade before it assumed its upward growth.^a

The better exposure to the sun goes far to explain the fact that coconut palms usually thrive better close to the sea. It is easier to give coconuts the necessary exposure along the beach where the other vegetation is less luxuriant than a few rods farther back, and the beach locations where the coconuts will thrive may be of no use for any other crop. Coconuts are accordingly planted in many spots where no other evidences of agriculture appear, so that the unwary traveler has many opportunities to form conclusions which a little further investigation would dispel.

It is very natural, no doubt, to assume that the coconuts rising up from among other vegetation or overhanging the sea from the end of a promontory (pl. 54, fig. 2) are wild palms, but a moment's reflection would make it apparent that the planting of palms in such a place is necessarily the work of man. Coconuts might be stranded on a low or sloping beach, but they are not to be thrown up on high ground where the waves do not come. And if they were carried in among the other plants they could not by any possibility have survived. The other vegetation has to be cleared away when coconut palms are planted.

The possibility that a coconut might be stranded on a newly formed island and multiply in the unoccupied soil, according to the fable, may not be absolutely excluded, but we know that the monopoly would not be of long duration. The very prosperity of the palms would but assist in the gathering of more fertile soil and hasten the ascendancy of their forest-forming competitors, many of which are far better able than the coconut to establish themselves on unoccupied shores. The game would be a losing one, with extinction in prospect

^aJardine, W., *The Cultivation of the Coconut Palm*, *Tropical Agriculturist*, vol. 24, p. 151. (1905.)

at the end of a few generations, even though the coconuts arrived first and succeeded in establishing themselves.^a

Many cultivated plants and weeds have escaped from gardens and adopted an independent existence in parts of the world very remote from their original home. The finding of such a species in a wild state proves that the conditions are favorable to its growth, even though it gives us no evidence regarding the original home of the species. When a plant with the prolonged, world-wide opportunities of the coconut fails anywhere to escape and become established, but remains completely dependent upon man, it seems obvious that the tropical coasts where man has planted it do not afford the ideal conditions for its existence, the conditions under which it would be likely to develop as a wild plant.

Other kinds of palms afford excellent examples of intolerance of shade, showing that this character is shared in different degrees by many members of the group. An extreme case is found in Central American fan palms of the genus *Brahea*, that usually grow on precipices of limestone rock. In forested districts these fan palms are confined to the perpendicular walls, the only situations that afford them the necessary exposure to sunlight. Most of the seeds of these palms must fall into the forests below, but young palms are found only in the crevices of the cliffs. It does not appear that even small seedlings are developed without more light than the forest conditions afford. If natural selection could have rendered the species more

^aDr. H. B. Guppy has held (*Journ. Trans. Victoria Inst.*, vol. 24, p. 267. 1890) that the coco palm was native in the Cocos or Keeling Island of the Indian Ocean, to the southwest of Sumatra, but his account is far from convincing. He admits that the island had been visited by Malays before the advent of European settlers, and also that the crabs never permit the young palm seedlings to become established unless the nuts are well buried by the planters.

Schimper found in his extensive studies of Malayan strand floras no instance of successful self-grown coconuts. (Schimper, A. F. W., *Die indo-malayische Strandflora*, 162. 1891.) Mr. W. E. Safford reports that coconuts, along with seeds of many other plants, are frequently drifted to the sandy windward beaches of the island of Guam, but that no palms grow on this uninhabited coast.

A recent work entitled "The New Flora of the Volcanic Island of Krakatau," by Prof. A. Ernst, contains a photograph of a group of nearly a dozen coconut palms, standing well back from the strand, all of nearly the same size and at nearly equal distances. Reports of the early visits to the island did not show the presence of coconut palms, though many other plants had established themselves. An explanation of the presence of the palms away from the strand is probably to be found in the changes that have continued to take place in the topography of the new island, as indicated in the following statement:

. . . "It is obvious that the oldest strand-plants, which sprang from the seeds and fruits from the drift formed in the first year, have been gradually separated from the beach by a constantly increasing belt and that during this shifting of the shore-line new plant-germs were introduced with the pumice and took part in the formation of the present discontinuous strand-forest" (p. 69).

tolerant of shade the conditions would seem to be most effectively arranged for bringing this about, but very little progress appears to have been made, in spite of the most rigorous and persistent selection that could well be imagined.

Many other palms are able to germinate in places where there is not light enough to enable them to grow to maturity. The seedlings may be reckoned as shade tolerant during the early period, while they can draw upon the nourishment stored in the seed, but without access to direct light they never complete their development. Young seedlings of the Porto Rican mountain palm (*Acrista monticola*) were found in great numbers near Utuado, Porto Rico, in July, 1901, in one of the dense forests of tabonuco (*Dacryodes hexandra*) that still crown the summits of a few of the mountains of that island. The young palms grow thickly over large areas, forming almost the sole undergrowth of the forest. Yet in spite of the vast numbers of seedlings not a single adult palm could be seen. The seeds of the mountain palms are said to be brought into the forest by wild pigeons that prefer the lofty tabonuco trees for roosting places.^a

The African oil palm presents similar facts. The seedlings are tolerant of shade and very tenacious of life. They are found in vast numbers along the paths in the forests where the seeds are dropped by the natives, who commonly use the fruits as food on their journeys. But in spite of the vast numbers of seedlings, mature oil palms are never found in the forest belt, except where natives have cleared the land for rice or cassava. It is easy to understand why oil palms are much more abundant in regions that support large native populations, as in Dahomey. The more frequently the land is cleared the greater the advantage of the oil palms over other forms of vegetation.

In their relation to external conditions the whole natural order of the palms can be divided into two distinct series, those that are tolerant of shade and those that are not. Many species of small palms live as undergrowth in the shaded depths of tropical forests, and are, in nature, strictly confined to such situations. The forests of tropical America afford numerous examples of undergrowth palms among the species of *Chamaedorea*, *Geonoma*, and related genera. All of the large palms, those that attain the dimensions of trees, require exposure to the sunlight in order to complete their development.

The palms may have been more prosperous in some former geologic time, but the competition of more modern and efficient types of vegetation now confines them to situations relatively unfavorable for

^aThe Porto Rican mountain palm was described as a new genus in 1901. (O. F. Cook, A synopsis of the palms of Porto Rico, Bulletin of the Torrey Botanical Club, vol. 28, p. 555.) For a photograph of the tabonuco forest in which the seedling palms occur, see Cook, O. F., and Collins, G. N., Economic Plants of Porto Rico, Contributions U. S. National Herbarium, vol. 8, p. 132, pl. 34. (1903.)

other plants, where special conditions enable the palms to persist. Some of the North American palms that require sunlight have taken refuge in deserts of Mexico, while others are confined to the fire-swept pine barrens of Florida. A third series, represented by *Thrinax* and allied genera, occupies the exposed precipices and crags of the dry limestone hills and keys of the West Indies. A fourth series is limited to swamps or river banks (*Augustinea*), and a fifth to high mountain summits (*Acrista*). With the exceptions of the undergrowth palms and the slender rattans and similar climbing types, there are very few true forest species able to secure a footing or even to hold their own in undisturbed tropical tree growth.

These limitations are shared by the coconut and all of its nearer relatives, which inhabit relatively open interior districts, rocky mountain slopes, and barren or exposed situations where vegetation of other types is comparatively sparse. Some of the species frequent river banks, but these are distant and rather degenerate cousins of the coconut. Few members of the family, if any, are natives of truly maritime districts. Very few palms, even of other families, are to be reckoned as definitely maritime plants, for while several frequent the seashore, such as the palmettos of Florida and the West Indies, they are also able to grow away from the sea. A species of *Phoenix* (possibly *P. reclinata*), native in Liberia, is confined to the sea beach, occurring only in the outermost zone of shrubby vegetation stunted by the salt spray, but this apparent preference is likely to be due to the fact that the sea beach affords more of the necessary exposure to the sun than can be obtained in the adjacent forest.

For the want of a more distinctive term, the larger palms are called "trees," but they might be described more correctly as overgrown herbs. Their trunks are always constructed on the same general plan as the cornstalk or the sugar cane, consisting of a central mass of pith with a hard external shell, but without the true bark which enables the trunks of other trees to increase gradually in thickness after beginning their growth as slender shoots. The young coconut palm is under the necessity of producing many leaves at the surface of the ground before the trunk can attain its full diameter and begin its upward columnar growth.

The two or three years that are lost before the upward growth of the trunk can begin are a very serious handicap in the race for existence among the luxuriant and tangled growth of shrubs, trees, and vines which promptly overrun any abandoned land in the humid Tropics. Exogenous plants begin the elongation of the stem immediately after germination, and usually produce much longer internodes in the shade than when exposed to the sunlight. Unless the human friends of the young coconut are at hand to keep down the other vegetation the period of infancy is not survived.

The rattans and other climbing palms that produce slender, long-jointed trunks are able to outgrow other vegetation, but all the palms that form thick, short-jointed trunks suffer the same disadvantage as the coconut. They are unable to compete with other quick-growing forms of vegetation that cover and smother young palms before they can escape by the building of trunks.

The coconut must be reckoned among the palms that are unable to develop without full exposure to sunlight. The seedling plants attain a considerable size in locations that are partially shaded, but this apparent growth arises from the nourishment stored in the huge seed. Large amounts of sunlight appear to be necessary to enable young coconut palms to make any independent growth. This intolerance of shade is a fact of primary importance in the study of the coconut, either from the botanical or from the agricultural standpoint. It explains why coconuts are not able to establish themselves as wild plants in any of the wide tropical regions of low elevation in which they are cultivated.

SOUTH AMERICAN ORIGIN OF THE COCONUT PALM.

As soon as we recognize that the coconut is unable to establish itself or even to maintain its existence on any tropical seacoast, we are no longer at liberty to believe that the species originated in maritime situations. It becomes evident that the home of the plant must be sought in interior localities where the young palms could escape competition with the more luxuriant types of tropical vegetation. While we imagine that the coconut can be disseminated by ocean currents to any part of the Tropics, it seems hopeless to fix upon any particular coast line as the original home of the species, but when we understand that the species must have originated in an interior locality the problem of origin is immediately simplified and very definite conclusions can be reached.

If the coconut could be submitted as a new natural object to a specialist familiar with all other known palms, he would without hesitation recognize it as a product of America, since all of the score of related genera, including about three hundred species, are American.^a With equal confidence the specialist would assign the coconut

^aThe only member of the family Cocaceae that has an extra-American distribution is the African oil palm, *Elaeis guineensis*, a species rather closely related to the American *Elaeis melanococca*. Even in this case the idea of maritime distribution has become unnecessary. The African oil palm has been found in Brazil in an apparently wild state, and may have originated in that country. Dr. F. H. Knowlton, of the U. S. Geological Survey, has showed me seeds of the African oil palm which were taken from an albatross shot off the west coast of Africa by the United States Eclipse Expedition of 1889-90. The powers of flight of the albatross are such as to render it a much more effective agent of distribution than the ocean currents. Moreover, the oil palm does not behave as a littoral species, like the coconut.

to South America, because all other species of the genus *Cocos* are confined to that continent, and he would further locate it in the northwestern portion of South America, because the wild species of *Cocos* of that region are much more similar to the coconut than are those of the Amazon Valley and eastern Brazil. Thus, from a purely biological standpoint, it is reasonable to suppose that the vigorous and productive coconut palms reported by Humboldt in the interior districts of Venezuela and Colombia may have been growing near the ancestral home of the species.

In dealing with a plant like the coco palm we can be confident that it originated in a definite geographical region, along with the other similar and related species. To suppose that the same species has originated in two or more remote regions is quite as absurd an idea, from the standpoint of modern biology, as it would be in geometry to talk of a plane triangle including three right angles. It might be a matter of difficulty and debate to determine which of the other species of *Cocos* were most nearly related to the coconut, or which of the other American genera of *Cocaceae* were most nearly related to *Cocos*, but to insist that the coconut had sprung from the unrelated Malayan or Polynesian palms would be altogether fantastic. Biological facts, though seldom appearing to be as exact and invariable as those of mathematics, are for some purposes equally definite. Geometry gave us the sciences of geography and navigation, and also made it possible to understand the motions of the planets. Biology, like geometry, is a system of bearings and measurements which may assist us in the solutions of many problems.

The inability of the coconut to withstand the competition of ordinary tropical vegetation makes it unreasonable to suppose that the species originated in any region that had a natural forest covering. The fact that other related palms are much more tolerant of shade than the coconut makes it only the more probable that the coconut originally inhabited open places where it could have full exposure to the sun; that is, a place where the conditions were unfavorable for other types of vegetation, but favorable for the coconut. A condition that the coconut can tolerate and that excludes most other vegetation is the presence of salt in the soil. Many salt deposits are found along the eastern side of the Andes from Colombia to Peru. Cieza de Leon devotes a special chapter to the native salt industry of Colombia, mentioning many springs, streams, and lakes in the Cauca Valley, and especially in the district of Anzerma where the coconut palms were found.

Before I treat of the kingdom of Peru, or leave the government of Popayan, it seems to me well to give some account of the notable fountains there are in this land, and of the rivers of water from which they make salt, for thus the people are sustained, having no salt pits in these parts, and the sea being far distant. . . .

In the province called Cori, which is near the town of Anzerma, there is a river which flows with considerable force, and near it there are some ponds of salt water, whence the Indians obtain the quantity they require, and, making great fires, they place jars of this salt water on them, and set the water to boil until from an *arroba* there is not left half an *azumbre*. Then their experience enables them to convert the residue into as pure and excellent salt as is made from the salt-pits of Spain. Throughout the districts of Antioquia there are many of these fountains, and they make so much salt that they take it inland, and exchange it for gold, cotton cloth, and other things which they may require.

Beyond the great river which flows near the city of Calí, and near that of Popayan, towards the north, we discovered a village called Mungia. . . .

In this village of Mungia, and in another called Cenusara, we found some other fountains in mountains near a river, and from these fountains the natives made so much salt that their houses were full of it, molded into shapes exactly like loaves of sugar. They took this salt by the valley of Aburra to the provinces to the eastward, which have not been discovered or seen by the Spaniards to this day. This salt has made the Indians exceedingly rich. . . .

In the province of Anzerma, and in all its districts, there are fountains of the same sort, from which they make salt.

In the city of Cartago every citizen has his apparatus for making salt, which is prepared in an Indian village called Consota, a league from the city, where a small river flows. Near the river there is a mountain out of which comes a large spring of very black and thick water. The water is taken from this spring and boiled in cauldrons until it is nearly all evaporated, when a white-grained salt remains, as good as that of Spain. . . .

In the city of Popayan there are some of these fountains, especially among the Coconucos, but not so many, nor of such good quality as those of Anzerma and Cartago. At Pasto all the salt is obtained by trading, and it is better than that of Popayan. I have seen many springs, besides those which I have now described, with my own eyes, but it seems to me that I have said enough to make the reader understand the manner of procuring salt from these springs.^a

Herndon, who explored the upper waters of the Amazon in eastern Peru near the middle of the last century, mentions deposits of salt in numerous localities in the eastern valleys of the Andes.

. . . At a quarter past 10 we passed the Quebrada, or ravine of Huinagua, on the right. A small stream comes down this ravine, the water of which is salt. The people of Uchiza ascend it—a day's journey—to a salt hill, where they supply themselves with this indispensable article. At twenty minutes past 11 we passed another; and at 1 p. m. another, where the people of *Tocache* get their salt. It is a day's journey from Tocache to the mouth of the Quebrada, and another to the salt hills.^b

The hills of Piltuana, which we now soon passed, have their base immediately upon the river, on the right-hand side. They are about 300 feet in height, and stretch along the banks of the river for a quarter of a mile. The salt shows like frost upon the red earth at a distance; but seen nearer the heavy rains seem to have washed away the loose earth and left nearly the pure salt standing in innumerable cone-shaped pinnacles, so that the broken sides of the hills look like what drawings represent of the crater of a volcano, or the bottom of a geyser. Where the hills have been excavated, beautiful stalactites of perfectly pure salt hang from the roof in many varieties of shapes. There

^a Cieza de Leon, pp. 124–127. (See footnote, above, p. 287.)

^b Herndon, W. L., and Gibbon, L., *Exploration of the Valley of the Amazon*, pt. 1, p. 154. (32d Cong. 2d sess., Executive No. 36, 1854.)

are much higher hills back of these, that appear also to contain salt; so that there seems a supply here for all people and for all time.^a

We passed the salt hills of Callana Yacu, where the people of Chasuta and the Indians of Ucayali and Marañon get their salt. The hills are not so high as those of Pilluana, and the salt seems more mixed with red earth. It "crops out" on the banks of the river, which are shelving, and rise into gentle hills as they recede, covered with bushes and small trees.^b

Every year at this season the Indians of the Marañon and Ucayali make a voyage up the Huallaga for their supply of salt. They travel slowly, and support themselves by hunting, fishing, and robbing plantain patches on their way.^c

Unfortunately, this traveler saw no coconut palms, or at least made no note of them, but a reference to coconuts in eastern Peru has been pointed out to me by Professor Pittier in the surveys of the Intercontinental Railway Commission, near a place called Choros, on the Marañon River, at an elevation of 765 meters.

Vegetation existed only in narrow strips along the immediate edges of the side streams entering the Marañon, and consisted mostly of coarse bushes and undergrowth. At this particular point the natives had a small patch of sugar, and there were half a dozen cocconut palms.^d

No coconut palms are reported by the English botanist Spruce, who explored the region of Tarapoto in eastern Peru and ascended the humid valleys of the Pastasa and Bombonasa rivers on his way to Quito.^e

It would be reasonable to turn to these saline districts of South America if any attempts were to be made to definitely ascertain the original home of the coconut by finding it in a truly wild state. Such a discovery is hardly to be expected, because of the probability that localities suited to the spontaneous growth of coconuts would have attracted human inhabitants, even in very early times. We may hope, however, to find a series of local varieties or subspecies of the coconut palm in these interior localities, varieties that will be more hardy and vigorous than the maritime forms of the palm cultivated in the humid parts of the Tropics, and more likely to thrive under semitropical conditions.

^a Op. cit., pp. 154, 155.

^b Op. cit., p. 165.

^c Op. cit., p. 168.

^d Intercontinental Railway Commission Report, vol. 3, p. 16. On a previous page of the same series (vol. 2, p. 61) coconut palms are noted as cultivated "in a few places" in the Cauca Valley of Colombia.

^e Spruce, Richard, Notes of a Botanist on the Amazon and Andes, edited by A. R. Wallace, vol. 2, ch. 17. (London, 1908.) Also Kew Bulletin of Miscellaneous Information, 1909, p. 216.

DOMESTICATION OF PALMS IN ANCIENT AMERICA.

The general acceptance of the idea that agriculture and other arts of civilization originated in the Old World has undoubtedly tended to complicate the question of the origin of the coconut palm, as studied by Seemann, De Candolle, and other writers on the subject. As the art of agriculture must have begun with the domestication of wild plants, it may be argued that the plants must have existed in the regions where domestication was practiced. The fact that the date, the betel nut (*Areca*), the Palmyra palm (*Borassus*), the toddy palm (*Caryota*), and the sugar palm (*Arenga*) were domesticated in the East Indies would naturally incline the ethnologist to include the coconut in the same list, especially if there appeared to be a difference of botanical opinion on the question of origin. It is important, therefore, from the ethnological standpoint, to take into account the fact that several other palms were more or less completely domesticated in ancient America, some of them relatives of the coconut. The importance of the Old World series of domesticated palms appears greater because higher stages of civilization were reached in the Old World, but the relative importance of palms in the indigenous agriculture of America appears to be fully as great as in the Old World Tropics.

DOMESTICATION OF THE PEACH PALM IN SOUTH AMERICA.

The Indians of the northwestern part of South America—the same region that must be looked upon as the original home of the coconut—domesticated the so-called “peach palm” (*Guilielma*), one of the numerous relatives of the coconut palm. (Pls. 55 and 56.) The peach palm is armed all over with long, slender, shining black spines, sharp as needles, but in spite of this unfriendly exterior the Indians have found it worthy of cultivation. Its handsome red or yellow fruits serve as an important article of diet among the natives of a vast region along the eastern slopes of the Andes, from Brazil and Peru through Ecuador, Venezuela, and Colombia, and even beyond the Isthmus of Panama in the Central American Republic of Costa Rica.

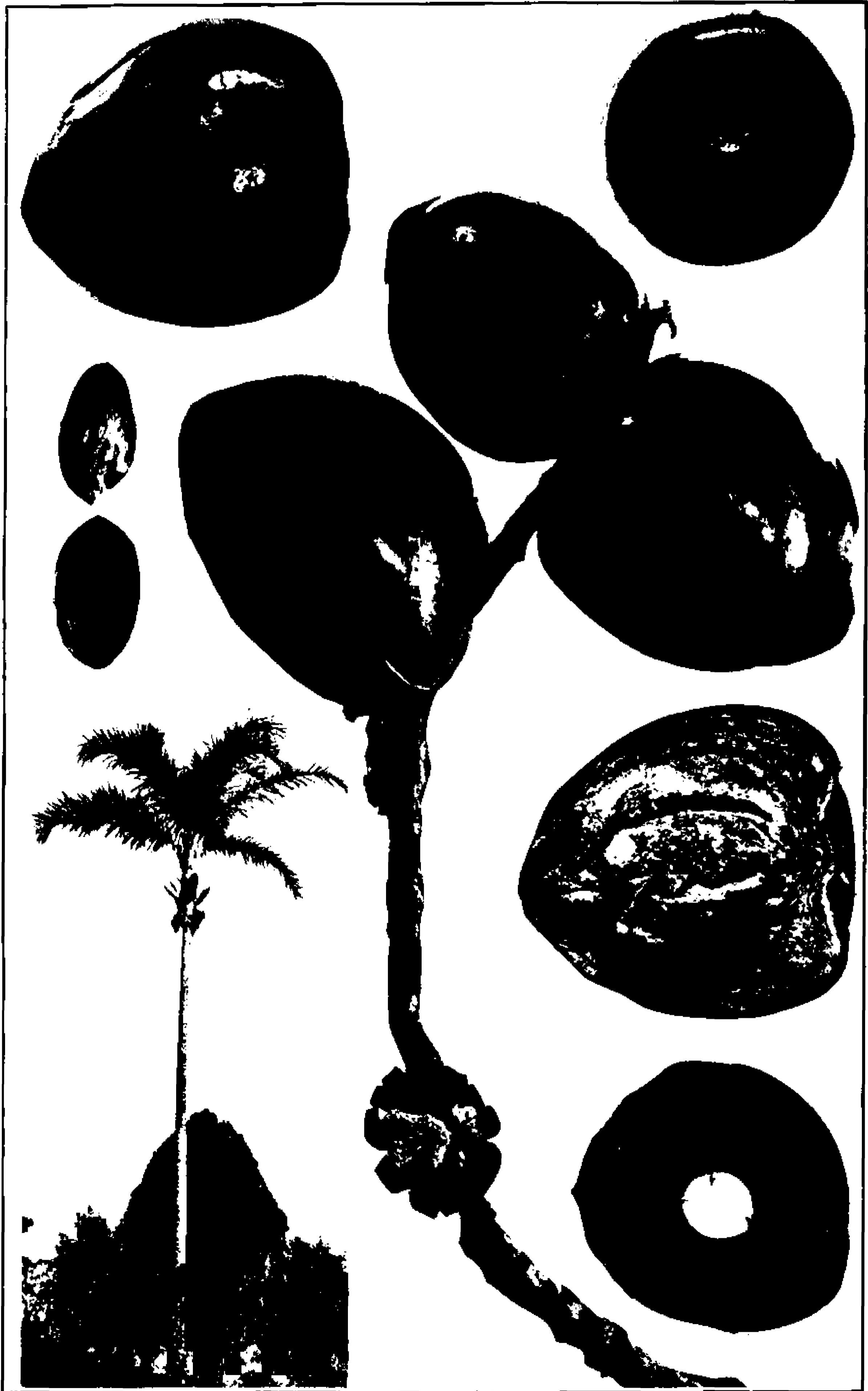
The peach palm appears to be as thoroughly domesticated among the Indians of South America as the date palm among the Arabs. Several botanical explorers of South America have described this palm and its importance among the Indians. The following extract from Alfred Russel Wallace’s “Palm Trees of the Amazon” shows its status in the interior districts of Brazil:

The fruit is about the size of an apricot, of a triangular oval shape, and fine reddish-yellow colour. In most instances the seed is abortive, the whole fruit being a farinaceous mass. Occasionally, however, fruits are found containing the perfect stony seed, and they are then nearly double the usual size. This production of undeveloped



PEACH PALMS (*GUILIELMA SPECIOSA*) IN COSTA RICA.

A relative of the coconut, domesticated in South America. Photograph taken at the coffee estate of señor Federico Tinoco, Juan Vinas.



PEACH PALM (*GUILIELMA SPECIOSA*) WITH FRUIT AND SEED.

Specimens from the cacao estate of Mr. Leon G. Laprade, Rio Hondo, Costa Rica. The small photograph of an adult tree with fruit clusters was made at San Juan, Costa Rica. (Details natural size.)

fruits may be partly due to change of soil and climate, for the tree is not found wild in the Amazon district, but is invariably planted near the Indians' houses. In their villages many hundreds of these trees may often be seen, adding to the beauty of the landscape, and supplying the inhabitants with an abundance of wholesome food. In fact it here takes the place of the cocoa-nut in the East, and is almost as much esteemed.^a

The peach palm is one of the gregarious or cespitose species that send up shoots from underground rootstocks. It is regularly propagated by the use of these young shoots as cuttings, much as in the case of the date palm. It might be inferred that the culture of the peach palm is older than that of the date because some of the varieties are seedless. The propagation of plants from cuttings appears to represent an older system of agriculture than the raising of plants from seeds. Some of the more primitive Indian tribes are accustomed to grow cassava, sweet potatoes, and other root crops from cuttings, though they do not plant corn or beans. The celebrated English botanist, Richard Spruce, who spent eleven years in the interior of South America, was especially impressed with the agricultural importance of the peach palm among the Indians, and attempted to solve the problem of its origin by finding it in a wild state.

. . . I tried in vain to find a root for this name [pijiguao] in any of the native languages, and when I asked the people where they supposed the palm had originally come from they pointed westward and said, "From the Cordilleras;" and I got a similar answer from the natives of the Caupés.

When at length I reached those Cordilleras and traveled along their eastern foot from 7° S. latitude to the Equator, I found, indeed, the Peach Palm very abundant, but still only in the neighborhood of habitations, and always a cultivated plant. If, however, I remained in as complete ignorance as before of its true native country, I saw at once that the Venezuelans, along with the plant, had got also its name from the Andes, but travestied; for the Peruvians call it (in their native Quichua) "Pisho-guayo," i. e. Bird-Fruit, whence to "piguao" the transition is easy. . . .

Although I am compelled to leave the native country of the Peach Palm doubtful, I quite expect the wild plant will still be met with in some unexplored recess of the Oriental Andes, perhaps with the fruit so much smaller and drier than what it has become by long cultivation as to be not easily recognizable. Spruce, Richard, *Palmae Amazonicae*, Journ. Linn. Soc., vol. 11, pp. 81, 82, 1871.

A FIBER PALM DOMESTICATED IN BRAZIL.

Wallace also reports the domestication of another of the spiny relatives of the coconut in the interior of Brazil, not for the sake of the fruits, but for a fiber derived from the young leaves:

Every part of this palm [*Astrocaryum vulgare*] bristles with sharp spines so as to render it difficult to handle any portion of it; yet it is of great importance to the Indians, and in places where it is not indigenous, is cultivated with care in their mandioca fields and about their houses, along with the "Pupúnha" and other fruit trees. Yet they use neither the fruit, the stem, nor the full-grown leaves. It is only the unopened

^a Wallace, A. R., *Palm Trees of the Amazon and their Uses*, pp. 93-94. (London, 1853.)

leaves which they make use of to manufacture cordage, superior in fineness, strength and durability to that procured from the *Mauritia flexuosa*. They strip off the epidermis and prepare it in the same manner as described in the account of that species, but while the "mirití" is principally used for hammocks, the "tucúm" serves for bow strings, fishing-nets and other purposes where fineness, combined with strength, is required. . . .

The Brazilians of the Rio Negro and Upper Amazon make very beautiful hammocks of fine "tucúm" thread, knitted by hand into a compact web of so fine a texture as to occupy two persons three or four months in their completion. They then sell at about 3£ each, and when ornamented with the feather-work borders, at double that sum. Most of them are sent as presents to Rio de Janeiro.^a

The method of stripping the epidermis and of twisting it into cords on the naked thigh, as described by Wallace, appears to be exactly the same as that used among the native negroes of West Africa in preparing the fiber known commercially as "raffia," which is derived from the epidermis of the young leaves of the African wine palm (*Raphia*).

DOMESTICATION OF THE PACAYA PALM IN GUATEMALA.

Another domesticated palm, not hitherto recognized as such, exists in the Coban district of eastern Guatemala. It is a species of *Chamaedorea*, locally known as *pacaya*. It is not grown for the sake of its fruits or leaves, but for the fleshy inflorescences that are cooked and eaten as a salad. Only the male plants furnish the edible inflorescences, this palm being dioecious, like all of the species of *Chamaedorea*. The whole of the spadix or flower-bearing part of the inflorescence is eaten and is of very delicate texture. It compares with other so-called "palm cabbages" much as cauliflower does with other garden cabbages, the cauliflower representing the young tender inflorescence of the plant instead of the fleshy leaf bud. The taste of the cooked *pacaya* is slightly bitter, but the flavor is generally relished, not only by the native population, but also by resident Europeans.

The difficulty of obtaining cabbages from other palms is that the whole palm has to be sacrificed in order to obtain the small mass of tender edible tissue in the terminal bud. With the *pacaya* no such sacrifice is necessary. The removal of the inflorescence does not injure the palms, and they continue to produce a succession of crops during a considerable period of years. The *pacaya* is not planted as a field crop, but is grown in considerable numbers as a garden plant, not only about Coban, but in Purullhá and other towns of eastern Guatemala. In the wild state it seems to be confined to heavily shaded, humid valleys with other related species, but it also thrives when planted in the open. The palm grows to a height of 15 or 20 feet, and has a crown of very handsome, gracefully drooping leaves.

^a Wallace, op. cit., pp. 105, 106.

The smooth green trunk has a diameter of 2 or 3 inches. The unopened inflorescences are about the size of a large ear of corn and are inclosed in green spathes somewhat similar to corn husks.

DOMESTICATION OF PALMETTOS IN MEXICO.

One of the native arts that flourishes in many localities in tropical America is the weaving of hats from the fibrous leaves of various species of fan-leaved palms related to the Florida palmetto. These are not the same as the so-called Panama hats made in South America from the leaves of *Carludovica*, which is not a true palm. Large numbers of the palmetto hats for local use are made in Guatemala and Mexico, though the most advanced state of the palmetto hat industry is found in Porto Rico, whence large quantities have been exported to the United States during the last decade.

The Porto Rican hat palmetto, *Inodes causiaram*, does not appear to be regularly cultivated, though it is valued and allowed to grow in many places for the sake of the leaves. The largest quantity of these palms is found along the seabeach at a place called Joyua, on the west end of the island between Mayaguez and Cabo Rojo.

Palmettos grow wild in great abundance along the Pacific coast of Guatemala and the adjacent district of Soconusco in the Mexican State of Chiapas, and their leaves are gathered in large quantities for the thatching of houses and the weaving of hats. The hats themselves and the straw, or "paja," prepared for weaving are important articles of domestic commerce, carried about on the backs of the Indians and sold in all the native markets. To secure additional supplies of the material the palms are also commonly planted about the native towns, sometimes in considerable numbers. Even on the east side of Guatemala in districts where there do not appear to be any native palmettoes, the Indians have planted many of them in their villages, as at Cajabon and San Augustin, near El Rancho, and at other places. In southern Mexico the planting of palmettos is carried still further, thousands of these palms being found in the larger towns of the Soconusco district. Regular field plantings of palmettos were seen about Comitán in southwestern Chiapas and again near Merida in Yucatan. Palmettos are also grown extensively at San Bartolomé, Chiapas, as reported by Mr. G. N. Collins, though no field plantings were noticed.

PARTIALLY DOMESTICATED PALMS.

In addition to the palms that may be said to have been definitely domesticated in the American tropics, there are several others that may be described as partially domesticated. Though seldom actually planted or cared for, they are on a distinctly friendly footing with

mankind, and are much more abundant in inhabited regions than in the undisturbed forest.

These partially domesticated palms take advantage of the clearings made for the planting of corn, cassava, and other crops, and repay this indirect assistance by their fruits or other parts sufficiently useful to cause them to be tolerated, if not actually prized. Some of these voluntary camp followers of primitive agriculture are of distinct importance, so much so that they would undoubtedly be cultivated if they did not grow spontaneously without the need of direct assistance. Some of them are worthy of much wider consideration in tropical agriculture than they now receive.

The royal palm of Porto Rico (*Roystonea borinquena*) is a tree of much importance to the natives of the island, a large proportion of their houses being roofed with the tough sheaths of the leaves of this palm, known in the island as "yagua." While the leaves are alive the sheaths form complete cylinders 4 or 5 feet long, but when the leaves fall the sheaths split down one side and are then cut off and flattened out to form large leathery shingles. The side walls are often made of the same material or from the hard surface layer of the trunk of the same palm, split up into board-like strips.

The fruits of the royal palm are small and are not eaten by man, but they have an oily flesh much relished by the pigs, so that the palms are generally welcomed in the pastures, where they are vastly more abundant than on lands where the forest is allowed to grow. It is claimed that the fruits dropped by each adult palm will keep a pig in good condition without any other food than grass. There can be no doubt that the royal palm is a more important species in Porto Rico than the coconut itself and that it is worthy of much wider consideration in tropical agriculture.

The American wine palm, *Acrocomia*, is found in all parts of the American tropics, from Paraguay on the south to Porto Rico, Cuba, and Mexico on the north. Whether this wide distribution is due to natural agencies or to human assistance is not known. Several species of *Acrocomia* have been described from different countries, but their characters are not very distinctive, and they may prove to be only local variations of a single species.

In most places the *Acrocomia* palms are found only about human habitations or in lands that have been cleared for agricultural purposes, as indicated by Wallace for the Pará region of Brazil.

The stem of this tree is about 40 feet high, strong, smooth and ringed. The leaves are rather large, terminal and drooping. The leaflets are long and narrow, and spread irregularly from the midrib, every part of which is very spiny. The sheathing bases of the leaf-stalks are persistent on the upper part of the stem, and in young trees clothe it down to the ground.

The spadices grow from among the leaves, erect or somewhat drooping, and are simply branched. The spathes are woolly, persistent and clothed with spines. The



THE COYOL PALM (*ACROCOMIA VINIFERA*), COSTA RICA.

A relative of the coconut, partially domesticated in Central America. The photograph was made at La Colombiana banana estate, near Port Limon. This species was originally described by Oersted from Costa Rica.

fruit is the size of an apricot, globular, and of a greenish-olive colour, and has a thin layer of firm edible pulp of an orange colour covering the seed.

This species is common in the neighbourhood of Pará, where its nearly globular crown of drooping feathery leaves is very ornamental. The fruit, though oily and bitter, is very much esteemed and is eagerly sought after. It grows on dry soil about Pará and the Lower Amazon, but it is quite unknown in the interior.^a

The native Porto Rican species, *Acrocomia media*, grows spontaneously in the sparse forests that occupy lands too barren and craggy for agricultural use, and the same is true of the Central American species, *Acrocomia vinifera*, in Guatemala and Costa Rica (pl. 57). It is possible, however, that these individuals that appear to be growing wild have only escaped from cultivation through the accidental scattering of the seeds.

The wine palms are well equipped to establish themselves in the vicinity of human habitations. The trunks and leaves are beset with sharp, black, needle-like spines, which protect them against grazing animals, and the crown of leaves formed by the palms while still quite young is thick enough to occupy the land and even to withstand fire when clearings are made around it. Even after the palm has grown tall enough to expose the trunk the wood is so hard that the Indians avoid cutting it unless the palms become so abundant as to interfere with the lands they need for their corn or other crops.

The accounts of the early explorers indicate that the sap of the wine palm was in general use as a beverage among the Indians, but its popularity seems to have greatly declined now that the white man's liquors are obtainable. The palm is cut down to obtain the sap, which continues to flow out of the upper end of the severed trunk for several days.

The wine palms bear spherical fruits which attain a diameter of about 1½ inches. There is an outer layer of oily pulp with a slightly acid flavor, combined with a dense coating of fine fibers, that adhere to the wall of the nut inside. The pulp is often eaten by children or by adult Indians on the road, though hardly to be reckoned as a staple article of diet. The nut itself, without the fibers, is about the size of a horse-chestnut, with a hard shell like that of a coconut and of about the same thickness. The inclosed kernel is solid and has a taste like coconut meat. In times of famine these nuts are extensively eaten, but usually they go to waste. It is often proposed to utilize them for the extraction of their oil, which is said to be much like that of the coconut, but the problem of collecting and cracking the nuts has not been solved, unless it be in the Paraguay region of South America. It is said that the nuts are cleaned of the fiber by being eaten by cattle and that the kernels are becoming an article of export to Europe.

^aWallace, A. R., *Palm Trees of the Amazon and their Uses*, p. 97.

Other partially domesticated palms are found among the species of *Attalea*, known in some countries as *corozo*, in others as *manaca*. The *Attalea* palms are among the most magnificent members of the group and would undoubtedly be in demand for ornamental planting if they once became known. They bear a crown of immense leaves, often attaining lengths of from 30 to 40 feet, and these do not droop as in other long-leaved palms, but spread very gracefully by the bending of the long midribs. The leaves are extensively used in some localities for thatching the houses of the natives and for making the natives substitutes for umbrellas and raincoats.

The fruits of the *Attalea* are born in enormous clusters, weighing 200 pounds and upward (pl. 58). In some species there is a pulpy outer husk with much the same texture and taste as in *Acrocomia*. In other species, such as *Attalea cohune* of eastern Guatemala and British Honduras, the nut has a thin dry husk and a very thick bony shell. The kernels are very hard, but can be eaten in times of scarcity, or made to yield oil by the application of heat. Considerable quantities of the kernels are gathered in Mexico and the oil extracted for the making of soap and for other domestic purposes. Vast quantities of these nuts might be gathered in other parts of the American tropics if any profitable use were found for them.

As the *Attalea* palms have no spines to protect them from the grazing animals or from man, they are at a disadvantage in comparison with *Acrocomia* and have not attained so wide a distribution. On the other hand, they are much better able to compete with other forest growth, so that they are often found in vast numbers in regions that have been abandoned by the Indians in the last century or two, and now distinguish such reforested areas from the forests of older growth where the long-lived hard-wood trees have taken full possession to the exclusion of the *Attalea* palms.^a

ORIGIN OF THE NAMES COCO AND COCOS.

The lack of native American names for the coconut has been accepted as proof that the palm could not have existed in America before the arrival of the Spaniards. This argument is considerably weakened by the probability already noted that the name "coco" itself is of American origin. It is certain, at least, that the Spaniards did not need to bring the word "coco" to America, since it was a favorite plant name in several Central American languages. It is applied in particular to plants that have bulbs or bulbous roots. For example, the bulbous rootstocks of *Xanthosoma*, a taro-like plant

^a Vegetation Affected by Agriculture in Central America, U. S. Department of Agriculture, Bureau of Plant Industry, Bull. No. 145.



TRUNK AND FRUIT CLUSTERS OF THE COROZO OR MANACA PALM (*ATTALEA COHUNE*),
EASTERN GUATEMALA.

A relative of the coconut, partially domesticated in Central America. The photograph was made near Patzún, Alta Verapaz.

extensively cultivated in Porto Rico under the native name *yautia*, are still commonly called *cocos* in Jamaica.

Peter Martyr used the word *coccus* in his ninth Decade in describing coconuts in the East Indies (*Coccus appellant fructus illos . . .*), but no modern writer seems to have recorded the word as a native East Indian name of the coconut. None of the numerous names given in Watt's Dictionary of the Economic Products of India and in Wallace's vocabularies of thirty-three languages of the Malay Archipelago has any apparent resemblance to *coco*, unless it be *copra*, the East Indian name of the dried meat.

Some authorities note an ancient Egyptian word as the original of the Greek *kouki* of Theophrastus and the Latin *cuci* of Pliny. Seemann denies that the Egyptian *kouki* referred to the coconut, but applies it to a native African fan palm, *Borassus*. It is also possible to identify the *cuciophoron* of Theophrastus with the doum palm of Upper Egypt (*Hyphaene*).^a Indeed, the word "*kouk*" is still to be heard in the bazaars of Cairo as the name of the horny endosperm of the doum palm, commonly used for making the beads of rosaries, and other small objects.

Some etymologists would assimilate *kouki* with *kokkos*, a general Greek word for fruit, berry, or seed, the same as the Latin *coccus*. The word *coccus* seems to have come into Latin as the name of the Kermes insect (*Coccus ilicis*) that yielded the scarlet dye, rather than as the name of a seed or a berry. Nevertheless, we find among later post-Columbian writers of botanical Latin, such as Piso, the expression *Coccus Indica* taking the place of *Nux Indica* as the name of the true coconut and *Coccus Medica* or *Coccus Maldivica*, instead of *Nux Medica* or *Nux Maldivensium*. Eden's English translation of Oviedo shows the word *cocus*; Oviedo himself adhered consistently to *coco*, except as he wrote *cocos* in the plural number, as in the heading of his chapter. Linnæus, in his older works, such as the *Hortus Cliffortianus* and the *Flora Zeylanica*, also used the generic name *Coccus*. The change to *Cocos* seems to have been made in the first edition of the *Species Plantarum* (1753) without any previous author being indicated as having used the name in this form. The fourth edition of *Genera Plantarum* (1752) uses the old spelling *Coccus*, but the fifth edition (1754) adopts the new form *Cocos*.

The Latin and Greek derivations that have been invented for the word may have quite as little basis in fact as the fanciful theory given by Oviedo, and repeated by many later writers, that the name was suggested by the resemblance of the base of the shell to the face of a monkey. The Spanish language has a verb *cocar*, meaning to make faces like a monkey, and even a noun *coco*, meaning ogre or bugbear,

^aGreene, Edw. L., Landmarks of botanical history, pt. 1, Smiths. Misc. Coll., vol. 54, p. 132. (1909.)

connected by philologists with the Greek adjective *kakos*, the equivalent of the English word bad. Eden's translation^a elaborates Oviedo's original statement to the extent of definitely ascribing this etymology to the Indians, and associating it with the cry of the howling monkey.

OTHER AMERICAN NAMES OF THE COCONUT.

It now appears that names other than *coco* are applied to the coconut by aboriginal Indians. Such names have been found by Prof. H. Pittier among the inhabitants of the southern part of the Central American republic of Costa Rica, where several very primitive tribes have hidden themselves in the forest and avoided contact with the Spanish colonists. The name *ko-ko* is used by the Cabécara, Dorasque, and Guaymí tribes; the Cunas say *o-kób*, also slightly suggestive of copra, while the Bribri and Brunka people have quite distinct terms, *sura uó* and *sia uá*, respectively.

According to Professor Pittier the Brunkas are good sailors, who make voyages of considerable length along the Pacific coast, though they are careful to keep their canoes within sight of land. The Brunkas live not far from the Burica peninsula where Oviedo found the *coco* palm in special abundance in the early part of the sixteenth century. The Burica district is also the nearest part of the mainland to Cocos Island. That this region possessed at one time a much more advanced civilization is shown by the graves of the adjacent Chiriqui district of Panama, and other ancient remains discovered in the southern part of Costa Rica by Professor Pittier.

It is to be expected that other native names will be found in the interior districts of South America where the coconut is known to exist, but these regions are still largely unexplored. The native names of the coconut in Brazil, *inaiaguacu*, recorded by Piso and Marcgrave in Brazil, have been noted in a previous chapter. According to Martius the name *inaja* or *inaia* is also applied in Brazil to another related palm, Maximiliana. Martius associates the Tupi names for fruits, *yba*, *iba*, and *ia* with such words as *nha* or *nia*, which relate more specifically to the large fruits of the Brazil-nut tree, *Bertholletia excelsa*, and then points out the similarity to *niu*, the Hawaiian name of the coconut.^b

^a See footnote *a*, p. 278.

^b Martius, C. F. P., Beiträge zur Ethnographie und Sprachenkunde Amerika's, vol. 2, p. 417. (Leipzig, 1867.) In Marcgrave's vocabulary of a native Brazilian language, published in 1658, the word *nha* is said to signify heart (*cor*).

DISSEMINATION OF THE COCONUT PALM BY PRIMITIVE MAN.

Without the recognition of human agency in its dissemination the history of the coconut would be likely to remain forever as mysterious as it was to the eminent botanist Seemann, who traversed the subject in several of his books in attempting to solve the problem by means of natural agencies alone:

. . . And the great puzzle has been, whence did it originally spring? Though having paid considerable attention to this subject, I am not acquainted with any theory, nor have been able to start one myself, which would be in unison with the part the Coconut plays in different countries. ^a

Seemann was inclined to believe that the coconut palm must have been a native of Polynesia because of its extreme economic importance in that part of the world. In support of this view, and in opposition to the idea of Asiatic or Malayan origin which previous writers had advanced, Seemann argued that the coconut could not have been brought to the Pacific islands from the west, because colonists from Asia would certainly have brought the Asiatic art of bleeding the sap from the palms by cutting the young flower stalks, to make toddy and sugar from the juice. Such facts tend to show that the original inhabitants of the Pacific islands did not derive their agricultural habits from Asiatic sources, and that the more modern contacts with Asia have also been very slight, since they have left the Polynesians in ignorance of the art of making toddy.

. . . Had the Polynesians therefore once known the process, they would probably never have forgotten so easy a way of obtaining sugar, vinegar, yeast, and a pleasant drink, the strength of which may be regulated by time to any man's taste. So either the Polynesians could never have come from eastern Asia, or else, after spreading over the South Sea, ages must have elapsed before the cocoa-nut made its appearance in these waters, so that the process of toddy-making (there being no other suitable Polynesian Palms to operate upon) had been entirely forgotten, and even disappeared from native traditions. Under such circumstances, it behooves us to suspend our final judgment whether Polynesia be or be not the native country of the cocoa-nut. ^b

If we admit Seemann's argument, and there is no good reason for rejecting it, we can not suppose that the original settlers of the Pacific islands came from the Malay region, for the coconut is the one thing that they would have taken with them, if all else had been left behind. It not only furnishes in that part of the world the chief ration for native voyages, but is the only source of fresh water on many of the smaller islands, and is thus indispensable for human existence.

The fiber of the husk of the coconut is equally necessary to the Polynesians in the building and handling of boats. The mystery

^a Seemann, B., *Dottings on the Roadside, in Panama, Nicaragua, and Mosquito*, p. 152. (London, 1869.)

^b Seemann, *op. cit.*, p. 154; *Flora Vitiensis*, p. 276. (London, 1868.)

clears only when we are prepared to admit that the original colonists in the Pacific islands were native of the same continent as the coconut palm, so that they could take with them the cultivated plants on which their future existence depended. By keeping close to the practical agricultural facts we avoid the confusion to which De Candolle and Seemann were brought by conflicting theoretical methods of ascertaining the origins of plants. The uses of the coconut have been most highly developed in the Pacific islands because lack of other plants has compelled the inhabitants to depend more and more upon the coconut. Necessity has given rise to the multiplicity of uses, but the palm itself had to be brought from the only part of the world where such palms grew—South America.

The relatively slight economic importance of the coconut in America could be given as a reason for believing that the palm was not introduced into America by the Polynesians in the same way that Seemann used the absence of toddy in Polynesia to prove that the palm was not brought to the Pacific islands by people from Asia.

It is gratuitous to object to human agency as accounting for the spread of the coconut since there were other cultivated tropical plants, such as the sweet potato and the banana which were also cultivated on both sides of the Pacific, and must have been carried across by the men who knew and used them. They are propagated only from cuttings, would not survive soaking in salt water, and do not grow on sea beaches. The indications are that nearly all the cultivated plants which Polynesia shared with America were natives of America, but whatever their source, they do not permit us to doubt that there was communication across the Pacific by primitive agricultural people. Ethnological evidence for such communication may also be found in the similarities now commonly recognized between the natives of America and the present inhabitants of eastern Asia and the Malay region. That the straight-haired peoples of the East Indies are not true aborigines of the countries they now occupy is shown by the presence among them of remnants of the former curl-haired populations, such as the Ainus in Japan, the Negritos in the Philippines, the Alfuros of Gilolo and Ceram, the Papuans, and the Andamanese. On the continent of Asia as well recent investigations are showing that primitive peoples related to the Negritos or to the Ainus preceded the Malayan and Mongolian occupations.

That the present Polynesians do not more closely resemble the natives of America does not warrant an objection to the idea that the coconut palm was originally carried into the Pacific islands from America. Ethnologists are familiar with the fact that the prevailing direction of recent racial movements in the Pacific has been from west to east. Whatever may have been the conditions in the remote times when the islands were first occupied, the island people have

had more recent contacts with the Malayan and Melanesian races. This eastward movement into the Pacific explains the presence, even in the most eastern archipelagoes, of many seedless varieties of the breadfruit, banana, and other Malayan plants, and of an infusion of Papuan or Melanesian blood. Yet these later influences have not destroyed the essential likeness of the Polynesian and Malayan culture to that of ancient America. The general unity of the Malayo-Polynesian language and the similarity of the people and their customs to those of the American Indians are more obvious in the remote islands, such as New Zealand, Easter Island, and Hawaii, than in the equatorial archipelagoes, where the Melanesian influences are more apparent. The Polynesians have traditions and genealogies that refer to the introduction of the breadfruit as having taken place about eighty generations or two thousand years ago, but this eastward migration that carried the breadfruit need not have had any connection with the westward migration which carried the coconut into the Pacific from America, and which probably took place at a much more ancient period.

Nor is it necessary to believe that contacts of the islanders with America entirely ceased during the modern period of eastward migration. The presence of the banana in pre-Spanish America forbids such an assumption. In addition to numerous traditions of the arrival of people from the seas, in Peru and elsewhere, there was the definitely reported historical incident of the black, frizzle-haired people of the Isthmus of Panama, which can hardly be explained except by supposing that a tribe of Polynesians had established themselves on the Isthmus when Balboa crossed it and discovered the Pacific Ocean.

The origin of the coconut in America and its dissemination by human agency to the tropics of the Old World do not stand alone as botanical theories, but are in full accord with more recent and well-established discoveries in the fields of ethnology and archæology. It is now generally admitted by ethnologists that the ancient civilizations of tropical America were of native, indigenous origin and not imported from abroad. In Egypt and Assyria, on the contrary, it does not appear that the earliest civilizations were indigenous. Recent discoveries make it possible to trace them back to the shores of the Persian Gulf and to southern Arabia, and to a seafaring exotic race, skilled in agriculture and navigation.

That the primitive agricultural people who distributed the coconut and other American plants over the islands and shores of the Pacific and Indian oceans came originally from America is a possibility that appears worthy of careful consideration by students of botany and ethnology. The tropical contact of the two hemispheres was so remote in time, and the subsequent changes have been so great on

both sides of the Pacific, that the ethnological evidence alone might not be sufficient, but the addition of definite botanical data may yield conclusive proof. The earlier idea of an Asiatic origin of American civilizations having been given up, the tendency has been to believe that agriculture and other arts of civilization have developed quite independently on the two sides of the Pacific. But even if we were willing to believe in closely parallel developments in customs and arts, this could not explain the prehistoric distribution of the same cultivated plants over the Tropics of both hemispheres.

ORIGIN OF CULTIVATED VARIETIES OF THE COCONUT PALM.

One of the most convincing arguments for the Malayan origin of the coco palm was the existence of many and very diverse varieties in the East Indies. It was a favorite line of reasoning with De Candolle that the native home of a species was the region in which it had been longest in domestication. The length of the period of domestication was inferred from the number of varieties as a measure of the time that selection had been at work. Such calculations were applied to the sugar cane, the taro, and numerous other plants.

In dealing with the coco palm this plan seemed to be particularly effective, for nearly all of the recorded varieties are in the East Indies. The coco palm in America is not as uniform as commonly supposed, though the varietal diversities do not approach those of the Malay region.

Careful consideration of the evolutionary argument will lead, however, to a conclusion directly opposite to that reached by De Candolle, for the greatest and most definite variations of a cultivated plant are much more likely to occur and be preserved outside its natural range, where intermixture with the wild type of the species is prevented. There are many reasons for believing that the abrupt and striking "sports" that appear among our cultivated plants are not, in reality, caused by selection, but are induced by new conditions and by the state of inbreeding that generally accompanies domestication.

The normal or wild type of a species is generally prepotent over the varieties which have arisen in domestication, so that the "improved" breed rapidly "deteriorates" when allowed to become crossed with the wild stock. Darwin and many later experimenters have proved, also, that when diverse breeds are crossed the offspring are very often not intermediate between the breeds, but tend to revert to the ancestral form. The breeders of high-grade varieties look upon such mongrels as degenerate, but from the standpoint of the evolutionist they may be said to be recovering from the injurious results of inbreeding. It was noticed, for example, that in parts of Guatemala, where the wild tropical papaw (*Carica*) is common, the cultivated trees also have very small fruit. The tendency to such

reversion would be particularly strong in plants like the palms, cross-fertilized by the wind.

If economic importance and multiplicity of variations were to decide the question of origin, coffee could be proved to be a native of the East Indies or of Central America, instead of Abyssinia. Many striking variations of the coffee plant have arisen in the American Tropics, and none, as far as known, in Abyssinia. The breadfruit could be shown by such reasoning to be a native of the eastern archipelagoes of Polynesia, where most of the specialized varieties are found and where the tree has an economic importance and an agricultural popularity far beyond that enjoyed in its original Malayan home.

If the Malayan varieties of the coco palm are to be accepted as proof of anything, it is that the wild ancestral type of the species has not existed in that part of the world during the period in which the diverse mutations have arisen. The relatively unmodified coconuts of America, on the other hand, may indicate the comparatively recent presence of the "unimproved" wild stock, and corroborate the evidence afforded by the geographical distribution of the related species of *Cocos* and the presence of the coco palm itself, in the salt-spring regions of the interior of Colombia.

The history of the coco palm has been discussed recently at some length by Professor De Vries as affording evidence that the numerous cultivated forms of the species have originated during the period of domestication and do not represent separate domestications of wild species or varieties already diverse. There could seem to be no question that this is true of the coconut as of other cultivated plants.^a

The inference to be drawn from the fact that *Cocos nucifera*, as now cultivated in the Old World Tropics and made up of a large number of very distinct varieties, is not that wild species are so constituted, but that domestication conduces to the formation of the diverse varieties. The wild plants show individual diversity, the cultivated plants varietal diversity. The individual members of wild species are generally more diverse than individuals of domesticated varieties. On the other hand, wild species seldom present any such measure of diversity as exists among domesticated varieties.

Trees of the larger varieties of the coco palm grow to a height of 50 to 100 feet, but a dwarf kind mentioned by Watt reaches a height of only 10 or 15 feet. The nuts differ correspondingly in abundance, size, and shape. In some varieties they are comparable in size to a man's head; in others to a turkey's egg. In shape they may be spherical or pointed at one or both ends, or with prominent angles. The outside of the husk may be green, yellow, red, bluish, brown,

^aDe Vries, H., *Species and Varieties, their Origin by Mutation*, pp. 82-89. (Chicago, 1905.)

or black. On the inside the husk may contain coarse or fine fibers or may consist of a reddish edible pulp. The meat may be thick or thin, hard or creamy, and rich or poor in oil. One sort has an outer layer of the meat red instead of white. Finally, the varieties differ in size, number, and color of the leaves, some being light green and some dark, or yellowish, grayish, or reddish. Most kinds have the pinnæ separate, but in a few they remain united as in the young seedlings.

No wild palms have been found with any such individual or varietal diversification as the coconut varieties; indeed, most of the species of palms are less easy to distinguish from their nearest relatives than are these varieties. Professor De Vries has described many such variations of the evening primrose as new species, on the ground that they answer all the requirements of species as treated by systematists, but if this be true it would seem to be better to modify our taxonomic criteria than to set ourselves the unnecessary task of naming as new species all the cultivated varieties of coconuts and other plants.

The objection to the classification of these mutative variations as species is not that the amount of difference may not be as great as between some wild species, but that the evolutionary status of the mutation is not the same as among the wild species. The natural species is a group of freely interbreeding diverse individuals, while mutative varieties generally represent the progeny of a single individual variation, induced and maintained by inbreeding.

To give Latin names to fifty or a hundred Malayan mutations of the domesticated coco palms might appear to place them in the same taxonomic rank as the South American species of *Cocos*, but it would amount, after all, only to an assertion of the identity of conditions essentially unlike.

The Malayan varieties of the coconut are said to propagate true from seed with great uniformity, and this fact may have strengthened the idea of diverse ancestry in the wild state, but it is now known that the so-called mutations or abrupt variations of inbred domesticated plants, such as coffee, are often as constant in their characters as the parental type, or even more so. In this respect they often differ strikingly from new varieties, originated by hybridization, in which it is generally thought necessary to "fix the characters" by selection.

The coconut palm appears to be the only cultivated tree whose varieties are in the nature of mutations that come true from seed, if exception be made of the varieties of mangoes and citrous fruits that can be propagated from seeds because of the peculiar habit of polyembryony, the formation of false embryos from nucellar buds. The mutative varieties of the coffee shrub form a parallel with those

of the coconut, and some varieties of the peach also yield a considerable percentage of seedlings that retain the parental characters. The vast majority of varieties of cultivated trees have to be propagated from cuttings or grafts. The reason for this contrast between trees and annual plants is doubtless to be found in the greater amount of time required for the selective breeding of trees. The existence of mutative varieties might be considered as an evidence that the culture of the coconut palm is older than that of the date palm. That date varieties are usually propagated from cuttings should not interfere with the development of mutative varieties, but the dioecious habit of the date may be a more serious obstacle.

The evolutionary interest of the varieties of the coconut does not lie, therefore, in any difference of behavior from other plants of like history, but in their complete agreement, and in helping to show that even in plants so peculiar as the palms the same law of evolution holds, that narrow segregation, or inbreeding, is accompanied by mutative variations, often distinctly degenerate from the biological standpoint. The peach palm, the coconut, the oil palm,^a and the date have series of similar variations, indicating that like evolutionary causes are active in the production of like effects, in spite of the fact that the palms themselves and the conditions under which they live are very different.

Although the disparity in coconut varieties between the East Indies and tropical America is very great, it is a mistake to suppose that there are no distinct varieties in America. Velasco's account of the four different kinds of coconuts in Colombia has already been quoted, and reference has been made to the small variety found on Cocos Island by Professor Pittier as distinct from the ordinary commercial variety grown on the adjacent shores of Costa Rica. Mr. O. W. Barrett, who formerly resided in Porto Rico, states that there are two distinct varieties on that island, one with yellowish leaves and fruits, the other with green. The milk of the latter is considered preferable while the yellow variety has the thicker "meat." It is stated by planters and importers that the coconuts of the coast of Colombia, sometimes called San Blas coconuts, are considered different from those grown in other places in the Caribbean region. The ready separation of the meat from the shell gives these nuts a special value for manufacturing purposes.

A further example of what may be a distinctively American variety of the coconut was found in 1902 at Tapachula, a town in the

^a Preuss, P., Ber. Deutsch. Pharm. Gesellsch., vol. 13, p. 109. 1903. Fendler, G., loc. cit., p. 119. The latter paper describes three varieties from the Togo colony, the first with the shell so thin that it can be broken with the teeth, the second with green instead of red fruits, the third with the leaf segments united and the leaf bases persistent. See also The varieties of the oil palm in West Africa, Kew Bulletin of Miscellaneous Information, 1909, p. 33.

Soconusco district of southern Mexico. Instead of being oval or spherical, these nuts are strongly flattened on the very broad apex, so that the shape would be described in botanical terms as broadly obconic or turbinate. All of the nuts observed in the markets of Tapachula at the time of our visit in the spring of 1902 seemed to be of this type. They are also of distinctly larger size than those, for example, of Costa Rica. This fact may have caused them to be preferred for planting, but there is no probability that the peculiar shape has been secured by selection. The variety doubtless originated as a mutation or "sport," like those of the Malay region.

It is also reasonable to believe that the coconut was established on the Pacific coast of Mexico by human agency, as well as on the islands of the Pacific. There were Indian tribes of the Aztec family scattered along the coast at least as far south as the Nicoya Peninsula of Costa Rica, where many objects believed by archaeologists to have been made in Mexico have been dug from prehistoric graves. The claim of some writers that the Indians of the Pacific coast of America are not navigators finds little support in fact, for all along between Alaska and Terra del Fuego there have been, even in the post-Columbian epoch, tribes with maritime skill and seafaring instincts. The Pacific coast of America from Mexico to Peru^a is dotted at frequent intervals with human remains which mark former centers of ancient cultural activity, many of them already decayed and forgotten before the Spaniards came, as the early explorers themselves had occasion to reflect.^b

ADAPTATIONS OF THE COCONUT FOR GERMINATION.

For nearly two centuries the coconut has been described in books of travel and natural history, and even in formal scientific works, as an example of a plant widely distributed in nature through the agency of ocean currents. Thus in a recent text-book:

The Cocoanut seems especially designed for floating, inasmuch as its outer fibrous husk forms a veritable life-preserver; it has been known to float hundreds of miles on the surface of the ocean. On reaching a strand, it readily germinates; in this way coral and volcanic islands in the South Seas are populated with Cocoanut palms.^c

^a The Indians of the islands off the coast of California, now extinct, are supposed to have been allied to the maritime tribes of British Columbia. The eminent American ethnologist Cushing maintained that a direct connection existed between the Peruvians and the ancient people who built the extensive irrigation canals of Arizona.

^b In ancient times these Indians were not natives of Quimbaya, but they invaded the country many times, killing the inhabitants, who could not have been few, judging from the remains of their works, for all the dense canebreaks seem once to have been peopled and tilled, as well as the mountainous parts, where there are trees as big around as two bullocks. From these facts I conjecture that a very long period of time has elapsed since these Indians first peopled the Indies.—Cieza de Leon, p. 89. (See footnote above, p. 287.)

^c Osterhout, W. J. V., *Experiments with Plants*, p. 325. (New York, 1905.)

Warburg includes *Cocos nucifera* in a list of "all-tropical shore-plants" (*Litoral-Pantropisten*) that have pronounced adaptations for swimming (*ausgepraegten Schwimmanpassungen*). The adaptations are specified as "swimming-tissue in the husk and empty space in the kernel" (*Schwimmgewebe im Mesocarp und Hohlraum im Endosperm*).^a

It is true that the coconut is provided with a tough, fibrous husk from an inch to 2 inches in thickness which enables it to remain afloat for a long time. There is even a layer of wax on the surface, as though to render it impervious to water. A contrivance better suited for the maritime distribution of the nut would be difficult to imagine, and it is not surprising that writers who approach the subject from the standpoint of structure alone should continue to rely on apparently indubitable proof regarding the true habits of the plant in nature.

Unfortunately there appears to be no direct evidence to support these deductions from the structure of the coconut and its powers of floating. The same general type of husk is to be found among scores of other related species of palms, which do not grow on seacoasts and are not distributed by water. That the husk of the coconut is thicker than that of the other related species but comports with its larger size and the greater danger of breakage when it falls to the ground. The waxy coating of the surface is also no unique character, but is to be found in well-nigh the whole group of palms, the small fruits of many inland species being far more waxy than the coconut.

In the East Indies, where the culture of the coco palm has reached its highest development, nuts intended for planting are picked from the trees and let down carefully to avoid injury, even to the external coat of the husk. The breaking of this is thought to reduce materially the chances of successful germination. To permit the husk to dry out or to become infected with putrefactive bacteria or fungi might be equally dangerous for the young plant.

The unique habit of the coconut of preserving a store of water in an interior cavity of the seed is in itself an indication that the species was native in some relatively dry interior region where the regular supply of moisture from external sources would not suffice for germination. These extensive provisions for water storage would seem superfluous in a maritime plant able to draw moisture from sandy beaches wet twice a day with tidal brine. The distance to permanent moisture on a sandy ocean beach is very short; in fact, the sand is never really dry at all except at the surface. For a plant able to thrive on a salt solution, a covering of an inch or two of sand

^a Warburg, O., Einige Bemerkungen Ueber Die Litoral-Pantropisten, Annales du Jardin Botanique de Buitenzorg. Supplement II, p. 133. 1898.

would be a sufficient permanent protection against drying out. It is only when we think of the coconut as growing in an alkaline interior region, subject to prolonged drought, that we can appreciate the large hollow seed and the very thick husk as characters that give the palm special adaptation to the natural conditions of its environment.

The very large size of the coconut, which is the largest of all seeds except one,^a undoubtedly tends to keep it from becoming buried in the ground, and would thus interfere seriously with germination if it were not for the fact that the young plant sends its first roots into the fibrous material of the husk, which serves as a sponge for the storage of water. By virtue of its husk the coconut is able to proceed with germination without waiting to be buried in the ground.

Palm seeds are notoriously short-lived, with very little of the usual power of seeds to remain dry and dormant for long periods of time. If palm seeds are very carefully packed so as to keep just the right amount of moisture, enough to prevent drying out but not enough to permit germination, they can often be kept for several months; otherwise a single drying may be fatal. The seeds of many species have a natural packing in the form of a fleshy external pulp like the date, able to hold moisture by reason of the sugar it contains.

But with most palm seeds early germination is a necessity and if, as often happens, the fruit ripens in the dry season,^b germination becomes a very critical problem for which many specialized solutions have been worked out in the various natural groups of palms. And even if the germination can be deferred until the rainy season the next period of drought may find the young plants still very small, for the palms labor under the further disqualification of very slow growth, especially in their earlier stages.

The process of germination is extremely slow in the palms. The embryo is very small in comparison to the hardened food materials which have to be digested and absorbed into the tissues of the seedling. Long before any external sign of germination appears there is a growth of the cotyledon, or absorbing organ of the embryo, at the expense of the hardened food materials stored in the seed. In the

^a The so-called double coconut, or coco-de-mer *Lodoicea maldivica* (L.), a huge fan palm native in the Seychelles Islands of the Indian Ocean, has seeds several times as large as coconuts. A single fruit of *Lodoicea*, containing three or four seeds, sometimes weighs from 40 to 50 pounds.

^b In India the hot, dry months are counted upon to bring the nuts to maturity.

"In six months from blossoming, the kernels of the nuts begin to solidify; in a year, the fruit is fully ripe—even sooner if the season is very hot and dry. The produce of the tree in full health and properly tended is much dependent on soil and climate. The average may be put down at 120 nuts in the twelve months; in a low and sandy soil, it will amount to 200; in gravel and laterite, not 60. The most productive months in India are from January to June, that is for ripe nuts, the heat bringing them quickly to maturity."—Spous' Encyclopedia.



FIG. 1.—GERMINATING COCONUT.

The young plant shows one bladeless leaf sheath and one simple, deeply divided leaf. (Reduced.)

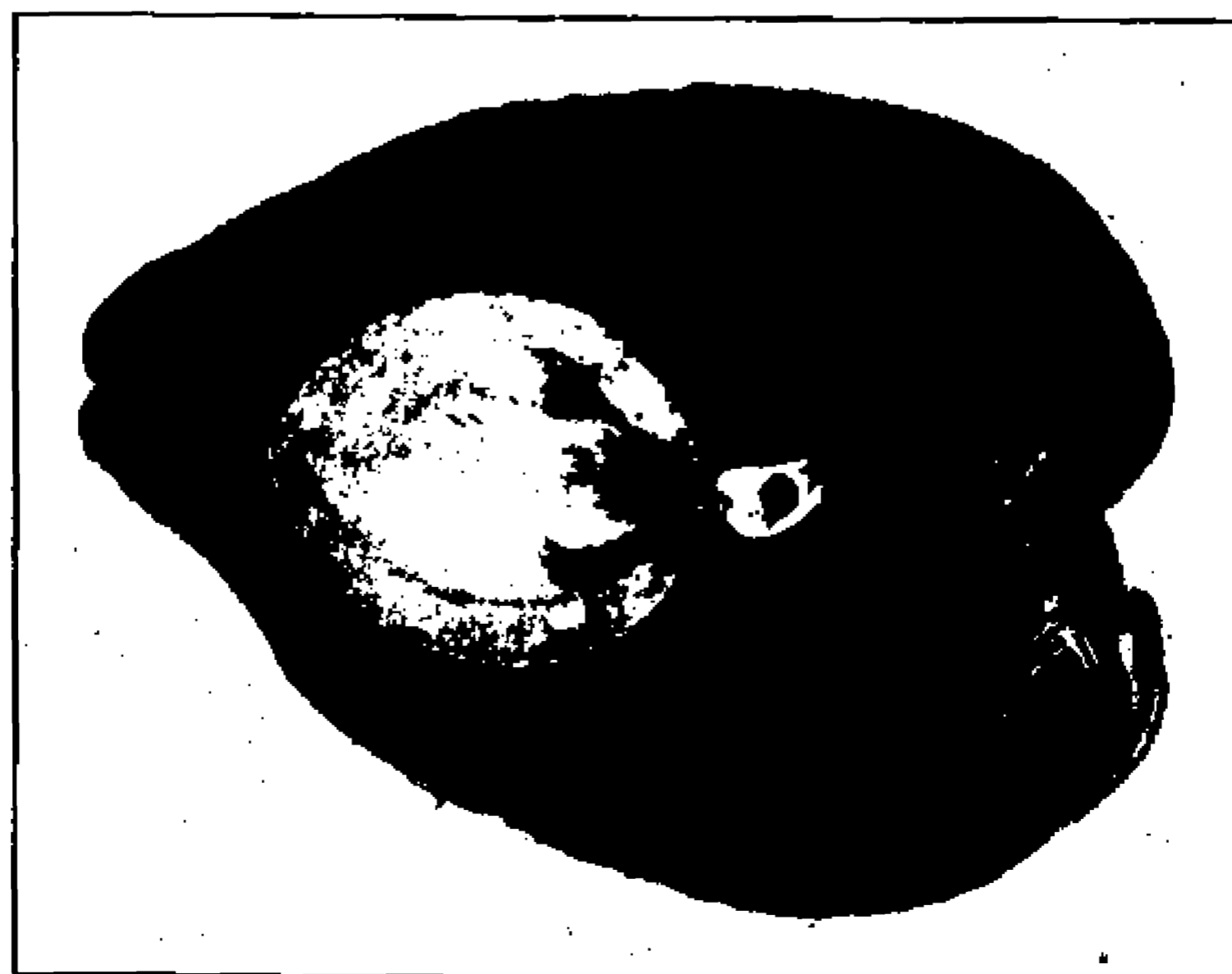


FIG. 2.—CROSS SECTION OF COCONUT GERMINATING INSIDE THE HUSK.

From Prudhomme, *Le Cocotier*, fig. 31, p. 105 (Paris, 1906). (Reduced.)

case of the coconut the embryo lies inside the largest of the three thin spots or "eyes" at the base of the shell, and the soft spongy cotyledon grows out from this point to fill the whole interior cavity of the nut and then continues to digest and absorb until all of the surrounding food materials have been taken over and conveyed into the growing parts of the young plant.

Palm seeds with thick hard shells like the coconut are provided with special channels or pores for the exit of the embryo, covered only by a thin scale of the shell material or a specially formed lid or plug easily pushed out of the way. When germination finally occurs the base of the cotyledon grows out of the seed, carrying with it the plumule or leaf bud of the young plant, which later emerges from the cotyledon by a split on one side.

With the relatives of the coconut, which have not thick husks, the second phase of germination, the escape of the young plantlet by the opening of the cotyledon, necessarily takes place outside the husk, but with the coconut the whole process of germination may be completed inside the husk. Coconuts buried in the moist soil germinate without any special assistance from the husk, and even without waiting for the cotyledon to grow to full size by absorbing the food materials of the endosperm. It is said to be customary in some localities to remove the husk before planting. But if the husk is allowed to remain intact the coconut is able to germinate without even being placed in the ground. And not the germination alone, but the subsequent growth of the young plant may go on for months without any external contacts, the leaves often attaining considerable size before the roots have made any external growth beyond the fibers of the husks. The young coconut seedling, with its ample provision of food and moisture and its fibrous husk for the accommodation of its roots, might be described as a self-potted plant. It is to a very large extent independent of external conditions during the early stages of growth, which are much more precarious for all other palms. The preference of gardeners for coconut fiber as a potting material may be accepted as a testimonial of the success of the palm in meeting the needs of the seedlings. (Pl. 59, figs. 1, 2.)

For palms that are natives of humid, densely forested regions such a provision would be superfluous and disadvantageous, for with them it is a question of increasing the number of seeds and seedlings and of thus multiplying the chances that some of the seedlings will find favorable situations, with light enough to permit them to grow. Natural selection in the form of competition of other vegetation would discriminate against the evolution of an excessively large seed in a species tolerant of shade. But for a palm that lives in an open country with long, dry seasons, the protection of the seed and the

seedling against drying out would be of the greatest possible advantage. An evolutionary tendency in this direction would be favored by natural selection and might be expected to make rapid progress. The natural result would be that we should have one species highly adapted in one respect, but remaining otherwise closely like its relatives, as in the case of the coconut. The adaptive value of the husk as an expedient for germination can also be estimated by comparing the habits of the coconut with those of related palms that encounter similar environmental problems.

Excellent examples of adaptive germination devices are afforded by *Attalea* and *Acrocomia*, two relatives of the coconut found in Guatemala. The seeds of *Attalea cohune*, which abounds in eastern Guatemala, are about the size of a turkey's egg, with a thin woody husk and an extremely hard, bony shell almost half an inch in thickness, perforated at the base for the exit of the embryo. But instead of pushing out a young plant as in the coconut, the first organ to emerge from the seed is the long, slender, cord-like cotyledon, which grows down into the ground for a distance of from 3 to 6 inches (pl. 60). The true germination takes place at the end of this burrowing organ, so that the young plant, though produced from a seed lying on the surface of the soil, is well and deeply planted, and at once sends its roots still farther down to establish communication with the permanent moisture of the deeper layers of the soil. The cord-like cotyledon connecting the seed with the young plant remains alive for a long time, to carry down food materials from the storehouse above.

In *Acrocomia* the same difficulties have been solved in a very different way, though not less definitely adaptive. The nursing foot or cotyledon is very short and remains functional for a much briefer period than in *Attalea*. The young plant completes its germination and begins its development close to the surface of the soil. It partially supplies the deficiency of the length of the cotyledon by growing downward at first instead of upward, the bases of the leaves being abruptly bent (pl. 61). These first joints of the seedling very soon thicken into a fleshy bulb, formed, doubtless, by a prompt transfer of the nutrient material stored in the seed, thus avoiding the need of a long-lived cotyledon as in *Attalea*.

The coconut follows neither of these policies. Being provided with its own water supply inside and outside the nut, it is able to grow a plant of considerable size before attempting to make any connection with the soil. And then being thoroughly prepared, and the proper season having arrived, it is able to send down a good supply of roots to the level of permanent moisture in the soil and establish itself on a self-supporting basis.



GERMINATION OF THE COROZO PALM (*ATTALEA COHUNE*).

Showing the long burrowing cotyledon that carries the embryo into the ground. For comparison with the germination of the coconut as shown in plate 59. (Natural size.)



GERMINATION OF THE COYOL PALM (*ACROCOMIA VINIFERA*).

Showing the nuts with their foramina, the very short cotyledon, and the downward growth of the stem of the young cotyledon to form a fleshy subterranean bulb, producing the first leaves from its lower end. (Natural size.)

Even when actually hung up or kept in the house coconuts will often germinate and grow a plant 2 feet or more in height. In fact they often do much better when treated this way than when buried in the ground too soon, and it is the regular custom in some tropical countries to germinate coconuts in sheds before planting them in the ground.

Nevertheless it is difficult to believe that the moisture of the nut and its husk can sustain the plant for so long a period. The possibility that atmospheric moisture is drawn upon to replenish the supply may be worthy of consideration, though it seems not to have been regarded in studies of the germination of the coconut. Thus Kirkwood and Gies declare:

Neither the husk nor the shell appears to serve any other than passive mechanical function, and only the constituents of the endosperm and milk, so far as the nut is concerned, nourish the young plant before it finds in the soil the elements provided there in abundance for its growth to maturity. . . .

The lowest part of the stem contains almost as little solid matter and is nearly as watery as the cotyledon. The percentage of water in the stem diminishes as the distance away from the "root crown" increases. The watery condition of the lower part of the stem is increased, doubtless, by the fact that the surrounding husk is impregnated with water, thus favoring direct absorption by osmosis and at the same time preventing evaporation from the surface of the growing tissue.^a

But on a previous page these writers have referred to chemical analyses which support in a striking manner the suggestion that the husk of the coconut may be able to collect moisture for the benefit of the young plant, and that it is the husk for which the plant makes demands of salt and potash.

Bachofen's results indicate that sodium chloride and potassium phosphate are the chief inorganic matters drawn upon in the development of the coconut—chemical data in harmony with the fact that the cocoa palm does not thrive away from the coast or where salt is lacking in the soil.^b

A summary of Bachofen's analysis is also given, showing that of the important ingredients of the soil 1,000 nuts remove the following quantities:

	Total in pounds.	Portion in husk.
Nitrogen	8.65	3.70
Phosphoric acid	2.45	.84
Potash	18.75	13.52
Lime	2.30	1.82
Sodium chloride	21.42	20.23

This means that each coconut husk contains about a tablespoonful of salt, to say nothing of the lime and potash, the presence of which

^a Kirkwood and Gies, Bulletin of the Torrey Botanical Club, vol. 29, pp. 352, 357. (1902.)

^b Kirkwood and Gies, loc. cit., p. 334.

may well assist in increasing the power to attract and hold water for the young plant.

The more we appreciate the highly specialized adaptive characteristics of the coconut the more unwarranted appears the idea of maritime distribution. The huge size of the nuts and the necessary limitation of their number, would have no meaning from the standpoint of maritime distribution, the maximum production of flourishing trees under favorable conditions being reckoned at only 200 nuts. Related palms comparable in size to the coconut, such as *Attalea* and *Acrocomia*, produce seeds in vastly greater numbers. The number of pistillate flowers is relatively very small in the coconut palm and many of these are abortive (pls. 62, 63, 64). It would be impossible for any large number to develop. The chances of any sea-borne nut floating to a favorable destination are so infinitesimal that the natural perpetuation of the species by this method would be entirely impracticable. The specialization of the coconut toward greater size is in itself an evidence that natural selection has favored this tendency. If a few large seeds had not been more advantageous to the palms than many small seeds we may be sure that the large seeds would never have developed. How important the factor of human selection may have been we do not know, but it does not appear that larger size has been a desideratum. The largest varieties do not seem to be especially preferred in cultivation.

BEHAVIOR OF THE COCONUT PALM IN INTERIOR LOCALITIES.

The popular impression that the coconut will grow to normal maturity only in the immediate vicinity of the ocean has arisen from the fact that this palm, like the date, is a salt-loving plant and in continuously humid tropical countries finds no congenial soil except near the seashore. Many agricultural treatises and general works of reference continue to repeat the traditional theory of direct and necessary connection between the coconut and the sea. Even Nicholls asserts the limitation to the seacoast.

The climate, however, must be a maritime one, the palm delighting in the saline atmosphere of the seacoast. When the tree is planted inland, in order to make up for the want of a saline atmosphere, it is usual to put salt in the holes before the seedlings are set out, and as much as half a bushel of salt is sometimes used in this way for each tree.^a

But this view is no longer universal, and is very definitely denied by a recent writer on coconut culture in British India.

The old idea that it would not thrive far from the influence of the sea breeze is exploded, as it grows well all over the low country, where the soil and rainfall are suitable, and even in sheltered valleys at an elevation of 2,000 feet, as in the town of Badulla.^b

^aNicholls, H. A. A., *Tropical Agriculture*, p. 167. (London, 1900.)

^bJardine, W., *The Cultivation of the Coconut Palm*, *Tropical Agriculturist*, vol. 24, p. 151. (1905.)



FLOWERS AND FRUIT OF A YOUNG COCONUT PALM, BELIZE, BRITISH HONDURAS.

The fibrous leaf sheaths and tubular spathes that inclose the inflorescences when young are also shown, as also the scars of the bases of fallen leaves on the trunk.



FRUIT CLUSTERS OF MATURE COCONUT PALM, COSTA RICA.

In a banana plantation at La Colombiana, near Port Limon. More productive trees are sometimes seen, but this gives a fair impression of the clusters of nuts as they hang in their natural position.



INFLORESCENCE OF THE COCONUT PALM, WITH STAMINATE AND PISTILLATE FLOWERS.

a, Four staminate flowers; *b*, base and tip of a branch of an inflorescence, with staminate flowers; *c*, part of a spathe inclosing the inflorescence, with numerous buds of staminate flowers and one pistillate bud; *d*, bases of two branches, each bearing a very young coconut. (*a—d*, Natural size.)

The traditional partiality of the coconut for the seabeach is fully explained by two considerations, the salt and the relative absence of other vegetation, which enables it to be grown with less care or to persist longer without cultivation. The limestone of coral islands may also afford sufficient alkaline matter for the coconut, even out of reach of the sea water, as described by Wallace on the island of Matabello in the Malay Archipelago.^a

Nor is the coconut confined to humid tropical climates or to low elevations. Coco palms have been reported as thriving away from the sea in relatively dry localities in several tropical countries. Pickering reported them in Arabia in the district behind Muscat. Coconuts are extensively grown in the southern part of the Hindustan peninsula, and even in Bangalore, in the middle of the peninsula at an altitude of 900 meters. Field cultures of coconuts are recognized as acutely dependent upon particular kinds of soils.^b

An old report of coconuts in the interior of Africa, in the region of Timbuctu, was probably a mistake, as Seemann has pointed out, though it does not appear improbable that they would grow there if planted. Landor refers to five kinds of palms as seen about Timbuctu, but makes no mention of coconuts.^c

^a“The natives of Matabello are almost entirely occupied in making cocoa-nut oil, which they sell to the Bugis and Goram traders, who carry it to Banda and Amboina. The rugged coral rock seems very favorable to the growth of the cocoa-nut palm, which abounds over the whole island to the very highest points, and produces fruit all the year round.”—The Malay Archipelago, p. 281. (London, 1889.)

^bA report “On the composition of Indian soils” contains the following statements: “No. 375-96. Black loam; lies on a gravelly substratum at a depth of 2 or 3 feet; is therefore unfit for cocoa-nut. The ryots complain that the soil of this and the neighbouring fields is not retentive enough, and needs to be more frequently watered than the fields farther down the Cauvery Valley. Irrigated under the Kaling-arayan channel from the Bhavani.

“No. 377-96. Clay, black; more mellow and clayey than No. 375. At a depth of 3 to 5 feet there is a bed of impalpable black sand; cocoa-nuts and plantains thrive on this remarkably, and nowhere in the Cauvery Valley are cocoa-nuts more extensively cultivated. The nuts are comparatively small. (The sample received could not be called either black or clayey; it consisted of a dark-brown loamy soil.)”—Leather, J. W., The Agricultural Ledger, No. 2, p. 8. (1898.)

^c“A few date palms, the *gorboy-musukuru*, the *gorboy-homo*, with long green thorns and a bitter fruit much enjoyed by the children, and a number of dwarf palms are to be found, as well as the forked palm, *thebaide*.”—Landor, A. H. S., Across Widest Africa, vol. 2, p. 451. (1907.)

The palms with the long green thorns may be oil palms, *Elaeis guineensis* Jacq., which have the lower pinnæ narrow, stiff, and spine-like. Many other palms have spines along the margins of the petioles, but usually short and brown or black in color. The fruits of *Elaeis* are rather bitter when raw, but not after they have been roasted.

A recent publication on the German colonies contains a photograph of a group of apparently thriving coconut palms at Misahoche, in the interior of the Togo colony in West Africa, but no statement is made regarding them.^a

Coconut palms are grown in large numbers on limestone soils in interior districts of the Yucatan peninsula, especially about the city of Merida, and they are also said to thrive on the Pacific side of Mexico, around the volcano of Colima. They are also reported by Mr. G. N. Collins at Acala, a town in the State of Chiapas, in an arid interior district with a natural growth of cacti and other desert plants.

Humboldt remarked particularly the vigorous condition of the coconut palms found by him in the interior of Venezuela and Colombia, which he considered as an anomalous fact in the distribution of a maritime species. Sir Richard Burton mentions the coconut palm as flourishing and very productive in interior districts of Brazil that have alkaline soils which he recognized as a practical substitute for "sea air."^b

More recent testimony to the existence of the coconut palm in interior localities of South America is that of Prof. H. Pittier, a special agent of the Department of Agriculture, who makes the following statement:

Until 1891, I had no notion of that species bearing fruit at any great distance from the seashore or high above the sea level, but when, on behalf of the Intercontinental Railway Commission, I crossed the Azuero peninsula from Remedios to Santiago de Veragua, in the present Republic of Panama, I was surprised to see groves of coconut palms surrounding the houses in the high savannas of Tolé, more than 365 meters above sea level. The sites of many houses in the valley of Tabasará were marked by isolated coconut trees. This, however, did not seem so very wonderful on account of the proximity of the sea, and at Tolé the inhabitants attributed the fine condition of the palms to their being fully exposed to the sea breeze. But in 1905, when we entered through Buenaventura into the Dagua Valley of Colombia, we began to notice coconut trees as soon as we reached the drier region of the interior, at an altitude of over 2,000 feet. On the inner watershed of the Western Cordillera, near a hostelry and on the brink of a precipitous slope, another beautiful specimen was found at about 4,800 feet above sea level. In the Cauca plain, in the interior of Colombia, at a mean level of over 900 meters, in a warm, temperate climate, with extreme conditions of wet and dry seasons, groves of coconut palms were seen everywhere. (Pl. 66, fig. 1.) The people of the Cauca Valley did not seem to distinguish their variety from the one growing on the seashore at Buenaventura, but Dr. Evaristo García, a noted naturalist and physician of Cali, assured me that coconuts brought into the valley from the seabeach do not thrive.

In the Cordillera de Santa Marta I have seen several coconut trees on the hills around San Andrés at nearly 1,090 meters of elevation, and the palm seemed to be quite familiar to the Indians. All over Central America the coconut palm is also

^a Wohltmann, F., Kultur-und-Vegetations Bilder aus unseren Deutschen Colonien, pl. 52.

^b Burton, R., Highlands of Brazil, vol. 2, pp. 264, 280. (London, 1869.)



FIG. 1.—COCONUT PALM, NEAR PALMIRA,
CAUCA VALLEY, COLOMBIA.

FIG. 2.—COCONUT PALM AT CAJABON,
ALTA VERAPAZ, GUATEMALA.

Examples from interior localities. Fig. 1, altitude 900 meters; fig. 2, about 360 meters.



COCONUT PALM AT BELIZE, BRITISH HONDURAS.

Showing wide form of leaves as presented under sea-level conditions. To be compared with plates 62, 65, which show palms growing under interior conditions and having stiffer and narrower leaves.

frequently cultivated in the interior, especially in the drier districts, but the natives do not seem to be so well acquainted with it as is the case in South America, and they have no special names to designate it.

The palms shown in plate 52 (frontispiece) are growing in the city of Salamá near the geographical center of Guatemala. The broad valley or plateau in which Salamá is situated has an altitude of 900 meters, and has a distinctly desert climate, but the coconut prospers apparently as well as on the seashore. The leaves are not as large as usual in coast-grown palms (compare with pl. 65), but this is in accordance with a very general principle of plant growth, that plants produce smaller leaves under the stronger light and more rapid transpiration afforded by desert conditions.

The coconut is also planted with success in other dry valleys in Guatemala, notably in that of Cajabon (pl. 66, fig. 2). It is a curious fact that in several of these places the prosperity of the palms is coincident with the prevalence of goiter, a disease commonly supposed to be associated with alkaline water, which might be an advantage to the palms.

In eastern Guatemala, near Livingston, the coconut palm has given an apparent illustration of its requirement of salt by refusing to grow within a few rods of the ocean on slopes moistened only by fresh water. The nature of the soil and the water supply will probably be found to constitute a very large factor in all such cases. The palms thrive much better in the town of Livingston, built on a part of the same slope where the agricultural production of coconuts appears to have failed (pl. 54, fig. 2, facing p. 299). Proximity to the sea is not enough without the right conditions of the soil. Other tropical tree crops, such as coffee and cacao, often thrive under dooryard cultivation in districts where agricultural production is much less successful. Even at Panzos, 90 miles from the sea, coconuts are still able to grow in the yards about the houses.^a

The dryness of the interior valleys of Guatemala, and the alkalinity of their scant water supplies, are to a large extent artificial conditions induced by the long-continued presence of agricultural populations and the consequent destruction of the forests and denudation of the

^a An instance where proximity to the sea enabled palms to thrive in otherwise unfavorable soil is given in Spons' Encyclopedia:

"Coco-nuts growing in mangrove soil on the side of creeks, and more or less saturated with salt, have their milk brackish, and the sap is saline also. These trees do not suffer from the attacks of the rhinoceros beetle, and are found to bear much sooner than those planted on a sandy soil. As an illustration of this, while trees planted at Penang thirty years ago, on sandy soil, have not yet borne fruit—although they are fine-looking trees—others in the same plantation, only 10 years old, but on low ground, where the sea tide comes up daily, washes their roots, and runs off again, are in full bearing, giving 50—100 nuts annually, and the kernel is as thick as that of nuts grown on sandy soil, and produces as much oil."

soil. Under favorable conditions upon the seabeach the coconut palm may require only one form of assistance from man—protection against the shade of other vegetation—but in other places it may become dependent upon man for its water supply and for the saline constituents of the soil.

ABSENCE OF COCONUT PALMS ON THE COAST OF PERU.

The failure of archaeologists to find coconut shells in the ancient graves of Peru was used by De Candolle as an argument against the American origin of the palm, but coconuts still refuse to grow along the Peruvian coast, in spite of efforts to introduce them. Other palms flourish in the botanical gardens at Lima, but numerous experiments have shown that the coconut is entirely unsuited to the local conditions. Although much of the coast belt of Peru lies inside the Tropics, the sky is overcast and the weather continuously cool for several months of the year, a result of the cold Humboldt current that follows the Peruvian coast. The unfavorable climate continues northward nearly to Guayaquil, where the cloud belt is passed and the coco palm thrives.^a

The English botanist Spruce, who made a special study of the vegetation of this region, considers that the Peruvian desert extends along the coast even farther north than Guayaquil, almost to the equator, his first mention of coconuts growing on the coast being at 1° 5' south latitude.

The northern limit of the Peruvian desert is usually placed about Tumbes, at the southern extremity of the Gulf of Guayaquil, in latitude 3° 30' S., but I now know, from personal inspection, that the coast of the Pacific north of the gulf has the same geological conformation, the same climate, and almost as scanty a vegetation as it has south of it. At what point to northward the struggle between barrenness and fertility begins to be equally balanced I am unable to say, but I am inclined to place it about Cape Pasado, at the mouth of the river Chones. Guayaquil itself, as seen from the river, with its groves of coco palms and fruit trees, and its picturesque wooded hills, might be supposed a region of forests; but the moment we pass the skirts of the city to westward we find that the country is nearly all savanna, either open and grassy or scattered over with bushes and low groves, and that the woods are confined to the hills and to the borders of salt-creeks. . . .

About Cape San Lorenzo (latitude 1° 5' S.) the coast is bold and broken, and almost completely clad with low bushy vegetation. In the village of the same name, which nestles in the bay to southward of the cape, at the mouth of a small stream, the houses stand mixed with Coco palms and Plantains, and steep wooded declivities rise at the back. . . .

A little farther northward, on the river Chones, there is real forest, from which much timber is obtained for Guayaquil.^b

^a For the facts stated in this paragraph I am indebted to Mr. W. E. Safford, of the Bureau of Plant Industry, U. S. Department of Agriculture.

^b Spruce, Richard, *Notes of a Botanist on the Amazon and Andes*, edited by A. R. Wallace, vol. 2, pp. 328, 329. (London, 1908.)

As soon as the coast belt is passed the coconut palms are able to thrive, not only at Guayaquil, but much farther to the southward. The following statement by Spruce shows the existence of coconut palms in an oasis of the desert in the region of Payta, in northern Peru:

When the traveler across the despoblado comes suddenly on one of the valleys, he passes at once from a desert to a garden, whose charms are enhanced by their unexpectedness. Standing on the cliff that overlooks the Chira, about Amotape, he sees at his feet a broad valley filled with perpetual verdure, the great mass of which is composed of the pale green foliage of the Algarroba; but the course of the river that winds through it is marked (even where the river itself is not seen) by lines or groups of tall Coco palms, here and there diversified by the more rigid Date palm, both growing and fruiting in the greatest luxuriance, their ample fronds never mutilated by caterpillars, as they are wont to be in other regions.^a

POSSIBILITIES OF THE COCONUT PALM IN THE UNITED STATES.

It will be apparent from the preceding chapters that we are not to expect the coconut palm to attain its utmost limits of extratropical distribution along the seacoast, but in interior localities that afford larger amounts of heat and sunlight. Applying these considerations to the United States, we ought not to accept as final the present limitation of the coconut palm to extreme southern Florida, but should test the possibility of establishing it in the frost-free interior valleys of southern California and Arizona. The low summer temperatures of the coast belt of California would doubtless exclude the coconut palm, though some of the Brazilian species of *Cocos* appear to thrive in the region of Santa Barbara and also farther north in Florida than the existing varieties of the true coconut.

The fact that the coconut is able to thrive and mature its fruit on tropical seacoasts shows that it does not demand the high temperatures that the date palm requires to ripen its fruit. It seems probable, therefore, that the coconut may prefer districts nearer to the coast in California than the very hot interior valleys where the date succeeds. The region about Riverside, or some of the valleys that are not hot enough for dates, may possibly afford conditions in which coconut palms can thrive.

The possibility of securing useful hybrids between the coconut and other related palms already known to be hardy in California is also worthy of consideration. Some of the Brazilian species of *Cocos* have been reported as thriving in California, as well as the Chilean relative of the coconut, *Jubaea chilensis*, which grows in South America well outside the Tropics.

It is said to extend to 36 degrees south latitude in the wild state, but lives in cultivation still farther south. It has proved hardy in

^a Op. cit., p. 335.

the south of France, where large trees exist more than 30 years old. Twelve degrees of frost have been endured with little or no injury.^a

While experimental plantings of coconuts in frost-free localities in southern California and Arizona are desirable to test the possibility of introducing the coconut into a new region, no assurance can be given in advance that the undertaking will be successful, either to the extent of affording a new agricultural industry or to the lesser extent of introducing a new ornamental palm. The fact that the coconut is not limited to maritime conditions, as usually supposed, but is adapted to dry climates, simply means that previous ideas of the habits of the palm should not be allowed to stand in the way of further study of its possibilities.

The only assurances that can now be given are that the climatic factors do not appear likely to exclude the palm from an extra-tropical distribution in frost-free interior localities with adequate exposure to sunlight, and that the heat requirement is not as great as in the case of the date palm. Whether coconuts can be made to thrive in any locality in the United States outside of Florida can only be determined by experiment. Other factors that are not to be foreseen may interfere with or entirely preclude success. Locusts or other insects or diseases may destroy the palms, as they have done in other parts of the world, or the soil conditions may prove unsuited in some manner that can not be corrected. It is also possible that the palms may not tolerate cold weather, even above the freezing point. Some tropical plants are permanently injured by cold, even when the freezing temperatures are not reached, but this susceptibility is not conspicuous among the palms and is not very likely to appear in the coconut, in view of what we already know of its ability to exist in dry and elevated regions subject to marked changes of temperature.

To undertake the commercial planting of coconuts in California before experiments have shown its feasibility would be altogether unwarranted. Such a caution may appear to some readers as altogether superfluous, but not to those who are familiar with the losses that have come from the premature expansion of rubber culture and other tropical industries in recent years. It is quite possible that coconut palms will be found to grow well in localities where they are able to produce little or no fruit. This would preclude commercial cultivation, but if coconut palms will grow in California, even without producing fruit, their introduction will be abundantly repaid, for they are one of the most beautiful objects in the whole vegetable kingdom and would be "a very great grace" in California as in the "city of Porto Rico."

^a André, E., *Revue Horticole*, vol. 74, p. 8. (1902.)

An adequate test of the possibilities of the coconut palm in California and Arizona can not be made by planting commercial nuts raised on tropical seacoasts. Except in South America, all the attempts to grow coconut palms in interior localities have probably been made with varieties brought in from neighboring coasts. It is something to know that the maritime varieties are able to grow away from the sea, but it is not at all to be expected that such varieties will represent the best possibilities of the species in subtropical localities away from the seacoast.

To rely upon maritime varieties for an experiment in the United States would be the same as to expect hothouse varieties of grapes or lettuce to excel in tests of hardiness. If an effort is to be made to establish the coconut in California, it should be based upon the study and introduction of the varieties that have shown their ability to thrive in the dry interior valleys and plateaus of South America, and especially the varieties that are able to withstand the most extreme conditions of drought and cold. In tropical countries the climatic conditions often differ greatly, even within very short distances. One valley or mountain slope may have a very prolonged dry season and wide extremes of temperature, while the next may have equable temperatures and relatively continuous humidity. Plants with large, heavy seeds are likely, in their natural state, to be confined to very limited districts, and this is to be expected of the wild stock or the native varieties of the coconut if any have survived in the original home of the species.

It seems strange that the numerous maritime varieties of the coconut which exist in the East Indies have never been introduced and tested in the West Indies or in southern Florida. They may be expected to differ quite as much in hardiness and earliness of bearing as in the characteristics of the nuts. Hardier or earlier coconuts would have a distinct value in southern Florida, since it would permit a more northern extension of the planting of coconuts, which is now confined to the keys and to the southern shores of the peninsula.

Conditions favorable for the coconut palm may also be found in interior localities of Palestine and Upper Egypt. In the coast districts where the summer climate is dominated by cool winds from the Mediterranean the heat requirements would not be met, but the interior valleys afford many sheltered places with tropical temperatures in summer and free from frost in winter. The soil requirements must be considered, of course, as well as the climate, but experiments might be well worth the making.

It is said that coconuts were germinated some years ago a few miles below Cairo, but the garden was abandoned and the young palms allowed to die for lack of water. Though royal palms and

several other species have been found to thrive, Cairo may be still too near the sea to give the most favorable conditions for the coconut. The partial shade of gardens that seem to be well suited to *Cocos plumosa* and other Brazilian species would not favor the true coco palm. Shelter against cold winds may be an advantage, but the young palms will probably require full exposure to the sunlight. The coconut may behave like the doum palm, that thrives in Upper Egypt but is kept alive only with difficulty in the gardens at Cairo.

That the possibility of growing coconuts in Egypt and Palestine should not have been more thoroughly tested may seem very strange, but it should be remembered that the Mediterranean region had no direct communication with coconut-producing tropical countries before the opening of the Suez Canal. Though the Poinciana, the banyan (*Ficus bengalensis*), the Assam rubber (*Ficus elastica*), and many other tropical trees have been established as ornamentals about Cairo and other towns, many other tropical and subtropical species that are likely to prove well adapted to the conditions remain to be introduced. Now that selected fresh nuts can be brought by swift steamers from Ceylon or other parts of the East Indies, other experimental plantings of coconut palms will doubtless be made.

SUMMARY OF RESULTS.

The history of the coconut palm has relation to several different kinds of scientific questions, so that the facts require to be summarized from several different standpoints.

BOTANICAL CONCLUSIONS.

All the palms that are related to the coconut, comprising about 20 genera and 200 species, are natives of America, with the possible exception of a single species, the West African oil palm. All the species of the genus *Cocos* and of the closely allied genera are natives of South America. The species of *Cocos* that are most related to the coconut are natives of the interior valleys and plateaus of the Andes, where the coconut also thrives, remote from the sea.

Comparison of the structure of the fruit and the method of germination of the coconut with those of the related palms indicates a high degree of specialization, but not for purposes of maritime distribution. The unusually large, heavy seed and the thick, fibrous husk are to be considered as adaptations for protecting the embryo, assisting in germination, and establishing the young plants in the dry climates of interior localities, the only conditions where this palm could be expected to maintain its existence in a wild state.

The habits of the coconut palm afford no indication that its original habitat was on the seacoast, and none of its closer relatives have maritime habits or maritime distribution. The coconut palm

does not appear to be able to maintain itself under littoral conditions without the assistance of man. Though carried by man to all of the warmer parts of the earth, it has not been able to establish itself as a wild plant on any tropical coast, but is always crowded out by other vegetation after human care is withdrawn.

Wafer's circumstantial account of the existence of large numbers of coconut palms on the Cocos Islands, 300 miles west of Panama, in 1685, taken together with their almost complete disappearance at the present day, affords a striking illustration of the dependence of the coconut upon human assistance not only for its distribution, but for its continued existence on oceanic islands.

The dissemination of the coco palm along the tropical coasts is to be ascribed to the agency of primitive man, as with the sweet potato, banana, and other domesticated plants which were widely distributed in prehistoric times. The theory that it has been disseminated by ocean currents is gratuitous, unproved, and improbable.

The development of distinct varieties of the coconut has not been confined to the Polynesian and Malayan islands. Distinct varieties are also to be found in isolated localities in America, such as the Soconusco region of Mexico and the island of Porto Rico.

The existence of many and diverse varieties in the Malay region does not indicate that the species is native there, but the opposite, since the proximity of the wild stock of a species is likely to hinder the appearance and preservation of mutations among its cultivated representatives. The relative uniformity of the coconuts of America is in accord with the probability of an origin in this hemisphere. The discovery of distinct varieties in isolated localities in America accords with the probability that the Malayan varieties have arisen, like other cultivated varieties, through segregation and mutation rather than by gradual evolution and natural selection.

HISTORICAL CONCLUSIONS.

At the time of the discovery of America the coconut was not confined to the Pacific side of the Isthmus of Panama, as De Candolle believed, but was already widely distributed along the Atlantic side of the American tropics. Early records show its presence in Cuba, Porto Rico, Brazil, and Colombia at dates so early as to preclude the idea of introduction by the Spaniards.

The statement of Pickering, frequently quoted in works of reference, to the effect that coconuts were reported by Columbus on the coast of Central America during his fourth voyage, proves to be erroneous. On the other hand, there appears to be a definite reference to the coconut in Cuba in the journal of the first voyage of Columbus.

De Candolle's inference from Acosta's report of coconuts in Porto Rico at the end of the sixteenth century, that they had recently been introduced by the Spaniards, proves to have no warrant in history and is directly opposed by the more extended reference to the coconut in Porto Rico by the Duke of Cumberland's chaplain, who visited the island only a few years after Acosta.

De Candolle's use of the testimony of Piso and Maregrave to support the idea of the introduction of the coconut into Brazil by Europeans is also unwarranted, since those writers only indicated that the plant was cultivated. An earlier and more explicit record, unknown to De Candolle, gives an account of the coconut as one of the native products of Brazil.

The journal of Cieza de Leon, who accompanied the first Spanish expedition to the interior of Colombia, indicates the presence of the coconut palm in localities where it still continues to exist, as shown by the accounts of Velasco, Humboldt, and more recent travelers, down to the present decade.

ETHNOLOGICAL CONCLUSIONS.

The American origin of the coconut palm and the strict limitation of its status in maritime tropics to that of a cultivated plant are facts of ethnological significance. The wide distribution of the coconut in prehistoric times is evidence of the antiquity of agriculture in America and of very early communication across the Pacific.

The American origin of the coconut palm, along with its inability to maintain itself on tropical seacoasts without human assistance, compels us to believe that its trans-Pacific distribution was the work of primitive man. The dependency of the Pacific islanders upon the coconut may be taken to show that these islands could not have been occupied without the previous domestication and dissemination of the coconut.

In view of the fact that several other palms of unquestioned American origin have been domesticated by aborigines of the American tropics, no ethnological objection can be raised to the idea that the coconut palm was originally domesticated in ancient America.

The name "coco" does not appear to have been applied to the "Indian nut" till after the discovery of America and is to be considered as a word derived from the natives of the West Indies. Other native names for the coconut are found among primitive tribes of Costa Rica, as well as in Brazil.

The presence of large numbers of coconuts on Cocos Island in the time of Wafer (1685) and their subsequent disappearance should be considered as evidence that the island was formerly inhabited, or

at least regularly visited, by the maritime natives of the adjacent mainland.

The fact that the coconut is largely restricted to islands and tropical countries of low elevation explains its importance among the pre-eminently maritime people of the Old World tropics and its relatively slight importance among the nonmaritime natives of the lowland tropics of America.

The evidence of the prehistoric dissemination of the coconut and other American cultivated plants across the Pacific Ocean is such as to warrant a careful consideration of other indications that agricultural civilization developed originally in America and was distributed to the shores of the Pacific and Indian oceans by a primitive people with agricultural and maritime habits, like those of the Polynesians and Malays.

The existence of a distinct tribe of frizzle-haired people near the Isthmus of Panama at the time of the discovery does not rest alone on Peter Martyr's casual mention of the finding of negroes, but is supported by Oviedo's contemporary history written directly from the testimony of Balboa and other members of his expedition, just after their return to Darien. The facts are not to be explained reasonably by assuming a chance arrival of African negroes, but indicate that prehistoric communication across the Pacific continued after the frizzle-haired Melanesian race had spread eastward in the Pacific.

Such communication would account for the existence of the banana plant in America previous to the arrival of the Spaniards, as well as for the Old World distribution of the coconut palm and other cultivated plants of American origin. The banana plant is as evidently a native of the eastern continent as the coconut palm of the western. Evidence of these facts appears very definite and concrete from the biological standpoint, and is worthy of careful consideration by ethnologists.

AGRICULTURAL CONCLUSIONS.

The coconut is confined to seacoasts only in the humid lowlands of the Tropics; in dry regions it is not restricted to coasts, but thrives in many districts remote from the sea. The fact that it received scientific study only as a maritime plant should not longer obscure the fact that it is also adapted to interior localities with saline soils. The cultural problems of the coconut palm should be investigated quite apart from the idea of maritime habits and distribution.

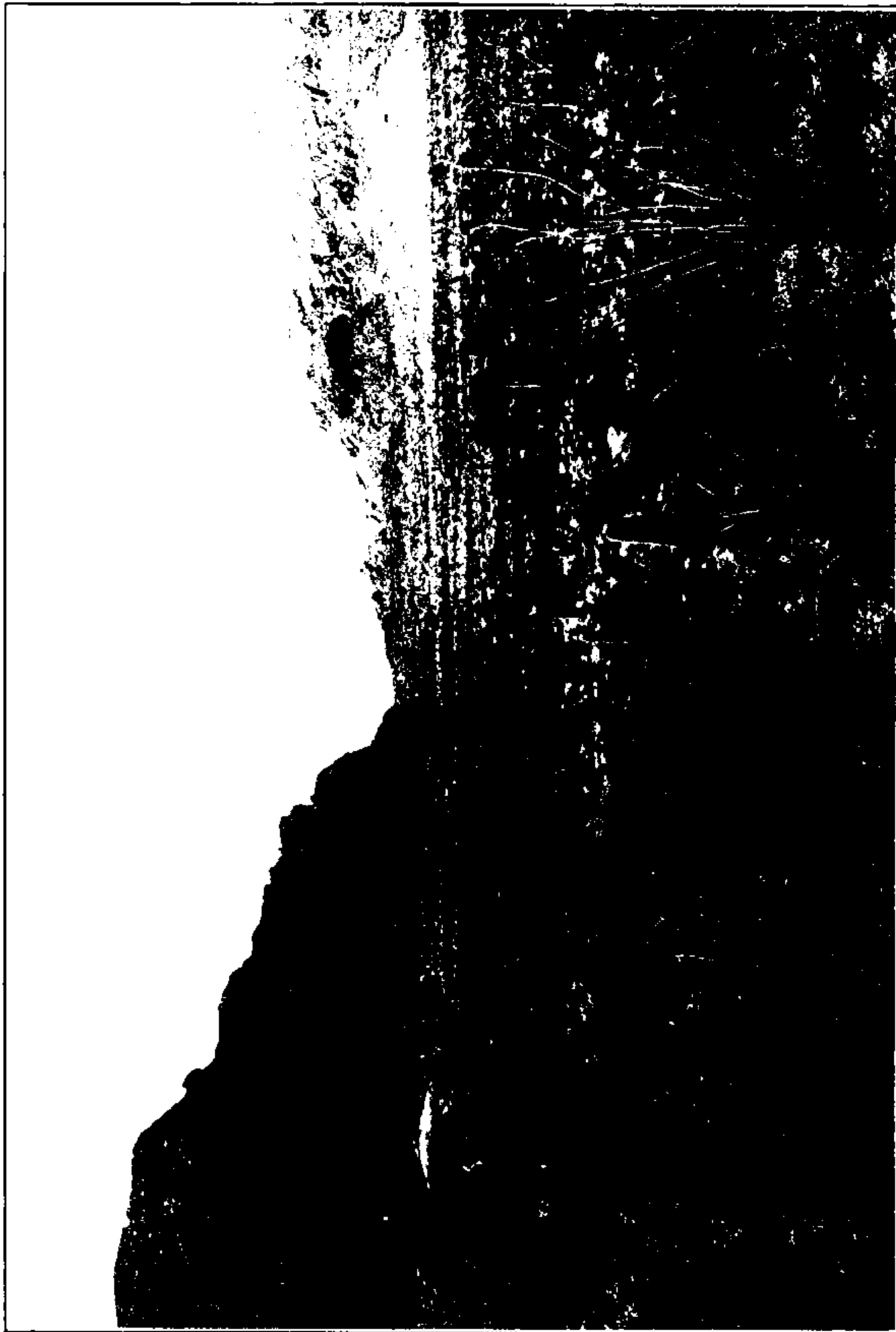
The possibility of raising coconuts in frost-free localities outside the Tropics is not to be tested along the seacoast, but in interior districts where larger amounts of sunlight and heat are available, as in the valleys of southern California and Arizona. The coconut, like

many other palms, is not tolerant of shade nor of long continued cool and cloudy weather. Other species of *Cocos* that are less exacting in their requirements of sunlight and heat have been found to do well along the California coast.

The possibility of introducing coconut palms into southern California is not disproved by the absence of these palms from Egypt and Palestine. Though the climatic conditions are probably favorable, it does not appear that any adequate effort has been made to introduce the palms in those countries.

The ability of the coconut to thrive on seacoasts shows that its requirements of heat are not as great as those of the date palm. Though probably less hardy than the date palm, it is not impossible that the coconut may be able to exist in frost-free localities that have not enough heat for the ripening of dates.

The possibility of introducing the coconut palm into southern California and Arizona can not be fairly tested by the planting of the maritime varieties. The chances of success will be very much greater with the varieties that are adapted to the dry interior localities of the temperate plateaus of the Andes.



HABITAT OF BOUTELOUA SPP. IN THE TUCSON MOUNTAINS, ARIZONA.

Arid low mountain situations occupied by forms of the low-growing species, *B. aristata* and *B. barbata*. The main shrubby consists of *Cercas* *gigantea*, *Eriogonum splendens*, *Arctostaphylos*, *Prosopis juliflora*, and *Fraseria*.