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# The aboriginal utilization of the tall cacti in the American Southwest

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*E. F. Castetter*

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The University of New Mexico  
Bulletin

Ethnobiological Studies in the  
American Southwest

*IV. The Aboriginal Utilization of the Tall  
Cacti in the American Southwest*



By

EDWARD F. CASTETTER, *Professor of Biology*  
*University of New Mexico*

and

WILLIS H. BELL, *Associate Professor of Biology*  
*University of New Mexico*

*Given to U. N. M. in memory of  
Dr. E. F. Castetter. Prince Pierce.*

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*March 1987*

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#### IV. THE ABORIGINAL UTILIZATION OF THE TALL CACTI IN THE AMERICAN SOUTHWEST

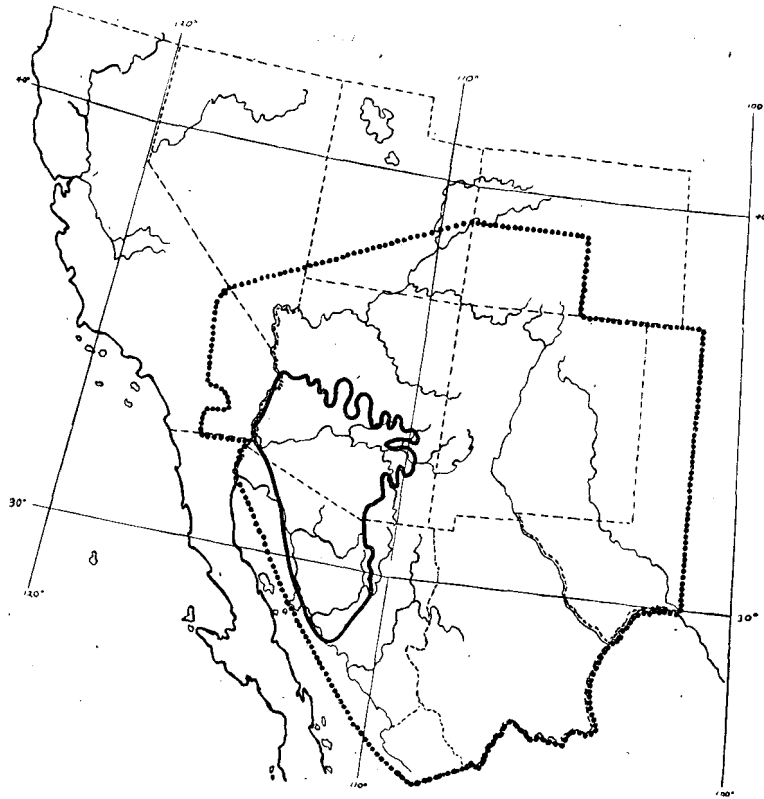
##### INTRODUCTION

The authors are engaged in a series of investigations on the ethnobiology of the American Southwest, a region variously defined by different investigators. To our conception of the Southwest, as represented on the accompanying map, Baja California has been added because of natural botanical affinities of the species presented. Culturally, Baja California does not belong to the typical central Mexican region nor to the Californian area, hence no particular violence is done by this temporary alignment.

The choice of the cacti discussed has been guided by the aboriginal utilization of species of tall cacti belonging to the old genus *Cereus*, and is, therefore, more or less arbitrary.

From several lines of evidence it is known that the fruits, seeds, and other plant parts of the species of cacti discussed below were used as food, etc., aboriginally in portions of the American Southwest, and it is our purpose to reconstruct, in so far as possible, the methods and extent of such pre-Columbian utilization by the various Southwestern aborigines. In so doing, our main sources of information have been the distribution of these species of cacti, the study of surviving peoples, and evidence gathered from recorded historical sources. Other lines of attack, valuable to some investigators, have proved practically fruitless in this particular study.

As regards the methods of investigation listed it may be said that the first, namely distribution, was often valuable in determining the identity of a particular species that was reported used in a given locality. Thus, when it was known that the fruit of some giant cactus was utilized in an area, the known distribution of the various species made it possible to ascertain the particular one by eliminating those not distributed in such an area.



Map showing the distribution of *Carnegiea gigantea*, as well as the limits of the American Southwest. Adapted from the map in "*Carnegiea gigantea* Britton & Rose" by Forrest Shreve, *Die Pflanzenareale* 3 (1): 7-8, 1931. By permission of author, editor, and publisher. Limits of the Southwest, as interpreted by the authors, shown by the heavy dotted line.

The second method of attack—study of surviving peoples—has been very fruitful. To be sure, European penetration in the Southwest wrought pronounced economic changes in some quarters. However, it left other, more isolated, regions relatively unaffected for considerable periods of time.

The growing and utilization of cultivated plants by Indian peoples is much more likely to be modified by white contact than is that of wild plants. Agriculture in the Southwest has been greatly modified by the introduction of foreign plants, although the methods of utilizing wild plant products still remain in some places essentially on the aboriginal level. The extent of dependence upon these same products has frequently undergone pronounced change because of the gradually greater availability of other products within historic times; also the persistence of aboriginal utilization among some tribes is much more marked than among others. For example, the Papago, living in a forbidding land, where comparatively little agriculture was possible, and where a subsistence had to be wrested with great effort largely from the wild products of nature, have, until recently, remained relatively unaffected by white contact. Because of the inhospitality of their desert land they did not suffer the thorough conquest which befell the Pima and many of the Mexican tribes to the south. Hence they have kept many of their ancient customs intact. Kino, who came to Pimería Alta in 1687, found it to be untouched and unknown, although to the east in Nueva Vizcaya were the already important *reales*, or mining camps, of San Juan and Bacanuche, and to the south were many missions, ranches, and mining towns (11:I, 51). Pimería Alta, which extended from the Altar River, in Sonora, to the Gila, and from the San Pedro River to the Gulf of California and the Colorado to the west, had been entered by Fray Marcos, by Melchior Díaz, and by the main Coronado party between 1539 and 1541. But these explorers had passed only along the eastern and western borders. Not since that day had Arizona been approached from the south by a single expedition, while, to the best of

our knowledge, not since Oñate, in 1604, traveled from Moqui down the Colorado of the West had any white man seen the Gila River. Hence the rediscovery and first interior exploration were the work of Kino (11:I, 53).

A differential rate of acquisition of white culture gradually became evident among the Papago as compared with the Pima. Kino labored incessantly to furnish a food supply for the Indians of the missions in his territory and even beyond, to the end that these missions might be given a basis of economic prosperity and independence (11:I, 57). Kino's missions dwindled soon after his death in 1711, and their later history, in spite of the picturesque labors of the saintly Garcés, shows no great revival. Thus the Papagos, after a brief Spanish influence, were left to their own devices. They had acquired horses from the Spaniards, and had learned to plant wheat and a few imported fruits and vegetables. Except for these changes, however, their old economic life continued (21:3-4). In sharp contrast, however, the Pimas dwelling along the rich bottom lands of the Gila possessed desirable agricultural lands much coveted by the white man and easy of access. Due to this and constant contact with the argonauts from the United States, Sonora, and Chihuahua, in 1848-49, when one of the Southwestern trails to California led through the Gila River country (10), the Pima changed much more rapidly, until today they represent only a vestige of their former selves.

Castetter and Underhill (21) made a rather detailed study of Papago ethnobiology as reported by the first Spaniards and as seen in the remoter villages of the present day. Russell (74) did the same for the Pima, as did Spier (85) for the Maricopa, and so on. The picture drawn, apart from the exceptions mentioned above, may be reasonably considered as aboriginal.

The third line of attack, the historical or documentary, involved the information obtainable from written records, in several languages, made by early explorers, travelers, and missionaries. These early intruders had ample opportunity to observe and set down the kinds of plants employed and

the methods of their utilization before European contact wrought much, if any, change.

By comparing the above three methods with each other it is felt that a reasonably accurate picture of aboriginal economy, as regards these cacti, has been reproduced. Certain facts bearing on utilization presented in the text are obviously not aboriginal, and these will be apparent to the reader as he proceeds. They are included for special reasons.

In approaching the subject historically it is not always possible to be certain which species the early writer was describing. In old Spanish accounts the term *pitahaya* was used indiscriminately to designate a number of species of tall cacti of the Southwest including *Carnegiea gigantea*. Clavigero (23:I, 49; II, 221), for example, referred, in 1780, to pitahaya fruits being used as food in Mexico without giving any indication of the species, and the author of the Rudo Ensayo (73:149-50), writing of Sonora about 1763, employed the term pitahaya for a small Sonoran cactus with "stalks as large as a wax taper," and added that *sahuaro* was larger and was found only in the highlands of the Pimas. Similarly Alegre (1:I, 232), who left his work incomplete in 1767 at the time of the Jesuit expulsion, wrote that the inhabitants of Sinaloa, Mexico, considered *pitayas* among their best delicacies. Bancroft, (3:I, 576) wrote that the northern Mexican tribes lived chiefly on wild fruits important among which was pitahaya, and Taraval (92:50) wrote of the Indians of Baja California being indocile, evidently due to the fact that it was the time of year when they were out gathering pitahaya fruit. Later the name *sahuaro* usually was employed with more definiteness to apply to *C. gigantea*. This species today is also occasionally designated pitahaya, but is more generally known in the Southwest by the Indian name of *sahuaro* (also spelled *saguaro*, *suwarro*, *zahuaro*, and *suahara*) (19:II, 165), although Coues (25:II, 439) observed in his own Arizona travels that the names pitahaya and *sahuaro* were used indiscriminately of the giant cactus (*C. gigantea*). In the following pages the name pitahaya or organ-pipe cactus will be used to designate *Lemaireo-*

*cereus Thurberi*, and *sahuaro* or giant cactus to refer to *C. gigantea*. According to Safford (75:555) the term pitahaya is of Carib or Haytian origin, brought early to Mexico by the Spanish conquistadores.

Oviedo<sup>1</sup> writing in 1535, described a pitahaya plant with its spines and fruit. He referred to it as having a thick skin, and that the fruit was filled with little seeds. The seeds were mixed with the pulp to form a kind of paste which had a crimson color. The wholesome mixture was eaten, and whatever it touched also became red. He noted that a few hours after eating the fruit the urine became red, like blood itself. Oviedo recorded that he had made ink from the fruit. He noted that there were also other pitahayas with fruits of different color. The identity of the plant described by Oviedo has not been established although Safford (75:556) thinks it might possibly be the variable *Acanthocereus pentagonus*.

It is the pleasant privilege of the authors to acknowledge their obligations: first, to the National Research Council, for two grants-in-aid, which in part made it possible to carry on some of the work here reported; to Dr. Forrest Shreve, of the Desert Laboratory, Tucson, Arizona, for considerable advice and information on distribution of the species discussed, as well as for reading and criticizing the manuscript; to Dr. Ira L. Wiggins, of the Dudley Herbarium, Stanford University, who has also checked the manuscript, made valuable suggestions bearing on distribution, and furnished some valuable notes on utilization of these cacti by Indians of Mexico; also to Mr. Lansing Bloom, and to Dr. D. D. Brand, of the University of New Mexico, who have carefully checked the manuscript.

#### CARNEGIEA GIGANTEA BRITT. AND ROSE

The tall, columnar giant cactus or *sahuaro* (*Carnegiea gigantea*) is a monotypic genus of the American Southwest and is the only cactus of this type which occurs in the United

1. Oviedo y Valdes, (Gonzalo) Fernandez de. La Historia general y natural de las Indias. 3 pts. in 4 V. Madrid, 1851-55. The work was first published in Seville, 1535. Reference is Lib. 8, Cap. 26, p. 311.

States. Thanks to a number of observers, particularly Shreve (80:8; 19:II, 164-65), Spalding (84:59-66), and MacDougal (58:132), we have detailed information regarding the range and ecology of this species.

As may be seen from the accompanying map, its range extends from the Yaqui River in southern Sonora northward to the southern corner of the Colorado Plateau in central Arizona. To the east and north its occurrence is limited by the minimum temperature of the coldest winters at an altitude of about twelve hundred meters. Westward the area reaches to the Colorado River and extends beyond in only three places, where the boundary appears to be determined as much by the fact that the rain falls only in the cold months as by the fact that the deserts of California, in which the cacti seldom occur, are unusually dry. The plant is much more abundant in the northern than in the southern part of its range.

The species reaches its greatest display on rocky, eroded slopes with coarse, stony soil, being only scantily distributed on soils of finer composition, and lacking entirely on the heavy diluvial type. Over its entire range it is widely distributed on mountain slopes facing southward. The region of its optimum development lies between five hundred and one thousand meters, and above fifteen hundred meters only a few specimens are to be found (80:8). It does occur in Sonora, Mexico, at sea-level, but wherever found below two hundred meters in altitude rarely attains the size and strength necessary for forming branches.

In part of its distribution area in the United States sahuaro is associated with the related pitahaya or organ-pipe cactus (*Lemaireocereus Thurberi*), and in Sonora is found also with the garambullo (*Lophocereus Schotti*). Both of these companions are more slender and smaller. In central Sonora it grows with *Pachycereus Pringlei*, a plant of similar form but even larger size (80:7).

*Papago Sahuaro*, formerly one of the United States National Monuments, is named for this plant and occupies more than two thousand acres of desert land situated about nine

miles east of Phoenix, Arizona, where there is a splendid display of *Carnegiea gigantea* on the rocky hillsides. Incidentally, sahuaro is the state flower of Arizona (19:II, 165).

We are especially indebted to Shreve for detailed information regarding the biology of sahuaro. He (80:7) finds that the plant seldom attains a height greater than twelve meters, and that it reaches a maximum age of 150 to 175 years. Flower formation begins when the plant is three to four meters high and from fifty to seventy-five years of age. The flowers appear in May and become densely formed under the apical growing region on both the main stem and the branches. The fleshy fruits ripen five to six weeks later. It is common for the red-shafted flicker (*Colaptes cafer collaris*) to dig holes in the stem of this species for nests (48:213; 19:II, 166; 65:II, 221).

\* \* \*

Although sahuaro was not botanically described until 1848 (19:II, 164; 33:159), when Engelmann proposed for the plant seen along the Gila River the name *Cereus giganteus*, it was known to the early explorers and missionaries in the Southwest.

Until 1905, it was assumed that *Carnegiea gigantea* was not known to civilized man before 1848, when it was described in Emory's report (33:159). This was accepted by Sargent (76:V, 54) and remained unchallenged until June, 1905, when attention was called to the fact that the plant doubtless had been observed much earlier. MacDougal (58:129) mentioned the Coronado expedition but stated that the earliest printed record of sahuaro was that relating to the journey of Oñate in 1604. Castañeda (93:515), chronicler of the Coronado expedition of 1540-42, writing of the region of Petatlan in Mexico (along the present Rio Sinaloa), said "The nature of the country changes here very greatly, because from this point on there are no trees except the pine, nor are there any fruits except a few tunas, mesquites, and pitahayas." He was undoubtedly, in the light of our knowledge of the distribution of sahuaro, not referring to this plant. However, on the following page (93:516), writing

of the Indians of the valley of Suyá in Mexico (somewhere in northern Sonora) he recorded: "They are great Sodomites. They drink wine made of the pitahaya, which is the fruit of a great thistle which opens like the pomegranate. The wine made them stupid." In the light of the distribution of pitahaya and sahuaro the plant to which Castañeda referred might have been either species, but from his description of it as "a great thistle" the author is inclined to think he had sahuaro in mind; Safford (75:557) is of the same opinion. Jaramillo (93:585), who accompanied the Coronado expedition, wrote of going from the present Arizpe, in Sonora, through deserted country to a river where some Indians presented his party with pitahayas (may have been either or both sahuaro and *Lemaireocereus Thurberi*), and stalks of roasted *maguey*.

The next reference to any of these giant cacti is undoubtedly that relating to the journey of Oñate (4:155), conqueror and governor of New Mexico, who, while on an exploratory journey westward from his headquarters on the Rio Grande in 1604, at length came to a small stream, named San Andrés, where the "tierra caliente began to produce the pitahaya" and by going down it (the present Bill Williams Fork) (25:II, 477) found the large stream which they sought—the present Colorado River. As pointed out by MacDougal (58:129) no other large arborescent cactus which might be confused with sahuaro is to be found in this region. Benavides (8:36) wrote, in 1630, of New Mexico abundantly yielding a number of specific crops among which was the pitahaya. The limits of Benavides' conception of New Mexico were, of course, more extensive than the present state boundaries, and his boundaries preclude the possibility of the pitahaya being anything but *Carnegiea gigantea*.

Padre Kino, who explored southern Arizona and northern Sonora as far west as the Colorado River, came to the Papago Indians in 1687. In letters to the Father Visitor Oracio Polise in 1698 he wrote (5:73n; 11:I, 187) of the Papagos of Sonora giving him foods among which were "plentiful pitajayas." Again, in 1700, he wrote of setting

out for San Luys Bertrando de Bacapa, a Papago village in northern Sonora, and that on the way, as well as at San Luys Bertrando, the Indians gave them many "viands and many very good *pitajayas* which on this coast (Gulf of California) are abundant, and last until December" (11:I, 256) (these pitahayas might have been either or both *C. gigantea* and *Lemaireocereus Thurberi*). He also recorded that the cowboys neglected their cattle in order to eat pitahayas (*C. gigantea*) at San Xavier (11:I, 291) near present day Tucson, Arizona. In this same connection Velarde (94:128), writing of Pimería Alta in 1716, observed that wild fruits were very few, only those of the tree cactus (undoubtedly *C. gigantea*), tunas, wild nuts, and acorns being available.

Sahuaro fruit was referred to in the "Documentos para la Historia de Mexico" (32:3rd ser. IV, 522) as occurring in Pimería Alta and described as little different from pitahaya fruit. Anza (12:1, 78-9), on his expedition through Papago land in 1774, traversed areas grown with sahuaro, pitahaya, etc., where the Papago at certain seasons lived on these as well as other desert fruits supplemented by small game. Diaz (12:II, 260-61), in the same year, in his diary of a journey made with Father Garcés and Anza in order to open a road from Sonora to northern California by way of the Gila and Colorado rivers, referred to the Papago as wandering almost continually in several types of country in search of wild animals and plants, among which were sahuaro and pitahaya fruit. Similarly Font (12:IV, 505-06), accompanying Anza on the latter's expedition to Monterey by way of the Colorado River in 1775-76, referred in his diary to having seen sahuaro near the ruined mission of Marcelo de Sonóytac which was located between Arroyo del Carrizal and Sonóita in southwestern Arizona.

Pfefferkorn (67:I, 139), writing in 1794 of the use of sahuaro by the Indians of Sonora, compared the fruit with that of pitahaya and observed that although it was inferior to the latter in quality, a syrup was prepared from the fruit which excelled that of pitahaya.



Pattie (90:104), an Indian trader and trapper, who spent the period from 1824-29 in the interior part of the continent, and during which time he passed several times up and down the Gila River, described a plant which was unquestionably sahuaro. However, Hardy (42:212), who passed through the southern portion of the region occupied by sahuaro and visited Sonora in 1825-28, wrote that "Our route lay over a plain, upon which immense quantities of petahaya were growing"; also of a stick which was used for "detaching the fruit from the top of the petahaya, a plant of the cylindrical cactus species, growing from eight to twenty feet in height." Although it may well be that Hardy was describing sahuaro one cannot be certain that such was the case.

Emory (33:72, 75, 79), leading the advance guard of the "Army of the West" from Fort Leavenworth to San Diego during the Mexican War, saw, along the Gila River in 1846, this plant, then botanically undescribed, and wrote of it bearing "a saccharine fruit much prized by the Indians and Mexicans" (33:72). Bartlett (7:II, 188-193, 209, 248, 272, 290, 296) encountered it a few years later at a number of points along the Gila River in Arizona, and described the plant, flowers and fruit as he also did on the way from Santa Cruz, Sonora, to Magdalena (7:I, 416). In this same connection, Sitgreaves (83:20) saw this species along the Colorado River below the Gila in 1853, while Bigelow (69:IV, 13), botanist of the United States Government Expedition which explored a route near the thirty-fifth parallel for a railroad from the Mississippi River to the Pacific Ocean, writing of the desert flora, noted the occurrence of sahuaro. It was also observed by Whipple and Ives (69:III, 101) of the same expedition, and by Möllhausen (65:218-21), who also found this same plant along the Bill Williams Fork in Arizona. The international boundary commission, working between 1891 and 1896 on the boundary between the United States and Mexico, also observed sahuaro at a number of places (70:20, 22, 23, 24). Bandelier (6) referred several times to the common occurrence of sahuaro in southern Ari-

zona and northern Mexico and recorded (6:484) that in the valley of the Sonora River the sahuaro was supplanted by the Piahaya.

\* \* \*

From aboriginal times to the present day, the Papago of southern Arizona and northern Sonora more extensively utilized sahuaro fruit than did any other people. The Papago country is part of the Sonoran Desert region, and broad alluvium-floored valleys bordered by relatively small steep-sided mountains are characteristic of the region (20:1). Springs which furnished a permanent water supply were to be found only in these hills and, therefore, to get even drinking water these people had to lead a migratory life. Their winter camp was known as the Well while the summer camp was called the Fields. These Indians returned from the Well in late June or early July to pick the ripe sahuaro fruit which they carried to their summer villages for their great yearly ceremony. This was held just before the rainy season and at this time the fruit was fermented and drunk, accompanied by dancing, singing, and oratory (21:4-5, 9). Although the Papago year contained numerous ceremonies, the most important was, and is, this great drinking ceremony which brought the rain and initiated the Papago calendar year (21:4-5, 9, 20). There is little doubt that sahuaro fruit has often served as a life-saver in ancient times when other sources of food failed by reason of extended drought periods. Thackery and Leding (89:407) observed a good crop of the fruit in southern Arizona after an unusually dry three-year period. The Papago depended upon this fruit to a much greater extent than did any other people of the Southwest, and some six hundred families gathered about 600,000 pounds each year (89:410; 50:23).

Cactus camp, established to gather the fruit, was an occasion of jollity. It meant almost the first fresh food of the year, the first taste of anything sweet and, principally, the preparation for the great drinking ceremony. The fruit, which grew at the top of the plant, was hooked down with a pole, as much as twenty-five feet long, made of two ribs

from a sahuaro trunk spliced together with agave fiber. At the top of this pole, and again at a lower point, were affixed short transverse sticks of either creosote bush or catclaw for dislodging the fruit. The picking season lasted about two weeks (21:20; 30:151; 62:207; 78:111).

The fruit, when fully ripe, split open on hitting the ground, otherwise the woman split the fruit with the sharp edges of the circular calyx attached to the fruit stalk. In either case she scooped out the pulp from each half with two motions of her thumb and threw it into the basket; the thorny shell was discarded, care being taken that its red lining fell uppermost, as this hastened rain (21:21).

After each round the newly gathered pulp, of a deep crimson color, was emptied into a water-tight basket and soaked to remove the black seeds. Since it shriveled within a few hours if left in the sun, they cooked their harvest daily, usually at midday when it was too hot for pulp gathering. The mother or mother-in-law officiated on this important occasion. She drained the water from the pulp, some of which had been soaking since the night before, broke up the masses, shook out as many seeds as possible, washed and dried these on a mat in the sun, and stored them in a jar for future use as flour. The pulp, with double the quantity of water, was brought to a boil in a clay pot, removed from the fire and placed in a straining basket. The liquid drained off was placed on the fire and cooked to a syrup, this being set aside from day to day. When the whole quantity was at hand it was sealed in a jar made air-tight by cementing a potsherd over its mouth with adobe mixed with fine grass or a transparent yellowish-brown "gum," produced by a scale insect (*Tachardiella fulgens*) on *samo prieto* (*Coursetia glandulosa*) (89:412; 21:21; 78:111).

All households made cactus jam, the most important sweet in their diet, and for this only a portion of the juice was drained off. The remaining moist pulp was boiled to a sweet, sticky mass, looking much like raspberry jam (21:21.)

If the liquid be drained off completely there remained a dry mass of fiber and seed, which was further dessicated on the housetop. It was then beaten with a stick to separate the seeds and these were parched and stored; they might be used to make meal cake or in later times as chicken feed. Another edible product from the giant cactus was oil, which could be extracted from the seeds by parching them, grinding and adding water, after which a small quantity of oil came to the surface. The pulp, instead of being disposed of as described above, might be sun-dried, stored, and cooked up as needed to make syrup, or was often eaten dry or after being moistened with water (21:22).

In addition to the above methods of preparation, the fruit of sahuaro might be preserved for future use by either of two methods. One was to open the fruit in the field and remove the seeds and fiber, these being taken home in sacks to dry. They were spread on racks of sahuaro ribs in the store house, and when perfectly dry were beaten on a mat to remove the fiber. The released seeds formed hard lumps which were stored in baskets and ground into meal when needed. The other method was to dry the pulp in the field. Women scraped it out with the fingers, patted it into cakes and dried these on a hot stone. This drying, however, was not sufficient for storage so the cakes were taken home and spread on the roof; when thoroughly dry they were stored in a jar (21:23, 46) but not for long, as they became wormy. Sahuaro seeds were parched, sun-dried, stored in sealed jars, and ground for flour as needed (21:45; 20:46; 78:112). The parching was done at the time of gathering and was really part of the storage technique to prevent mildew. The flour was used most often in the form of gruel, the favorite combination being cornmeal with sahuaro seed flour, which was slightly oily and sweet. Standley (87:909) also noted that the Papago made pinole of sahuaro seeds.

Although not so important as to the Papago, probably because of white contact and accessibility of other foods, sahuaro nevertheless constituted a rather staple source of food and drink among the Pima. From Russell's (74:35,

71-2) detailed study of the Pima we learn that sahuaro harvest, which was a season of feasting and rejoicing, marked the beginning of the New Year in the Pima calendar. Incidentally, beginning the year with the sahuaro harvest is found only among the Papago and Pima (86:20). After drying, the Pima preserved the fruit in balls fifteen or more centimeters in diameter. They extracted syrup by boiling, as did the Papago, ground the residue on a metate into an oily paste and ate it as such. The seeds might also be separated from the pulp at the time of drying, and eaten raw, or ground on the metate and used as meal by mixing with water to form a pinole, or combined with other meal to bake into bread. Russell (74:71) also records that sahuaro seeds which had passed through the body were sometimes gathered from the dried human feces, washed, treated as fresh ones, and eaten. This practice, followed by some of the California Indians with *Opuntia* seeds, was also recorded by Standley (87:909) for the Papago. This "second harvest" of seeds was also observed by McGee (62:209) among the Seri of Sonora. Standley noted that the Papago ate the seeds raw, or ground sahuaro seeds into a paste and spread it like butter upon tortillas.

Sahuaro seeds, dried fruit, and syrup were often obtained by the Pima from the Papago through barter (74:93).

\* \* \*

As early as 1774, Anza (12:I, 78-9) wrote of the great dependence of the Papago Indians upon sahuaro fruit, as did Diaz (12:II, 260-61). Almost three-quarters of a century later Emory (33:72) recorded that sahuaro fruit was highly prized by the Indians and said (33:159) "the molasses expressed from it was procured in abundance at the Pimos villages." Also writing (33:84) of the Pima appearing at camp Nov. 11, 1846, he informed us that the camp was soon filled with Indians, each with a basket of corn, frijoles, or meal for trade and that many had jars of syrup "expressed from the fruit of the *Cereus giganteus*." A few years later Michler, in the Report of the United States-Mexican Boundary Survey, wrote (34:I, 121) that the Pima and Papago Indians

used the pulp and seeds of the sahuaro fruit for food, and that (34:I, 123) the Papago made a kind of candy from sahuaro and pitahaya, also an excellent preserve by boiling the fruit without sugar. Similarly, Bartlett (7:II, 191), not long afterward, noted that the Pima collected the fruit and rolled the pulp into balls which were preserved as such. Also they boiled the pulp in water and evaporated it to the consistency of molasses, which was preserved in earthen jars. In this same connection Bigelow (69:IV), botanist of the United States Government Expedition of 1853-54, which explored a railroad route near the thirty-fifth parallel, wrote that the Indians of Arizona collected with a long willow pole quantities of sahuaro fruit, and utilized it in the manner described above. Bigelow wrote that the juice of the flesh of the sahuaro was quite bitter, and in this connection Coville (26:503) reported that *C. gigantea*, *Lemaireocereus Thurberi*, and *Lophocereus Schottii* were not available as sources of drinking water, as were some other species of cacti, because their juice was bitter and nauseating. However, MacDougal (58:130) reported that the plant furnished water for the use of animals on the desert. Water for this purpose was secured by felling young trees and then supporting the ends of the prostrate trunks a few feet above ground with the middle sagging in such a way that it rested on a kettle or bucket partly buried in the soil. Fires built at each end of the trunk drove out quantities of sap through incisions cut above the vessel.

In 1858 Möllhausen (65:II, 220) wrote of sahuaro being a favorite food among the Indians of the Bill Williams Fork region in Arizona, and ten years later Cremony (27:111-12) observed the use of sahuaro fruit as food by both the Pima and Maricopa. Shortly after this Palmer (66:416-17) reported that the Indians of Arizona, Sonora, and a portion of Southern California (unquestionably tribes along the Colorado River) regarded sahuaro fruit as a great luxury, that they dried it as a preserve and placed the pulp between soft inner maize husks, the ends of which were tied, whereupon the product was dried in the sun for winter use; also

the fresh fruit was sealed in earthen jars. He noted that the Papago were the largest producers of the syrup. Methods of preparing quantities of sahuaro fruit among the Papago and Pima were later related by Bancroft (3:I, 539-40), in the United States-Mexican Boundary Commission Report in 1898 (70:22), and by Coues (25:II, 439n), who noted that they made a kind of paste of the fruit. The use of sahuaro fruit among the Quahatika, a group almost identical with the Pima, was observed by Curtis (28:II, 42).

MacDougal (58:133) observed that sahuaro pulp and seeds constituted an important food not only for the Papago and Pima but also for the Maricopa and Yaqui, although there is very little of it in the Yaqui country. Among the Maricopa the chief interest in wild plants was, and still is, mesquite beans and sahuaro fruit (85:49-50; 28:II, 82). The middle of June, when sahuaro fruit ripened, was eagerly welcomed by these Maricopa, not because the fruit constituted any considerable dietary element but as an occasion of celebration and debauch. The species was not common in Maricopa territory proper and, moreover, expeditions to secure the fruit, which grew on the lower hill slopes north of the Salt River, were always attended by danger of encountering their enemy, the Yavapai. From Spier (85:231) we learn that in times of starvation the Maricopa would go to other tribes for whom they would sing in order to secure gifts. Often these gifts to the visitors included great jugs of sahuaro syrup, especially from the Pima. As among the Papago and Pima the fruit was gathered with a long hook. The fruit was eaten fresh or preserved by heating in pots over a fire. This might be stored until winter, when it was dissolved in water for a drink, or strained and boiled to syrup (85:56-7; 28:II, 82).

In 1891, Bourke (13:53) wrote of sahuaro in the vicinity of Tucson, Arizona, and again in 1895 (14:51-2) that the western Apache gathered the fruit in Arizona and at this harvest time also made war on their hereditary enemies, the Pima and Papago. In this same connection, Havard, both in 1895 (43:116) and 1896 (44:36), wrote that sahu-

aro fruit was a great favorite of the Apache of Arizona as well as of the Pima and Papago. Hrdlička (51:257), in 1908, reported that the San Carlos Apache, of Arizona, depended very considerably upon sahuaro fruit as a food, and that when the fruit began to ripen they moved to the locality where the plant was abundant, and remained for two or three months until the last of the fruit had matured and been gathered. This was regarded as a period of prosperity and the Indians returned home quite fat. Large quantities of the fruit were eaten fresh and the remaining portion of the crop dried in the sun, made into large cakes, taken home and stored. The seeds were roasted, ground, mixed with water and eaten without further preparation. The White Mountain Apache, of Arizona, made sahuaro fruit into a kind of butter, although they did not eat the fresh fruit, according to Reagan (68:143, 147, 156). Grenville Goodwin has informed the senior author by correspondence, under date of January 16, 1937, that all five groups of the Western Apache made use of the fruit of sahuaro. The fruit was knocked off the plants, gathered, and prepared. The fleshy part was dried and made into cakes for storing, while the seeds were parched, ground, and eaten. Goodwin (40:62) also referred to sahuaro fruit as a staple food in his paper on the Western Apache. Very recently Castetter and Opler (22:40) found that the Chiricahua Apache, who ranged in western New Mexico, southeastern Arizona, and to the south in Mexico, formerly gathered and utilized sahuaro fruit, using methods not unlike those of the Papago. They also used (22:50) sahuaro syrup as a sweetening substance in making *tulbai*.

Dr. Ruth Underhill, working among the Mohave Indians in the fall and winter of 1936, informed the senior author under date of November 27, 1936, that the Mohave never used sahuaro fruit. These Indians say it was "an Apache food." Dr. Underhill reported at the same time that the Yuma Indian women went into the hills to gather the fruit—a half day's journey from the valley. They squeezed out the juice with their hands, mixed it with water and drank

it fresh. They also dried the pulp and winnowed out the seeds, which were parched and ground into flour like other seeds. They never made pinole, as did the Pima and Papago, but ate the flour dry by handfuls and then drank water. The fact that Forde (35) does not mention the use of sahuaro fruit in his study of the Yuma is perhaps to be taken as an indication that it did not constitute an important food among these Indians. Spier (85:8, 56) noted recently that the western Yavapai, a roving, mountain dwelling Indian, sometimes came down to the Salt River in Arizona where they remained for several weeks gathering sahuaro fruit. Gifford (36:205, 210) recorded that the southeastern Yavapai, who subsisted wholly upon wild products, used sahuaro fruit as one of their outstanding foods. It was usually removed from the plant with a hooked pole, peeled, and taken home in watertight burden baskets. The juice was diluted with water if too sweet, and drunk, while the fruits were dried on sticks and grass for a day, then packed in pottery ollas. These were closed by sealing a small pot over the opening with clay.

Ripe sahuaro fruit which had fallen naturally to the ground was best, and this was sometimes pressed with the hands into a cake about the size of a large layer cake. If stored in a dry place it kept for years, but moisture produced a yellow mold, and it also became wormy. Pits, either lined with straw or walled with flat slabs of stone, were preferred for such storage (36:210). When the dried product was to be eaten, a piece was sliced off with a knife or knocked off with a stone, soaked in water, and sucked. The seeds were picked out, dried, and stored in sacks of fawn skin. Before eating they were parched in a basket, ground, and the meal pressed into a cake sufficiently solid to permit slicing (36:210-11).

Similarly the fruit of sahuaro was utilized by the Northeastern and the Western Yavapai (37). Among the former the fruit was removed from the plant with a long pole made of several lengths of sahuaro rib with a hook at the end of the pole and another lower down, made from the

forked branches of the jojoba or goat-nut bush (*Simmondsia californica*). The fruit was collected in the burden basket, and those broken by falling were piled on sticks over a water-tight basket to save the red juice, which was drunk. The fruit was sometimes eaten as it came from the plant, but more commonly it was opened, mixed with water and the decoction drunk by scooping up with the hand. The small black seeds settling to the bottom of the vessel were washed, dried, basket-parched, then ground on the metate to the consistency of peanut butter. This paste was squeezed into a black, greasy, and nutritious compact cake, which was often carried on the warpath. The whole fruit was opened and flattened by hand pressure, laid on a litter of *Sphaeralcea ambigua* sticks to dry for two days, and smeared with juice from the fresh fruit. The product was then made into slabs one inch thick, and dried. The ripe, red, seed-bearing center of the fruit, which was the part most relished, was collected in baskets, dried, pressed into bricks six to twelve inches thick, and these kept a year or more. When needed, pieces were broken off and pounded with a muller to soften. A beverage was made by stirring this substance in water (37:260). Sahuaro cake was the property of the man of the house and might be wagered in games without his wife's consent.

Among the Western Yavapai, Gifford (37:260) reported that sahuaro fruit was gathered in a burden basket made partly water-tight by smearing it inside with gummy Indian "wheat" ground on a metate. Beneath the point of the burden basket was tied a small coiled basket to catch the drip of the red, sticky sahuaro juice.

The landscape in the southern part of the Walapai country in Arizona, particularly south of the Hualpai mountains, has an abundance of sahuaro (55:30). Here the northern limit of the species is the south end of the Hualpai mountains and it is not very common north of the Bill Williams Fork except on south slopes. The Walapai (55:18-9, 48, 49), according to their origin myth, gathered sahuaro with a long willow stick with a cross-piece tied on one end to make a double crotch. They drank the juice of the fruit, ground

the raw seeds, and either made the paste into a mush or mixed it with water to make a drink.

McGee (62:33-4), writing, in 1898, of the Seri Indians, who once held the barren coast of Sonora from Guaymas to Puerto Libertad (54:4), recorded that sahuaro was a dominant plant throughout portions of Seri territory, and that sahuaro and fruits of other giant cacti were eaten in abundance. During the height of the season the clans withdrew from the coast to give undivided attention to the collection and consumption of the fruits, which were never cooked nor preserved (62:206). Among the Seri on Tiburón Island, practically the only place where these Indians are to be found at the present time, Kroeber (54:11) states May is the month of ripe sahuaro as well as pitahaya fruit. He noted, however, that the seasonal happenings would probably be more accurately placed if the calendar fell a fortnight to a month later. In Seri astronomy the Ursa Major was a sahuaro or pitahaya fruit-gathering crook (54:12), as it was also among the Walapai and Havasupai (54:41). The Maricopa say "They went for giant cactus in the summer when the Pleiades (Xítcá) appear on the eastern horizon" (85:146); they also had a name for June when sahuaro fruit was gathered (85:144), and the Mohave had a song for Pleiades (85:269).

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The only important intoxicating beverage among the Papago was a sort of cider made from the fruit of sahuaro. The beverage was brewed once a year by each village with elaborate ceremony, the brewing, the drinking, and the actual intoxication, being part of the ritual for bringing rain (21:26; 30:148; 78:111).

When the beverage was to be made, every family contributed a jar of boiled juice to the large jars ceremonially guarded in the council house. At present, each family also makes several jars for home consumption. As soon as the juice was decanted from its airtight receptacle (as mentioned above) it was mixed with four times the quantity of water, the ideal being a mild intoxicant which could be

taken in quantity. A small fire was lighted in the council house to keep up a steady moderate heat, and official tasters directed the fermenting process. They usually had a small jar of the liquid, already fermented, from which they added a quantity to the large jars if fermentation were too slow. Individual Indians buried their jars in the ground to obtain the necessary heat. The established fermenting time was seventy-two hours (21:26).

The resulting drink called *navai't*, was a crimson colored sort of cider with a slightly nauseating taste, which, when drunk in the ritual quantity, induced vomiting. It was almost impossible to keep this beverage, therefore the tradition was that the whole supply must be consumed within twenty-four hours (21:26).

Even as early as 1540-42 the Coronado expedition (93:516) observed that the Indians of northern Sonora made an alcoholic beverage by fermenting sahuaro fruit. When writing of the drunkenness of the Pima on occasion of a feast honoring his arrival at the Pima villages in September, 1776, Father Garcés (25:II, 438-40) observed that this inebriation occurred in the sahuaro season and that the Pima governor informed him it made his people vomit yellow and kept them in good health. Garcés noted that no women became intoxicated, but that they looked after the men when the latter had lost their faculties.

Almost a century later Cremony (27:111-12) referred to the Pima and Maricopa Indians annually visiting the Gila Bend desert in Arizona to collect the fruit of this plant which they used to make an intoxicating drink; and Palmer (66:416-17) in 1870, and Grossman (41:419) a year later, observed that the Pima fermented sahuaro pulp or syrup and used the beverage to celebrate their annual drinking festival. In 1895 (43:116) and again in 1896 (44:36), Havard recorded that a beverage made of sahuaro fruit was a great favorite not only of the Papago and the Pima, but also of the western Apache. Its use by the Papago was also recorded by the United States-Mexican boundary commission in 1898 (70:22). Russell (74:72), as well as Curtis (28:II,

4-5), observed, in 1908, that the Pima prepared an intoxicating drink by boiling and fermenting fresh sahuaro fruit, and that the drinking of this beverage made their New Year's season one of debauchery. The same was recorded for the Pima by Hrdlička (50:45), who also found (51:28) that the only native drink among the San Carlos Apache, besides *tubai*, was a beverage prepared by fermenting sahuaro and pitahaya fruit. Lumholtz (57:45-61) in 1912 described the Papago harvest festival in detail as well as the making of the alcoholic drink from the fruit and the syrup, while Davis (29:175-76), as well as Densmore (30:151), more recently described the same among these Indians. Among these Papago, Hrdlička found that the only native alcoholic drinks were obtained by fermenting sahuaro syrup and mescal. To make the sahuaro beverage strong without retaining so much of the bad taste and after effects, they covered with blankets the jar in which the fermenting beverage was contained.

Dr. Ruth Underhill informed the writer by correspondence under date of November 27, 1936, that the Mohave never used sahuaro fruit for this or any other purpose, and that the Yuma drank fresh sahuaro juice but never fermented it. Recently Spier (86:8) recorded that the Maricopa resembled the Pima and Papago in the brewing and formal drinking of the Sahuaro beverage and that this element was not present among other Yuman tribes (86:13). This is further evidenced by the observation of Hrdlička (51:28), who found, in 1908, that the only native drink still prepared occasionally by the Maricopa, as well as the Pima, was that obtained by fermenting sahuaro fruit. Spier (85:56-8, 105, 229), as well as Curtis (28:II, 82), has pointed out that sahuaro was important among the Maricopa not so much because of its importance as food as its ripening provided an occasion for jollification and debauch. The boiled syrup was fermented—as many as one hundred large pots of the liquid being set in the heated meeting house for that purpose. The celebration was one of drunkenness and dancing, and friends in other tribes were invited to participate,

the method of handing out the drinks to them being quite stereotyped.

The making and drinking of the sahuaro beverage was commemorated in song by both the Halchidhoma and the Maricopa. There was no special dance with the singing. These Indians said that when they were drunk they thought of war. The song described "red water" (blood), its appearance, and how it was made, apparently identifying the crimson sahuaro drink with blood (85:269). The southeastern Yavapai made no intoxicating drinks (36:205). Kroeber (54:46), however, recorded that the Gila Pima trait of the fermented giant cactus drink was not found among the River Yumans, and Bancroft (3:I, 549), writing of the Gila region in Arizona, observed that sahuaro fruits were used to prepare an intoxicating beverage. Hrdlička (49:73) found the Opata making an alcoholic beverage by fermenting the fruit of the sahuaro, and Bancroft (3:I, 586) wrote, in 1883, that drunkenness was common among the northern Mexican tribes, where their intoxicating beverages were prepared from the fruit of pitahaya (doubtless sahuaro as well as other genera), mesquite beans, agave, honey, and wheat.

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Minor uses of sahuaro were as follows: the fruits of various species of *Opuntia* were gathered by Papago women, wooden tongs, made of a length of sahuaro rib, being used for this purpose (21:15), and both *Opuntia* and *Yucca* fruits were dried on racks of sahuaro ribs (21:23). They constituted an important warp material in Papago lattice wrapped weaving (21:53; 53:147), and warp material for house doors, sieves, and stirrers (53:147); cradles and children's carrying baskets were made, in part, of these ribs (53:147), also rounds of present day ladders (53:177), and among the Pima the burden carrier (61:520; 28:II, 6, 33). Kissell found the Papago using splints of sahuaro rib for the foundation element in coarse coiled basketry (53:137), the whole rib furnishing light strong rods and slats as a firm foundation element (53:135, 140), also warp sticks in the hanging

shelf (53:142). Split sahuaro ribs were utilized by the Papago for rough traps, especially for catching quail (21:43; 53:144), also for roofing and all sorts of light tools (21:53). From Standley (87:909) we learn that from these ribs the Indians made lances, while he, Diguët (31:395), Davis (29:166), Bryan (20:46), and Castetter and Underhill (21:66), found the Papago used them as framework and roofing material in building brush houses. Curtis (28:II, 42; Appendix) found the Quahatika, close relatives of the Pima, using sahuaro ribs as a house building material, while Spier's (85:82) observations included the wood of sahuaro in the building of Maricopa dome-shaped dwellings.

Part of the rope twister used by the Papago in making hair ropes was made of sahuaro rib (21:62), as were scraper sticks and handles for dressing skins (21:68-9). According to Russell (74:149), Bartlett (7:II, 225), and Spier (85:114, 119) sahuaro wood was used by the Maricopa to make the whorl for the cotton spindle as well as stakes and warp bars in the loom (85:114). Papago bowstrings of deer sinew were smoothed by running them through a small perforation bored in a stick of sahuaro wood (21:70); this wood served as fuel or hearth material in starting fires with the palm drill with both the Papago (21:73) and the Maricopa (85:129). The ribs were also used to make Papago ceremonial framework (21:75) and a type of dice for one of their games (21:77). The dice die was made of the end of a split sahuaro rib among the Northeastern Yavapai (37:289, 290).

Four sahuaro spines, tied in a row, made a piercing instrument in tattooing among the Papago (21:51), and these Indians occasionally used the dry spines, which burn rapidly and brightly, for signaling at night (20:46). Vessels, dishes, and tobacco pouches sometimes came from sahuaro wound scars (21:74).

Russell (74:118) observed that, among the Pima, sahuaro seeds were used in tanning hides, and Spier (86:17; 85:125) noted the same for the Maricopa. The flesh side of the hide was spread with the parched seeds (the residue

after a drink was made from the fruit), and the skin folded with the flesh side in. The use of sahuaro in ceremonies and song has been discussed by Mason (60:18, 19, 20), by Castetter and Underhill (21:75), Spier (85:162-63, 258, 262, 269), Strong (88:38), and Davis (29:166, 174); its significance in Indian mythology was recorded by Font (12:IV, 38-41), Russell (74:244, 247, 250, 331), and Goddard (38:66); while its place in war tales among the Northeastern Yavapai has been presented by Gifford (37:324, 337).

#### LEMAIREOCEREUS THURBERI (ENGELM.) BRITT. & ROSE

This plant, commonly known as the organ-pipe cactus, *pitahaya*, and *pitahaya dulce*, is closely related to sahuaro but is without a definite trunk, sending up from its base fifty to sixty or more branches which may attain a height of ten meters. The flowers appear from March to August, and are followed by large delicious fruits which are highly prized as food. These are smooth, olive-colored externally and crimson within, although quite spiny when immature (19:II, 97-8).

This species is distributed in southern Arizona in the Comobabi, Quijotoa, and Ajo mountains, where it occurs in comparatively small colonies and has small numbers of individuals. Its most northerly station is on the south-facing rocks in Gunsight Pass, on the road that runs from Tucson to Ajo, and this is about thirty miles north of the international boundary. This colony is on the northern extension of a narrow finger of rocky hills along the western edge of which the plant finds occasional footholds. It also occurs throughout western Sonora, especially southward on the west of the Sierra Madre, where it extends in the southern portion of the Sonoran Desert to the coast, and on both coasts of Baja California, where it occurs commonly as far north as Calmalli and as scattered individuals on the south slopes of rocky hills, almost to Laguna Chapala Seca. A few specimens also have been reported farther north between Rosario and the ruins of San Fernando Mission. In the cape



region of Baja California is found a more slender form which has been described as a variety. The reference in Index Kewensis to the occurrence of *L. Thurberi* in New Mexico is evidently erroneous. This is the only species of the genus which grows in the United States, and is also the only one found in northern Mexico and Baja California (19:II, 98; 15:23; 46:I, 547).

This organ-pipe cactus seems to be even more particular in its temperature requirements than is sahuaro, and in southern Arizona is rarely found except on the warmer slopes of the lower and more southerly mountains. Hence it does not appear in such large numbers nor in "forests" as does sahuaro. It is, nevertheless, rather abundant in parts of Sonora and the Indians prefer its fruit to that of *Carnegiea*. According to Shreve (79:285, 287), the occurrence of this plant in Sonora is confined to rocky slopes and coarse outwash and is more common on south slopes than on north ones.

Bartlett (7:I, 497), going from Guaymas, Sonora, to San Diego, observed and in 1854 briefly described this plant, and Bandelier (5:20) some years later wrote that in western Sonora it replaced sahuaro. Goldman (39:352), reporting an expedition to Baja California, said that in going southward this species was first encountered near Pozo Altamirano, and afterwards from this point southward to Cape San Lucas was found to be fairly common excepting on very sandy areas. Its range on the peninsula thus included the southern half from near latitude twenty-eight, and also on Cerralvo Island. It grew among the rocks on the lava-covered mesas along the backbone of the peninsula and on the plains near the Pacific Coast.

According to Diguët (31:168), Fray Antonio de Ascension, attached as cosmographer to the expedition of Sebastiano Viscaïno in 1602, had this species in mind when he referred to *pitayo* as being one of the principal vegetable productions of the middle part of the Californian peninsula. If so, it is the first specific recorded reference to this species.

The fruit of the organ-pipe cactus was very generally regarded as superior in quality to that of sahuaro, although smaller in size, and its use was quite similar. The plants were less common and fruited twice a year—in June and October (48:216)—and its many low branches were so plentifully covered that the Papago name for the "Milky Way" was "the second harvest of pitahaya" (21:22).

Padre Kino, who worked in Pimería Alta from 1687 to 1711, previously had been in Baja California. He wrote (11:I, 353) that the Guimies, and Edues or Laimones Indians, of the peninsula did not cultivate plants but utilized wild plants and game as food, among which was the pitahaya (*L. Thurberi*, and doubtless other species as well). He noted that the hills for a great part of the year were laden with various pitahayas (11:II, 56), and that the natives from the coast brought many tamales of dried pitahayas and some little boxes of fresh pitahayas, which were produced on the coast (east coast of Baja California) in October, November, and even in December (11:II, 198). It must here be pointed out that Kino's references (5:73n; 11:I, 187, 256) to pitahaya, as presented under sahuaro, no doubt refer as well to *L. Thurberi*.

The "Documentos para la Historia de Mejico" (32:3rd ser. (4) 521-22) records that the most important wild fruit in Sonora was pitahaya. It also described the plant, flowers, and fruit which the Indians, evidently the Opata, stored for their own consumption or also occasionally sold.

In 1794 Pfefferkorn (67:I, 132-136), who served as a missionary to the Indians of Sonora for eleven years, recorded that of native fruits Sonora had few, but that this lack of diversity was compensated by the abundance of those in the province. He knew of only four kinds which were worthy of notice—pitahaya, sahuaro, tunas, and wild grapes. He discussed this giant cactus at some length and noted that there were really two kinds of pitahaya in Sonora, one quite common, the other somewhat rare. The abundant species which fruited twice a year, had a blood-red flesh. Many of the Indians opened this fruit, placed it in the sun

for a few days to dry it somewhat, then separated the flesh from the rind, pressed it very firmly together, and made a kind of cake of it known by the name *tamale*. This product could be preserved for a long period of time and was to the poorer natives a true delight. They also prepared, by cooking, a sweet delicious syrup from the blood red juice. Evidently, he was referring to *L. Thurberi* as the common species.

Eaten in moderation, Pfefferkorn regarded the fruit as very healthful, especially since it had antiscorbutic value. Father Gregorius Reds, a German Jesuit, who had been in the California missions, likewise extolled the virtues of this fruit, and, according to Pfefferkorn, thought a more excellent fruit could not be found on earth. Reds sometimes sprinkled cinnamon over it but more often poured red wine over it and let it stand several hours before a meal.

Salvatierra (91: I, 108-09), who came to the district of Nuestra Senora de los Dolores, Sonora, in 1690 and who founded the permanent Baja Californian Missions, describing the pitahaya harvest chiefly in Baja California, said that the three pitahaya months resembled the carnival in some parts of Europe and described in some detail the feasting, buffoonery, and hilarity which transpired during the debauches. Similarly Venegas (91: I, 57-8), in the middle of the eighteenth century, describing the plants of California (chiefly Baja California), wrote that the first ranking tree among these trees and shrubs was the pitahaya. He described the plant and fruit, noting its singularity, and said that the fruit pulp was white, red, or yellow but always of a very exquisite taste, some being sweet, others acid. This fruit constituted the principal food of the inhabitants and was also important as an antiscorbutic.

Neither Salvatierra nor Venegas could have avoided seeing sahuaro and it is probable that their comments on large pitahayas are referable in part to *C. gigantea*, or more particularly to *Lemaireocereus Thurberi*.

Baegert, one of the Jesuits banished from Baja California by the general decree of Charles III, of Spain, in

1767, was a German who had spent seventeen years on the Californian peninsula. He published in 1773, after his return to his native country, a book describing the California peninsula and its aboriginal inhabitants. The Jesuits in Baja California superintended the missions established by the Spaniards since 1697, hence Baegert had a background which penetrated sufficiently deeply into aboriginal strata to be able to give a good indication of ancient culture on the peninsula. His mission was located under the twenty-fifth degree and twelve leagues distant from the Pacific coast, the St. Aloysius mission evidently being the scene of his labors (2: 352-53).

The pitahaya (apparently *L. Thurberi*, but perhaps other genera as well) constituted an important article of food among the inhabitants of the peninsula. Baegert described the fruit, noting its abundance and importance (2: 354), and observed that during harvest season the natives became quite corpulent from eating it in large quantities. Contrary to the Pima and Papago, these inhabitants never preserved the fruit (2: 363). Many years afterward, Bancroft (3: I, 560) observed that for a period of eight weeks the inhabitants of parts of Baja California lived on pitahaya (doubtless this as well as species of *Pachycereus*). Brandegee (18: 20) later found this species to be common in the southern part of the peninsula, where the fruit was made into quite sweet preserves without the addition of sugar. More recently Kroeber (54: 42) has found that the Waicura Indians of Baja California did not preserve the fruit. However, the importance of pitahaya fruit among these Indians was indicated by the fact that in their mythology the creator of food (pitahaya and fish) was said to have come from the north (54: 44). Sauer and Meigs (77: 292), writing of the ruins of the Mission San Fernando de Velicatá near the thirtieth parallel, in Baja California, observed that the Indians in this region had depended in part on pitahaya fruit for their subsistence.

Baegert (2: 365) referred to the Indians of Baja California collecting, during the pitahaya season, feces of persons

who had eaten pitahaya fruits (apparently *L. Thurberi* and *Pachycereus* species) and separating the undigested seeds which they roasted, ground and ate. This practice, called by the Spaniards the "second harvest of pitahaya," was fully confirmed by Clavigero (24:24), by Bancroft (3:I, 560), and by Diguet (31) for the Indians of the peninsula. Kroeber (54:42) also noted that the Waicura Indians of Baja California re-ate pitahaya seeds.

Clavigero, in 1789, doubtless writing of this species, mentioned its abundance in Baja California, where it ranked as the principal native fruit and constituted the chief food of the poor inhabitants. He gave a good description of the plant, the flowers, and particularly the fruits and the method of their utilization, and said: "The red pitahayas color the urine like blood, for which reason some strangers who have eaten them have been much alarmed, thinking that they have broken a blood vessel." In the southern part of the peninsula the harvest began the first of June, and ended the latter part of August; in the northern part it began later and the fruit was most abundant in August. He mentions the fruit being gathered with a stick, at one end of which was firmly attached a slender hook-shaped bone, and caught in a net before falling to the ground. During the time of the harvest the people went all day long over the mountains and plains hunting the ripe fruit, and for them this was the happiest season of the year. By the Cochimi Indians of Baja California the fruits were called *tammia* or *dammia* (24:5, 6).

Palmer (66:416-17), in 1870, observed that the fruit, which he found to be of decidedly better quality than that of sahuaro, was used in every way for the same domestic purposes by the Indians of southern Arizona and Sonora, as was sahuaro. They ate the fruit in enormous quantities, and in making syrup the seeds were easily separated from the pulp by the use of water. After the seeds were collected, dried, parched, and pulverized, they were digestible and very nutritious. In this same connection, Havard (43:116; 44:36) noted both in 1895 and 1896 that the fruit of this organ-pipe cactus was larger, sweeter, and finer than sahuaro fruit and

was used for the same purposes. Its utilization as food in the Sonóyta Valley in Mexico was also reported by the United States-Mexican boundary commission in 1898 (70:23). Standley (87:901) noted that the fruit was gathered in large quantities and sweetmeats sometimes made from it.

Recently Castetter and Underhill (21:22) found pitahaya fruit as highly prized among the Papago as sahuaro and used in the same ways, although not so extensively, since it grew only in the southern part of Papaguera. For this reason it did not constitute an article of food among the Pima of Arizona. Dr. Ruth Underhill, by correspondence under the date of November 27, 1936, informed the senior author that neither the Mohave nor the Yuma know the organ-pipe cactus. However, the Chiricahua Apache, who formerly ranged in western New Mexico, southeastern Arizona, and northern Mexico, did utilize the fruit of this species, their name for it being *madaya*, an Apache corruption of pitahaya (22:40). The San Carlos Apache, of Arizona, were found by Hrdlička (51:260) to eat the pitahaya fruit (evidently *L. Thurberi*) either fresh or peeled, crushed, and dried. Occasionally the dried fruit was soaked in water to make a drink. Grenville Goodwin has informed the senior author by correspondence under date of January 16, 1937, that since the pitahaya did not grow within Western Apache territory the only time they came in contact with it was on raiding expeditions southward into Sonora. They knew the plant and sometimes ate its fruit on these trips but never prepared it in any way. McGee (62:33-4, 206) observed pitahaya to be quite abundant in parts of the Seri country in northwestern Sonora, where, during midsummer, these Indians withdrew from the coast and eagerly collected and consumed the fruits which they esteemed most highly. However, they neither cooked nor preserved them.

Dr. I. L. Wiggins was recently informed by an Indian living at Jaraguay, Baja California, (12 miles south of Cataviña) that fruit of the pitahaya dulce is much more fattening than that of pitahaya agria (*Machaereocereus gummosus*). His family frequently moved south, sometimes as far

as Comondú, during the harvest season of pitahaya dulce, to gather the fruit, which they preserved. Natives of Jaraguay, Calmalli, San Ignacio, and Comondú described the harvest season as one of great feasting and happiness, at the end of which most people are "very fat."

\* \* \*

An alcoholic beverage made by fermenting pitahaya fruit, in the same manner as with sahuaro fruit, was used in the southern part of the Papago territory and constituted the ceremonial drink for that area (21:26; 30:151). It was also prepared and used in the same manner by the Opata of Sonora (49:73), and Bancroft (3:I, 586) was undoubtedly referring to this as well as other species of giant cacti when he wrote that the Indian tribes of northern Mexico fermented pitahaya fruit to obtain an alcoholic drink which was in common use. However, the Seri of Tiburón Island and the Waicura of Baja California did not ferment the Pitahaya or anything else (54:43).

Pfefferkorn (67:II, 76-7), writing in 1794, described the festivities, dances, and games of the Indians of Sonora, noting that for a dance a whole tribe, or the largest part of it, would assemble at one place. The first requisite of such an occasion was that drink be abundant. Hence, they chose the wine months, because the pitahayas were ripe at that time.

Pitahaya juice was the material of which the Sonoran Indians made wine. They pressed the juice out into earthen vessels, and after it had fermented in the sun for several days it was ready for consumption without further preparation. It was very agreeable to these Indians because it was somewhat sweet and quite intoxicating.

Pitahaya is also used in minor ways. Thus Clavigero (24:6), in 1789, wrote of the stele of this plant burning well when dry and making excellent torches for the Indians of Baja California. According to Standley (87:901), the dried stems made good fuel. The wood burns readily and makes a quick, hot fire of short duration. Digué (31:392) observed that the stems were used in the building of dwellings. Also

that a glue and a wax of high quality were obtained from the pulp (31:398).

#### PACHYCEREUS PRINGLEI (S. WATS.) BRITT. & ROSE

This tree-like cactus, which may attain a height of eighteen meters, usually has a very short, stout trunk, often with numerous thick, upright branches. The edible, dry fruit is globular in shape, covered with brown felt and bristles, and is commonly known as *cardon*, *cardon pelon*, and *saguesa*, although "sahueso" is nearer the vernacular.

The species is abundant and conspicuous, often forming the dominant plant in the landscape in many parts of western Sonora, especially south of the Altar River (46:IV, 45), its northern limit being on the rocky hillsides between Altar and Pitiquito; it occurs in Baja California, where it frequently forms extensive forests, and on many islands of the Gulf of California (87:894; 19:II, 70; 39:35). It is especially common in the Cape region of Baja California and there are few places between the southern end of the peninsula and San Quintín where it cannot be seen (16:26; 18:19), its extreme limit of known northern occurrence being on the San Felipe desert (59:43). It is present in considerable numbers as far north as San Vicente, although in this part of its range it does not approach the sea unless the hills protect it more or less from the direct influence of the sea breezes. At Camlu, ten miles north of Hamilton ranch, or twenty-five miles north of San Quintín, it occurs on the silt flats near the ocean, but the plants here are not large. In the canyons just back of San Quintín it reaches heights of six to eight meters, and often has five or six branches. In the vicinity of Playa Santa Catarina, it is very abundant in the broad canyon leading down to the ocean, and is plentiful within a mile or less of the beach. From this point south it seems to grow fairly well near the coast, but never as vigorously there as inland a few miles. The finest groves of it seem to occur in the vicinity of Punta Prieta, about Rancho Cajón, which is about ten miles northwest of Calmalli, and between Santa Rosalía and Mulegé. It is much less abun-

dant in Sonora than in Baja California, and usually considerably shorter than the heights attained in Baja California. Shreve (82:262) found this species to be one of the dominant plants in the northernmost part of the desert on the Pacific coast of Baja California, where it is limited to the desert or occurs only in warm situations, being more common on south than on north facing slopes (79:287), and reaching its maximum density at the head of Concepción Bay, Baja California (81:199). Britton and Rose (19:II, 70) reported it all along the east coast of Baja California and along the west coast of this peninsula as far north as Magdalena Bay, and that, on the peninsula, protected hillsides and valleys were covered with forests almost entirely of this species; also that, on the plain about Guaymas, in western Sonora, solitary giant specimens were seen, which they believed to be remnants of great forests once covering the plain.

A rather extended description of a pitahaya given by Hernandez (47:II, 172; III, 94) in 1690, and regarded by Bartlett (7:II, 193) as referring to sahuaro, was, unquestionably, as pointed out by MacDougal (58:129), a reference to either *Pachycereus Pringlei* or *P. pecten-aboriginum*. Similarly Humboldt (52:II, 223), very early in the nineteenth century, recorded that Don José de Gálvez, in passing from Sonora to the present Baja California, found naked mountains, without soil or water, which bore a few Indian fig trees and stunted shrubs in the crevices of the rocks. Those Indian fig trees may well have been giant cacti. Humboldt (52:II, 225) also wrote, in 1803: "At the foot of the mountains of California—only sand, or a stony substratum on which cylindrical cacti (*organos del tunal*) shoot up to extraordinary heights." It was MacDougal's (58:129) opinion that Humboldt also was referring to *Pachycereus Pringlei* or *P. pecten-aboriginum*.

McGee (62:33-4, 206), in 1898, found an immense tract of saguesa in the Seri country of northwestern Sonora, where these Indians went inland during the height of the season to gather and eat the fresh fruit, and Bancroft (3:I, 560) was undoubtedly referring in part to this species

when he wrote that for a period of eight weeks the inhabitants of part of Baja California lived on pitahaya. Similarly, Sauer and Meigs (77:292), writing of the ruins of the Mission San Fernando de Velicatá, near the thirtieth parallel in Baja California, observed that the Indians of this region had depended, in part, on cardon fruit as a means of sustenance.

The seeds of this cactus were commonly parched, ground, and used as food by Indian peoples (75:552; 31:408). The Yaqui Indians of Sonora ground cardon pulp and seeds together to make flour for tamales. It should be noted that there is practically no pulp available in the fruit of this species at the time the fruit is ripe. The dried wood was used for fuel, walking sticks, rafters, and beams for their huts (87:894-95; 19:II, 70). Clavigero (24:6-7) described a plant under the name of cardon, which fits the description of this species. He wrote that the people of Baja California utilized considerably the fruit as food. They first left the fruit in the sun for a time, then preserved it by heating; also that the missionaries of Baja California crushed out the juice until a sort of "balsam" was obtained which was good for wounds and bruises.

Ribs of this plant are now used as shafts for fish spears, building and fence materials, frames and springs for beds and couches, and for numerous other things about the Indian and Mexican home. The missionaries of Baja California in early times obtained from the pulp a flavoring substance used for jellies.

#### PACHYCEREUS PECTEN-ABORIGINUM (ENGELM.) BRITT. & ROSE

This plant, commonly known as *cardon barbon* and *cardon hecho* occurs in Chihuahua, Sonora, Colima, and Baja California (87:895; 19:II, 71). It was described from Hacienda San Miguel, near Batopilas, Chihuahua, also in the hot canyons cutting the west side of the Sierra Madre in adjoining parts of southern Sonora. Its restriction in Baja California is to the cape region from near La Paz southward, and is found mainly along arroyos, or on the lower, more sandy soil. The species is nowhere very abundant on the peninsula (39:355-56), although Brandegee (16:26; 18:19)

reported it fairly common at San José del Cabo, La Paz, Todos Santos, and in the Sierra de Laguna.

The entire plant is from five to ten meters in height, the trunk, crowned with many erect branches, being one to two meters high and thirty cm. in diameter. The fruit is covered with yellow "wool" and long yellow bristles (87:895; 19:II, 70-1).

Palmer (16:26; 87:895; 75:552; 48:64; 31:412), who collected the type material of this species in the Papago country of northern Sonora, found these Indians using the bristly covering of the fruit as a hair brush, a fact which suggested the specific name "pecten-aboriginum." They also parched and ground the seed and mixed the flour with their meal (75:552). Rose (72:254) observed that in northern Mexico the branches of this plant were cut off in five to nine foot lengths and transplanted into rows set together as stock fences. This, of course, was not aboriginal.

Lumholtz (56:I, 187-89), in 1902, wrote of stopping at the section of a barranca called Ohuivo on the Rio Fuerte in northwestern Mexico, and seeing the Indians come from the whole neighborhood to gather pitahaya fruit, which they plucked from the trees with long, four-pronged reeds. He observed that the pitahaya entered into their religion and was associated with the macaw, which is also very fond of the fruit. Likewise Bennett and Zingg (9:6, 149-50) reported that among the Tarahumara of northwestern Mexico, pitahaya fruit, eaten in May and June, was second in importance only to *Agave* in the list of wild food plants. They did not indicate the species used, but noted that the plant was found especially along the gorges of the Rio Fuerte in Chihuahua. From the locality, descriptions of the plants, and the figure of the giant cactus given by Lumholtz as well as by Bennett and Zingg, both publications evidently referred to the same species, apparently *Pachycereus pecten-aboriginum*. It is, in all probability, this species to which Hrdlička (51:266) referred when he said that the Tarahumara consume large quantities of pitahaya. However, mention should be made of the fact that there is practically no pulp available in the fruit of this species at the time the fruit is ripe.

The pulp of the stems contains an active principle, isolated and described by Hey under the name pectinine.<sup>1</sup> It produces a physiological reaction very similar to anhalonine contained in the peyote cactus, *Lophophora Williamsii* Coult. It is reported as being very virulent and producing tetanic spasms.

#### LOPHOCEREUS SCHOTTI (ENGELM.) BRITT. & ROSE

This genus consists of a single species, although three geographical races are recognized, distributed in southern Arizona, Sonora, especially toward Magdalena, and Baja California (87:910; 46:I, 546; 79:285; 19:II, 177). It was originally described from the vicinity of Magdalena, Sonora, and Goldman (39:353), going southward over Baja California, first saw it near the mouth of Esperanza canyon at the east base of the San Pedro Martir mountains and found it quite common over the desert to San Felipe on the Gulf of California. He also saw what he assumed to be the same species at San Francisquito and frequently along his route to La Paz, and was of the opinion that it probably extended throughout the greater part of Baja California. It is known to occur on the Pacific Coast side of Baja California as far north as Camalu, twenty-five miles north of San Quintín, and on the inland hills probably extends to San Vicente. Shreve (79:285) observed that in the Sonoran desert the species is most commonly found on alluvial and outwash soil. It usually occupies the silty areas of flats and broad valleys, and seems to be less at home in rocky places.

The plant usually branches only at the base, forming large clumps, sometimes with as many as a hundred ascending stems which are from one to seven meters high. The fruit is usually naked.

In Baja California the plant is commonly known as *garambullo* (39:353), and as *sina* or *sinita* (with various spellings) in Sonora where it is also occasionally called *pitahaya barbona*, *hombre viejo*, and *cabeza de viejo* (87:911; 19:II, 177; 59:19).

1. Archiv der Pharmacie t. 239, p. 451. 1901.

The fruit is edible, although it does not constitute a highly important source of food (87:911). It is, apparently, this plant to which Clavigero (24:6) referred as inferior to the *pitahaya* (*L. Thurberi*), saying that it was called *ghakil* or *garambujo* by the Spaniards in Baja California. McGee (62:33-4, 206) found the *sina* to be quite conspicuous in the eastern part of the Seri country in northwestern Sonora, where in late June and early July these Indians went inland to gather and eat the fresh fruits. Britton and Rose (19:II, 177) say it was sometimes used to make fences. The pulp of the stem contains a toxic principle which has been isolated and described by Hey under the name pilocerine (31:232).

#### MACHAEROCEREUS GUMMOSUS (ENGELM.) BRITT. & ROSE

This plant, commonly known as *pitahaya agria*, is found in Baja California along the coast as well as inland, and on its adjacent islands. Rose observed it in Baja California in 1911 and stated it was the most widely distributed of all the cacti there; he also found it at all stations visited on the peninsula, and on all islands of the Gulf of California, except Tiburón and San Esteban (19:II, 116-17).

Goldman, on an expedition to Baja California in 1905-06, first noted the species in the vicinity of Yubay, and one of the most abundant and generally distributed cacti along the route from this point to Cape San Lucas. It was also common on Magdalena, Margarita, Espíritu Santo, and Cerralvo Islands. Brandege recorded it from San Martín and Cedros islands, and more recently Rose collected it on Catalina and Santa Cruz islands in the Gulf of Mexico (39:352). Shreve (79:263) recently wrote of this desert plant as ranging north to the central part of the transition from desert to chaparral, extending north of Ensenada in close proximity to the ocean, where frosts are rare and light. Its northern limit seems to be the coastal slopes some eight to ten miles north of Ensenada.

The plant usually grows with a looping habit, the stems growing upward, then drooping over to touch the ground or some other stem, thus forming a tangle of scrambling stems.

These tangles are often three or four meters high, sometimes with a spread of as much as seven meters. The fruit is spiny with a bright scarlet skin and purple pulp (19:II, 116; 87:904).

The fruit of the *Machaerocereus gummosus*, is agreeably acid and is much eaten, being, in all probability, the most valuable fruit of Baja California (19:II, 117; 87:904; 31:176). It is evidently the plants and flowers of this species that Clavigero (24:6) described in some detail and compared with the sweet *pitahaya* (*L. Thurberi*). He also recorded that the harvest of the sour *pitahaya* (*M. gummosus*), called *tajua* by the Cochimi Indians of Baja California, followed that of the sweet *pitahaya* and that the harvest lasted through September to October, sometimes November. It was evidently this *pitahaya agria* to which Taraval (92:99-100) referred when he wrote of sour *pitahayas* being abundant in Baja California, where it was the only thing that might be termed a luxury. He wrote of the excessive fondness of the Indians for this fruit. Similarly Meigs (64:41, 58, 70) evidently had this species in mind, although he designated it *Lemaireocereus gummosus*, when he referred to the Indians west of the Colorado River lowlands in Baja California, particularly in the Rosario area, as utilizing *pitahaya* fruit as an important source of food in aboriginal as well as post-Columbian times.

Palmer (71:132), in 1890, found this plant on Carmen Island, off the east coast of Baja California, being used by the natives as a source of food. The large fruit, dull red without and bright red within, was used to make preserves and jams. In the same year Brandege (17:270; 18:20) found the species abundant in the Cape region of the peninsula, where the delicious scarlet fruit was prepared for eating by peeling off the outer skin and spines. The acid taste was quite agreeable and was retained for a long time if the fruit were left on the plant, but was lost soon after picking. It was often sold in towns by boys who gathered it and removed the spines. Similarly Goldman (39:352), who visited the peninsula in 1905-06, found that the fruit was even more palatable, less sweet, and less insipid than that of *L.*

*Thurberi*, and was gathered in large quantities by the inhabitants.

The stems of the plant were often crushed and thrown into running streams to stupefy fish (87:904; 19:II, 117; 31:177-78). The wood was also used for fuel (31:392).

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A few smaller species of the old *Cereus* alliance were utilized as food in the Southwest but constituted only minor sources of supply. Among these is *Machaerocereus eruca* (T. Brandeg.) Britt. & Rose, the fruit of which resembles that of *M. gummosus* but even more acid in flavor and therefore not so highly esteemed. So far as known, it extends from San Gregorio, Baja California, to below Santa Margarita Island along the coast in sandy areas (18:21). It occurs sparingly on the sandy and silty Magdalena Plains, but is not abundant enough to be of much importance from the standpoint of food-supply. Also the slightly acid, red, globular, spineless fruit of *Myrtillocactus cochal* (Orcutt) Britt. & Rose, found in Baja California, as far north as the vicinity of San Vicente, and called *cochal* by the Indians, was eaten. The fruit is still greatly prized, and it is said that the flesh of the small (two to three cm. in diameter) fruit, which tastes like that of a strawberry, remains cool even on hot days. The natives prefer to pick it early in the morning, however. The stems were used for fuel (87:911; 19:II, 178). Shreve (82:263) found this desert species ranging on the peninsula north to the central part of the transition between desert and chaparral and extending north of Ensenada in close proximity to the ocean. Another plant utilized to some extent was *Wilcoxia striata* (T. S. Brandeg.) Britt. & Rose, found in Baja California and Sonora, where it was known to the Indians as *pitahayita*, *sacamatraca*, and *jarra-matraca*. The insipid fruit was little used but the vine-like plant was valued medicinally. A cloth saturated with juice of the crushed roots was applied to the chest to relieve inflammation of the lungs (87:903; 18:19). In this same connection a night-blooming *Cereus*, *reina de noche* or *huevo de venado* (*Peniocereus Greggii* [Engelm.] Britt. & Rose),

was sometimes utilized (45:158; 75:553; 31:220). This plant, which reaches a height of one and one-half meters, is never very common and is distributed in western Texas, southern New Mexico, and Arizona to Sonora, Chihuahua, and Zacatecas (19:II, 112-13). Hrdlička, in 1908, recorded that the San Carlos Apache, of Arizona, ate the fruit as well as the flowers (51:257), and Castetter and Underhill (21:16) observed that the shoots were, to some extent, eaten as greens by the Papago, who also chewed the large root for thirst, or sometimes baked the root whole in ashes, then peeled and ate it (21:18). These Indians mixed the ground pod with deer grease to make a salve for sores (21:65). Lumholtz (56:I, 4-5) found the natives of northern Sonora using the very large fleshy root of this plant as soap.

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