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Ethnobiological Studies
in the American Southwest

*VI. The Early Utilization and the Distribution
of Agave in the American Southwest*



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and
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FOREWORD

The primary aim of the authors has been to investigate the aboriginal utilization of *Agave* in the Southwest. However, it has not always been possible to ascertain whether a specific use has been aboriginal, and such cases will be evident from the context.

Many of the data herein presented are the result of field work carried on during the past two years in connection with a general program of investigation of aboriginal utilization of wild plants. Wherever possible, however, the field studies have been supported by bringing in relevant documentary evidence. The field work and the literature thus have been combined so as to present as complete a picture as possible of the aboriginal utilization of *Agave* in the Southwest.

It is the pleasant privilege of the authors to acknowledge their obligations to: Dr. A. A. Nichol, of the University of Arizona, without whose assistance it would have been impossible to include the distribution maps, and to Dr. Forrest Shreve, of the Desert Laboratory, for considerable information on the distribution of certain species. To Dr. Ira L. Wiggins, of the Dudley Herbarium, Stanford University, we are indebted for information bearing on species distribution in Baja California. Dr. Herbert Mason, of the Department of Botany of the University of California, has kindly furnished information on distribution of *Agave* in California, as have Mr. Peter J. Rempel and the Department of Botany of the University of Southern California. Dr. E. B. Sayles, of Gila Pueblo, Arizona, has been kind enough to furnish information on distribution of mescal pits in west Texas, and Dr. Emil Haury, of the University of Arizona, has similarly located certain pits in Arizona. Finally, to Dr. D. D. Brand, of the University of New Mexico, and Dr. Leslie Spier, of Yale University, we are deeply

indebted for criticism of the manuscript and valuable suggestions. Specific indebtedness to other workers is acknowledged in footnotes.

THE EARLY UTILIZATION OF AGAVE IN THE AMERICAN SOUTHWEST

INTRODUCTION

Agave (Greek *Agavos*, admirable or noble) is a purely New World genus of Amaryllidaceae, commonly known in the United States as century plants, and consisting of fully three hundred species. In Europe they are known as American aloes, because of a slight resemblance to the Old World genus *Aloe*, of the family Liliaceae. The species range in size from the tiny mescalito, no larger than a Delicious apple, to the giant maguey of Mexico, which may weigh a ton or more. The name century plant was applied because of a belief that they flowered but once, and only on attaining the age of one hundred years. This belief is incorrect. Many species, especially the large magueys, do flower only after a long interval, and then fruit is set very sparingly without artificial pollination; others have not yet been known to flower in cultivation. The species in New Mexico require only a few years to reach maturity and are known to bloom in their native haunts long before attaining the century mark. Most species of *Agave* flower but once, some occasionally, others from year to year, and usually the leaves wither as soon as the seeds have matured. In a number of the smaller species, particularly *A. parviflora*, *A. Treleasei*, *A. Toumeyii*, and *A. Schottii*, the plants survive the phenomenon of flowering more often than do the larger species. The likelihood of flowering the following spring can usually be predicted the previous fall from increased thickening of leaf bases, and a wider angle of the terminal shoot. When used for landscaping, removal of the flower stalk after it is well started will in most cases save the plant from dying. Under favorable conditions of temperature, the flower stalks grow very rapidly, in initial stages the larger species making almost a foot of growth every twenty-four hours. In many species a colony of young plants is formed from suckers at the base,

or even underground shoots, of the parent plant before it dies, while in others buds are given off from the stem, which fall to the ground and take root. Some produce bulblets in the flower cluster, and most species may be reproduced from seed. The agaves are easy to grow (135:454-55; 145:1, 231; 136:107; 103:218).

Trelease (136:107-42, 1646; 145:1, 230-31) listed 186 species of *Agave* for Mexico alone, and Berger (12), in his treatment of the whole genus, lists a total of 274 species. It is essentially a steppe genus, centering on the tableland of Mexico and rarely dropping into the rainy piedmont. Mexico is regarded as the center of distribution, and the states of Puebla and Morelos, in particular, are very rich in species of several sections of the genus. Southward to the Isthmus of Tehuantepec this abundance decreases considerably. In some of its forms, *Agave* occurs in the entire chain of West Indian Islands, which are essentially arid in part of their coast region, at least, many of the islands having their peculiar species with a marked local occurrence of certain species. Some agaves, such as *A. americana* L., have become naturalized over large stretches of the world. The outlying representatives of the genus are found as far south as the northern Andean region and north to Utah, while its eastern and western limits are the oceans; large agaves have been observed even in Peru, but there is question as to their cultivation and perhaps naturalization. The large agaves with paniced inflorescence have the widest natural distribution, with Mexico proper as their center. *A. virginica* L. extends from Texas eastward through Missouri, Tennessee, Indiana to Florida, and northward to Maryland. By far the majority of species have their homes in Mexico, Central America, and southwestern United States. There is no native *Agave* known on an oceanic island. On the mainland no species is known to have a large range except *A. lechuguilla* Torr., and even this is represented by a series of closely allied succeeding forms in the extensive region over 100 miles wide and 700 miles long which it inhabits between

western Texas and San Luis Potosi. Dr. Perrine, while American consul to Campeche, strongly advocated the introduction of tropical plants into southern Florida. As a result a number of species were planted at Key West and on the Biscayne Bay in 1836, 1837, and succeeding years; among them *A. sisalana* Perr., which has become thoroughly naturalized below the frost line in its new home. This was introduced into Florida in 1838, and in 1855 there was a plantation of fifty acres at Key West (99:52, 64, 68-9; 12:8, 9; 143:38-9; 64:27).

So important was *Agave* to the people of the table lands of Mexico that Prescott (114:1, 137) called the plant the "miracle of nature." Leaves of various species contain excellent fiber. The century plant, *A. americana*, the most familiar species of the genus, is widely planted and has escaped around the Mediterranean. It has been reported as yielding the *pita* fiber which is used in the dainty lacework of the Azores, where the plant is also cultivated. However, contrary to the general conception, the fiber from *A. americana* has no significance in world commerce, the names *pita* and *henequen* generally applying to other species. Much of the fiber of the lechuguilla type is used for coarse sacking or enters into the complex of *ixtle*, or Tampico or Matamoras fiber (38:422).

Recently the zapupes have been exploited as comparable in quality with henequen or Sisal hemp (*A. sisalana*), the main basis of Yucatecan commerce, and are now extensively planted in tropical regions, especially the Bahama Islands and east Africa, and are doubtless the most important species for fiber. *A. cantala* Roxb., cultivated extensively in tropical Asia, particularly Java, Philippine Islands, and East Indies as sisal, and *A. fourcroyoides* Lem., grown widely in Yucatan under the name *henequen*, rank next in importance as fiber plants (38:422; 136:107).¹

1. A recent publication presents the uses of agave for textile. It is Antonio Ramirez Laguna, *Agaves textiles de Mexico*. Falletos de Divulgacion Cientifica. Inst. Biol. Univ. Nac. de Mex. 1932.

Pulque, the drink of central Mexico, is fermented from the expressed sap of the large fleshy-leaved species, such as *A. atrovirens*, and large plantations are maintained for this purpose. Moreover, a considerable amount of liquor, known as *mescal* and *tequila*, is distilled particularly from the fermented mash of roasted stems of a number of species, especially those of the group *Tequilanae* (136:107). Contrary to belief, mescal and tequila are not made by distilling pulque. Mescal has been reported for many years as a remedy for arterio-sclerosis, and in recent years an agave syrup has been marketed in the United States as a palliative or cure for high blood pressure.

The glucoside saponin is abundant in the rootstocks of a few species, and is used under the name "amole" for washing. Havard (61:518) writes of the soft leaf tissue of *A. lechuguilla* yielding a mucilaginous powder with remarkable cleansing properties due to the presence of saponin, and of being an excellent soap; *A. Schottii* Engelm. also has been extensively used as a source of soap in the Southwest (99:59). According to Von Humboldt (73:I, 120, II, 40), various species were used aboriginally by the Aztecs for making a sort of paper upon which manuscripts were written, but Pax and Hoffman contend that the paper of these ancient Mexican manuscripts did not consist of agave fiber, but of *Ficus* (136:107; 38:422).²

The most complete treatises on the genus *Agave* are those by Baker (5), Jacobi (76), Trelease (136, 141, 142, 144, 145), Berger (12), Terracciano (138), Mulford (99), and Engelmann (37).

2. Radin takes it for granted that some of the ancient Mexican codices were on agave paper. Paul Radin, *The Sources and Authenticity of the History of Ancient Mexicans*, Univ. Cal. Pubs. in Amer. Archaeol. and Ethnol. 17, p. 7, 1920.

Waterman says "The most important of these monuments for the study of the workings of the calendar system in detail are certain remarkable picture books or manuscripts, made on folded strips of deerskin, or on paper made of maguey (*Agave americana*)." T. T. Waterman, *The delineation of the day-signs in the Aztec manuscripts*. Univ. of Cal. Pubs. in Amer. Archaeol. and Ethnol. 11, p. 299, 1916.

Mr. Echaniz, of Mexico City, has in his possession a set of original Aztec implements purported to have been used in preparing agave paper.

The older accounts of the utilization of *Agave* leave considerable doubt as to the particular species referred to, for in many cases this is not given. In other cases, due partly to the unsatisfactory state of classification of the genus in early days, the specific name is incorrectly applied. Thus, Palmer (108:648) referred in 1878 to the Indians of New Mexico, Arizona, and Baja California roasting the crowns of *A. deserti* for food, and the Mexicans distilling the alcoholic drink mescal from it. Also of grinding the seeds to make edible flour, and of making ropes, mats, nets, and sewing thread from the leaves. This could not have been *A. deserti* Engelm. since the species is not found in New Mexico; he was perhaps referring to *A. Parryi* Engelm. In an earlier publication Palmer (107:405-06) referred to *A. americana* as constituting one of the chief articles of food of the Indians of New Mexico, Arizona, and Sonora, and discussed the usual method of baking the product, noting its common use among the Apache in the vicinity of Camp Grant, Arizona. From the known distribution of *A. americana* L., it is quite likely that Palmer was referring to another species, probably *A. Parryi* Engelm. The fact that *A. Parryi* was formerly known as *A. americana latifolia* Torr., was evidently responsible for the latter species being so often referred to by early writers as utilized in New Mexico and Arizona. Also, in Emory's report (36:213-15) of the U. S.-Mexican Boundary Survey, Torrey wrote of *A. americana* occurring in west Texas, bordering the Rio Grande, in the Mexican states westward, and along the Gila River. He also mentioned *A. americana latifolia* being in the hills near Copper Mines, New Mexico. Likewise, references to the Papago obtaining netting material from *A. heteracantha* are peculiar since the native home of *A. heteracantha* Zucc., (now known as *A. lophantha* Schiede) is Vera Cruz (122:142; 79:135; 136:136). As a matter of fact, *A. lechuguilla* of western Texas and southward furnishes the greater part of the ixtle or lechuguilla fiber usually ascribed to *A. heteracantha*; in fact most of what is called *A. hetera-*

cantha is really *A. lechuguilla* (145:1, 237). Similarly, some archaeological specimens of mescal are quite difficult to identify as to species. In view of the above it will be necessary to discuss the utilization of *Agave* more or less in a generic sense, although species will be given where this can be done with accuracy.

Another point should be made clear—species of *Furcraea* were also treated by the early writers without clearly distinguishing them from species of *Agave*, since until the 19th century no satisfactory taxonomic means of delimiting the two genera were established; hence it is often difficult or impossible to know to which genus the early accounts refer.

Frequently the various references to the Pueblo Indians wearing garments of mescal and maguey apply to *Yucca* rather than *Agave*. Thus, referring to the inhabitants of Cíbola, the "Translado de las Nuevas" states (148:102) "Some of these people wear cloaks of cotton and of the maguey . . .," and the "Relacion del Suceso" records (148:107): "and they wear cloaks of heniquen." We agree with Hodge when, in his notes on this work, he says these statements actually refer to yucca, since agave does not grow in the Zuñi country. The same applies to the account of the Espejo expedition, and Hammond and Rey (89:89, 91) in their notes, clearly state that the Zuñi blankets referred to in this account as being made of agave were really of yucca. Similarly, Bandelier (7:I, 38, 148) concluded that a number of references which he cites, alluding to the use of maguey, really refer to yucca. Winship's note on Castañeda's account of the Coronado expedition, to the effect that the Moki used the fiber of yucca and agave for making clothes, is also in error (147:517f). They used only *Yucca* for this purpose.

EARLY HISTORY

Historically, Columbus and his party were evidently the first Europeans to see specimens of *Agave*, although we have no such specific record. Since they landed on the island of San Salvador, or Watling Island, in the Bahama group,

October 12, 1492, they must have seen *A. indagatorum* Trel., which is found there.

The earliest record of the family *Agaveae* was made by Peter Martyr (2) in a work published at Basel in 1533. Among the plants on the island of Santo Domingo, Martyr described a Maguei, which he compared to a palm, this name signifying a drum or cymbal in the Haitian tongue. Martius (93), commenting on this record, was of the opinion that the Haitian drums were made from sections of the scape of maguey. Drummond (34:31) believes, however, there is every reason for concluding that the maguey described by Martyr was not an *Agave*, but the closely related *Furcraea tuberosa* Ait., especially since none of the West Indian agaves has a trunk except *A. Wrightii*; moreover this has a different distribution and does not have the palm-like habit. Berger (12:10) believes Martyr was writing of *A. antillarum* Descourt, although he gives no evidence in support of his belief.

Oviedo (106: Lib. VI, Cap. 22, p. 208, Lib. XI, Cap. 11, p. 384) has been credited with the first account of any *Agave*,³ when he recorded that the people of Araya in northern Venezuela were called Magueyes, from the abundance of maguey plant in their country. Although Oviedo did visit Venezuela, this statement was evidently based on hearsay, for the Maguey Indians are not recorded from that region. However, *A. Cocui* Trel., the native name of which is *cocui*, found in the vicinity of Caracas and Cumaná, and probably occurring farther inland in Venezuela, is undoubtedly the plant to which Oviedo referred (12:225). Alfaro⁴ has shown that Oviedo visited the Gulf of Nicoya, on the Pacific Coast of Costa Rica in 1529, where he witnessed and later described the preparation of cordage from two plants, which he called *henequen* and *cabuya*; from the descriptions of these the former was evidently an *Agave*,

3. K. Braun, Pflanze 14, Sept. 29, 1906.

4. Don. Alfaro, An. Boletín de la Sociedad Nac. de Agricultura (Costa Rica) 6, 1906.

the latter the closely related genus *Furcraea* (106: Lib. VII, Cap. 9, p. 277). This was published in 1535.

Martius (93:9-13) has discussed the early accounts of the *Agaveae* very fully, pointing out that in Oviedo's earliest work, the *Sumario* (published in 1526 entirely from memory), there is no mention of maguey, as was the case in the first edition of Oviedo's *Cronica*, published in 1535. The maguey notes remained in manuscript until 1851, while those on henequen and cabuya were published in 1535.

Thus, the first record of the family *Agaveae* was that of Martyr in 1533, the plant referred to evidently being a *Furcraea*, and the place Santo Domingo. The next reference to the family was to henequen (evidently an *Agave*) and cabuya (evidently a species of *Furcraea*), published by Oviedo in 1535, although he had seen both of these plants on the Gulf of Nicoya in 1529.

Following these accounts, F. Lopez de Gomara published, in 1556, more exact data on the *Agaveae*. He was followed by John Gilton, who from 1568-72 traveled through almost all of New Spain, and who presented full data on the occurrence and manifold uses of agave on the Mexican mainland. Said he "About Mexico and other places in Nova Hispania there groweth a certain plant called Magueis which yeldeth wine, vinegar, hony, and blacke sugar, and of the leaves of it dried they make hempe, ropes, shooes which they use, and tiles for their houses, and at the end of every leaf there groweth a sharp point like an awle, where-with they use to bore or pearce thorow anything" (35:100).

With the conquest of Mexico by the Spaniards between 1519 and 1525 specimens of *Agave* must have been taken to Europe. Thus, *A. americana* has been known in Europe since 1561, and a number of references bearing on the occurrence of agave species in Europe in the second half of the sixteenth century are to be found. Since Danielli has exhaustively covered this literature, and it has more recently been reviewed by Berger, there is no point in treating it here (12:11-15).

DISTRIBUTION OF IMPORTANT SPECIES OF AGAVE
IN THE SOUTHWEST

In mapping the distribution of the several species of *Agave*, the authors have circumscribed the areas within which the species occur. It is to be understood, however, that the species does not occur throughout the entire extent of such an area. *Agave*, in the Southwest, is essentially a genus of the lower mountains and foothills, and in general is not found in the valleys and other low zones of its limits of distribution.

Agave utahensis Engelm. is found in extreme southwestern Utah from Silver Reef southwestward along the Virgin River and in the Beaver Dam Mountains from about 4,000 to 6,000 feet. It follows very closely the Lower Sonoran zone of the southwestern part of the state, although it does reach into the lower limits of the Upper Sonoran region of the Pine Valley Mountains of Utah. The area covered by this species would not exceed four hundred square miles in the southwestern corner of the state, in the area of the Virgin River drainage.¹ It then extends southwestward into Nevada, California, and Arizona. From the Sheep Range in southern Nevada it extends southward, and occurs commonly in the general vicinity of Las Vegas at elevations about 4,000 feet and upward. Near the summit of Mountain Springs Pass, north of Olcott Peak in the Charleston Mountains, some of the hillsides are almost covered with the species. It is very abundant in the lower portions of the piñon belt of the southern part of the state, particularly in the Virgin and Mormon mountains. It extends westward into California, where it is common at Ivanpah, north of Resting Springs in the mountains east of Resting Springs Valley, in the Potosi and Clark mountains on the eastern Mohave Desert, in the Death Valley region as well as the Providence and Granite mountains, ranging in these mountains from about 3,000 to 5,000 feet. From southwestern

1. Dr. W. P. Cottam, personal correspondence under date of Sept. 27, 1938.

Utah, the species also extends into Arizona, one of the early collections having been made at Peach Springs. It is common in the northern part of the latter state, ranging southward from the Kaibab Plateau, and being very abundant on the Colorado Plateau and on rocks of the Grand Canyon. This has the northermost distribution of all species of *Agave*, except perhaps *A. virginica*, and was the mescal plant of the Walapai, Havasupai, and Paiute Indians (12:105; 77:252; 145:1, 235; 140:128; 101:97; 99:77-8; 28:201; 27:356). Its distribution can best be visualized by referring to Fig. 1.

Agave deserti Engelm. and *A. consociata* Trel. are so similar botanically that many authorities are inclined to place them together as *A. deserti* Engelm., and the authors

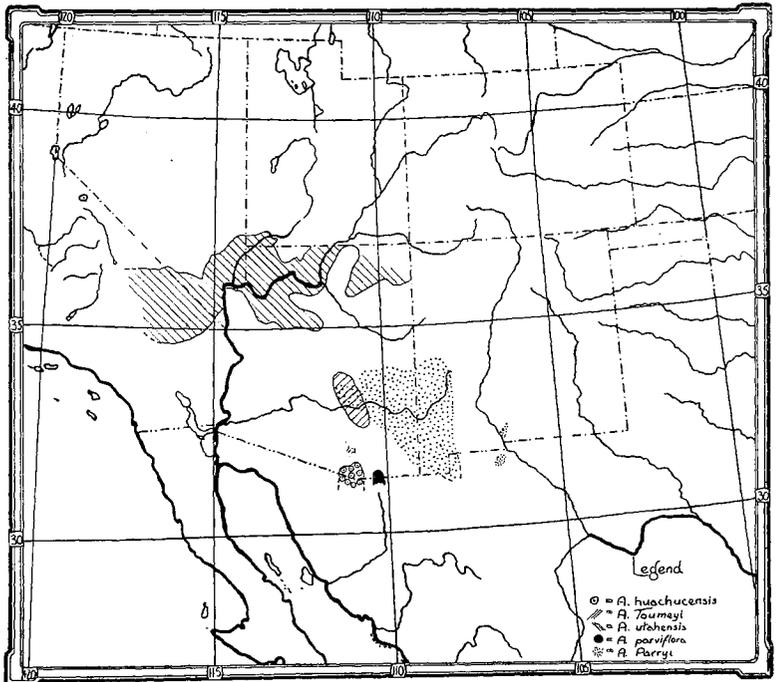


FIG. 1.— Map showing the distribution of *Agave* species in the Southwest

will regard them as one in the following pages. *A. deserti* covers a large area in southwestern Arizona (see map), and extends into southern California, being common on the eastern slopes of the desert mountains of the western edge of the Colorado Desert. In California it occurs in the San Jacinto, Whipple, Chemehuevi, Santa Rosa, Vallecito, Fish Creek, and Laguna mountains of the southern part of the state, from where it extends southward. It is common in eastern San Diego County. Collections are reported as having been made at San Felipe, Mountain Springs, and San Felipe Canyon.

Along the "Pines-to-Palms" road over the San Jacinto Mountains from Hemet to the desert, the species occurs at elevations as high as 3,500 feet, although its usual limit is the 2,500 foot contour, while its lower limit here is 1,200 feet. In Coyote Creek Canyon, in the Santa Rosa Mountains, the plant ranges from 600 feet to beyond 1,500 feet; in Sentenac Canyon in the Vallecito Mountains between 800 and 2,500 feet. In Fish Creek Canyon, in the Fish Creek Mountains, the lower limit of altitude is 600 feet, while in the Laguna Mountains the plant ranges between 550 and 2,250 feet on the Vallecito-Julian road and between 1,050 and 3,500 feet on the Coyote Wells-San Diego road. The indication is that *A. deserti* is rather adaptable to variation in the moisture relations and temperature differences, and it occupies a zone all its own on the eastern slopes of the Peninsular Range. Parish² indicates the altitudinal limits of *Agave* as between 2,500 and 4,000 feet in a more or less continuous belt extending from the San Jacinto Mountains to beyond the Mexican Boundary. Although Mulford (99: 80) described the belt as lying between 2,500 and 3,000 feet and extending from Palm Springs southward, a very recent exploration³ of several canyons near this town revealed no agave. Moreover, with the exception of one colony of

2. S. B. Parish, *Sketch of the Flora of Southern California*. Bot. Gaz. 36:203. 1903.

3. By department of Botany, University of Southern California.

six plants on the south wall of Berdoo Canyon in the Little San Bernardino Mountains, at an elevation of 2,500 feet, this exploration found no agave on the east side of the desert. In fact, apart from the Little San Bernardino and Cottonwood Mountains, the ranges on the east side of the desert in California support only a very sparse vegetation, all of which is extremely xerophytic.

This species extends into Baja California, where it occurs in Nachoguero Valley, at Alamo, and toward the summit of the Sierra Cucopas, which extend to an altitude of about 3,500 feet, and against the base of the Sierra Juarez. Goldman found it to be rather common at an elevation of about 3,400 feet on the Alamo Plain. It has been collected at Bahia de Los Angeles in Baja California, but it

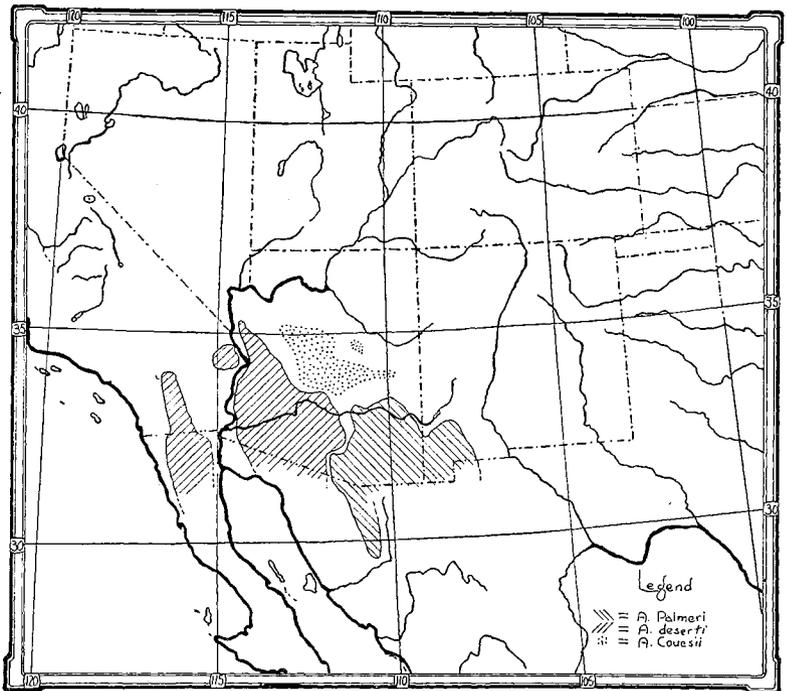


FIG. 2.—Map showing the distribution of *Agave* species in the Southwest

is possible the identification of the species was erroneous. It is not actually known how far south on the peninsula the species extends (77:252; 51:267; 80:54; 84:155, 218; 143:53-4; 54:381). See Fig. 2.

Agave Parryi Engelm. The range of this hardy species begins in Arizona on the north at approximately 34° and on the east a little west of 111° , and extends southeastward in the lower mountain areas into southwestern New Mexico, where it reaches its greatest development. It has been found at Santa Rita, Silver City, Fort Bayard, Fierro, Lake Valley, Mogollon Creek, just north of Reserve, in the Mogollon and Bear mountains, to the top of the Big Hatchet Mountains, in the Burro and Florida mountains and in the Black Range, Humboldt Mountain, and even occurs south of Columbus, New Mexico, in the mountains near Colonia Garcia, northern Chihuahua, in the Sierra Madre Occidental. It is the common mescal of western New Mexico, but also has been collected at Las Cruces and in the Organ Mountains; it is never so large as *A. americana*. It has been reported from as far north as the San Francisco Mountains of Arizona, and both Parry and Palmer referred to this species as the plant used by the Indians of the 35th parallel for making mescal, although Wilcox maintained that *A. Palmeri* was the only species used in Arizona for that purpose (136:125; 150:146; 12:179; 99:84-5; 26:430; 4). See Fig. 1.

Agave Palmeri Engelm.⁴ is distributed in southeastern Arizona, southwestern New Mexico, adjacent Sonora and a small portion of adjacent Chihuahua. In Arizona it is common in most of the small ranges in the Tucson area at altitudes of 3,300 to 4,000 feet, as in the Santa Catalina Mountains, but is found at an altitude as high as 6,300 feet in mountains such as the Huachucas and Santa Ritas. The species in Arizona extends from about $33^{\circ} 20'$ north to $111^{\circ} 45'$ west in the Baboquivari Mountains. From southeastern Arizona the plant extends into extreme southwestern

4. Experimental plots of *A. palmeri* have been established in the Coronado National Forest to ascertain its economic possibilities.

New Mexico, where it is common at Cloverdale, in the Animas, San Luis, and Florida mountains, and in the vicinity of Camp Bowie and Fort Bayard. It is also reported from La Luz Canyon, and occurs in the Sierra Madre Occidental in northern Chihuahua (4; 136:133; 99:88). In Sonora it occurs in occasional small colonies just on the upper edges of the desert and on into the oak belt near Nogales, also on hills between Magdalena and Ures. Wilcox (99:89) stated that after making many and careful inquiries, he was convinced this was the only species used in Arizona for food or for making the liquor "mescal." Our investigations lead us to different conclusions, as is evident later in the paper. See Fig. 2.

Agave Schottii Engelm. The range of this species is extreme southwestern New Mexico, southeastern Arizona, and extreme northern Sonora. In Arizona it is found all through the lower levels of the mountains at elevations of four to five thousand feet. It occurs commonly on Rincon Mountain, and abundantly on the Sierra del Pajarito, which extends to a height of about 6,000 feet, while on the southern slope of the Santa Catalinas are thickly covered mile-wide stretches in which one finds it almost impossible to travel. In Arizona the species is not seen far north of the Gila River, and only a little beyond the San Simon Valley on the east, while the western boundary is the Baboquivari Valley. In New Mexico it occurs only in the southwestern corner of the state, where it is common in the Upper Sonoran Zone of the Animas and San Luis mountains, and is reported from Guadalupe Canyon. It is found only in the eastern portion of extreme northern Sonora, and perhaps in small quantity in the extreme northwest corner of Chihuahua. This plant is the *amole* of Arizona, where it was a very important source of soap for the Indians, and was also used for the same purpose by the Tarahumara (150:146; 12:72; 99:59, 73; 11:163, 123). It is so abundant in mountains of the Southwest that it is often regarded as a nuisance, since the

short, stiff leaves often form a continuous carpet on dry rocky slopes. See Fig. 3.

Agave Treleasei J. W. Toumey. Very closely related to *A. Schottii*, although larger. Occurs in a comparatively small mountainous territory, a little to both the east and south of central Arizona, with a northern limit distribution in the East Verde River Valley. Berger (12:77) lists it as occurring on the southern slopes of the Santa Catalinas in company with *A. Schottii* at altitudes of about 6,600 feet. It is used by various Indian groups as amole. See Fig. 3.

Agave Toumeyi is found in a somewhat elliptical area in the mountain country south of central Arizona, the northern limit a little south of 35°, and the southern just a little

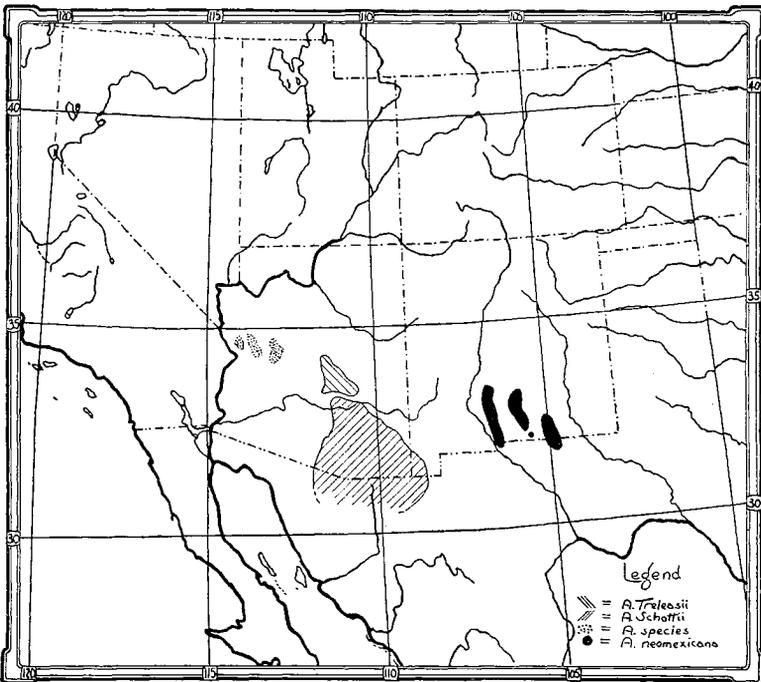


FIG. 3—Map showing the distribution of *Agave* species in the Southwest

south of $32^{\circ}20'$. It does not extend east of Globe, nor west of the latitude of Superstition Mountain. See Fig. 1.

Agave Couesii Engelm. This species ranges a little west and south of central Arizona, being common in the vicinity of Date Creek, Congress Junction, Prescott, and Fort Whipple, and from west of Wickenburg to the vicinity of Kingman. See Fig. 2.

Agave parviflora Torr. is confined to the mountains of Pimeria Alta, in extreme southern Arizona and northern Sonora, midway between the 110th and 111th meridians. See Fig. 1.

Agave huachucensis Baker has its common habitat in a very small area in extreme southern Arizona in the Huachuca Mountains, ranging from about 4,500 feet to the top, although it has also been reported as collected on the Santa Catalinas by Rose in 1908 (12:179; 99:85-6); this, however, seems to be erroneous. The species extends slightly into adjacent Sonora and also occurs in the Sierra Santa Clara in Chihuahua. It often forms pure stands covering small areas on rocky slopes and ridges. Rather recently a permit was issued to a liquor firm to harvest the caudices of this species in the Huachuca Mountains for the manufacture of mescal. See Fig. 1.

Dr. A. A. Nichol feels certain there is an undescribed species in the Hillside, Arizona, area, and Dr. J. J. Thornber is of the opinion there is another new species in the Tonto-Clifton region of that state.

Agave chihuahuana Trel. is found in central north Mexico, occurring commonly in the hills near Chihuahua, Santa Eulalia, and Cusihuiriac, but is most abundant in middle Chihuahua and fairly common in the Sierra Madre Occidental, or southwestern Chihuahua (142:90; 18:49).

Agave Hartmani S. Wats. ranges in eastern Sonora and adjacent Chihuahua, being common in the Sierra Madre Occidental (136:140; 18:49).

Agave Patonii Trel. This species ranges in north-central Mexico.

The west Texas types present a difficult problem of nomenclature. In 1896, Mulford (99:81-3) reported that a species of *Agave* in the mountains of west Texas was apparently *A. applanata* Lem., that it was quite variable, and many specimens showed a resemblance to *A. Parryi* Engelm. Also that there seemed to be many grades intermediate between *A. huachucensis* Baker and *A. Parryi*. As a result, she felt compelled to bring all three together as varieties of *A. applanata*. However, Nichol's⁵ observations in the field convince him that *A. huachucensis* is a very distinct species from *A. Parryi*.

Havard (61), in 1885, had observed that *A. Palmeri* and *A. Parryi* did not extend into Texas, but were replaced by a larger and taller species, *A. Wislizeni*, in all the mountains of west Texas, from the Guadalupe to the Chisos, and Coulter (26:430) gave the same distribution for this species in the United States. Engelmann also credited *A. Wislizeni* to Texas in his manuscript notes. However, Trelease (142:91) has since renamed this species *A. Havardiana* Trel., and described it as a species with the habit of *A. Parryi*, but larger, occurring on hills in the Big Bend of the Rio Grande as for example Wild Rose-Limpio Pass, Chenate, Guadalupe, and Chisos mountains. Dr. Omer Sperry⁶ of Sul Ross Teachers College, Alpine, Texas, finds that what is commonly known as *A. Wislizeni* (actually *A. Havardiana*), is frequent in several valleys and on many slopes in the Chisos Mountains. Also, that a recently named, but as yet unpublished, species of *Agave* is present in the Chisos Mountains, and that another species of *Agave* frequents many of the hills in the Davis Mountain region. Writing of Havard's material from the Guadalupe Mountains, labeled *A. Wislizeni*, Mulford noted that this seemed to be a form different from the three named above, which she was unable to separate and which occurred in the Chenate region, the Chisos, Guadalupe, and Sierra Blanca mountains to Fort Davis.

5. Dr. A. A. Nichol, personal correspondence under date of Nov. 30, 1938.

6. Dr. Omer E. Sperry, personal correspondence under date of July 20, 1938.

Trelease also described *A. gracilipes* Trel. and listed it as occurring in extreme western Texas, having been collected from Sierra Blanca and Rock Creek.

In 1916, Wootton and Standley (149:116) described *A. neomexicana* W. & S., which they regarded as a part of Mulford's earlier *A. applanata* discussed above, but as quite distinct from *A. applanata* Lem. This form is found in the mountains of southern New Mexico and a very small portion of west Texas. It is common in the Tortugas, Organ, San Andres, Las Cornudas, Guadalupe, and Sacramento mountains of New Mexico, and is quite common in the canyons of the more mountainous parts of the present Mescalero Apache Reservation. Cory and Parks (24:33) recently listed *A. neomexicana* for the Trans-Pecos area of west Texas, but Cory⁷ reports that it has been seen only in the vicinity of Pine Springs, just below the New Mexico line.

Other species listed in a recent publication by Cory and Parks (24) for the Trans-Pecos area of west Texas are: *A. applanata* Koch, *A. Havardiana* Trel., *A. heteracantha* Zucc., *A. lechuguilla* Torr., *A. neomexicana* Woot. and Standl., *A. Parryi* Engelm., and *A. virginica* L. Cory is now of the opinion that *A. Parryi*, *A. applanata*, and *A. heteracantha* should be dropped from the list.

Only further detailed systematic and ecological investigation will settle the taxonomic relations of these west Texan-southeastern New Mexican species, and for this reason no attempt has been made to map their distribution, other than *A. neomexicana*.

The most widespread species in the Southwest is *A. lechuguilla* Torr. Its native home is on low rocky hillsides and dry plains of Texas, New Mexico, and Chihuahua and Coahuila, to Tamaulipas, San Luis Potosi, and Zacatecas, where it exists in a variety of forms (136:136; 92:252). Trelease places its range as west Texas and southward, in a number of forms, southermost of which occurs below San

7. Dr. V. L. Cory, personal correspondence under date of Aug. 22, 1938.

Luis Potosi and goes under the name of *A. mesotillo* Hort. (145:I, 237). Berger has placed all these forms under the name *A. lophantha* Schiede, and has distinguished six varieties to which he has given distinct names, designating *A. lechuguilla* Torr. as var. *Poselgeri* (Salm) Berger (12:92-3). The species covers many miles of the steppe region of west Texas and reaches into New Mexico in the southern part of the state (135:453-54). According to Rose (120:242), the word "lechuguilla" means "cabbage-like," while Bolton (14:323f) says the word literally means "small lettuce," and Hammond and Rey (89:51f) regard it as referring to the leafy parts of a plant.

Coulter (26:430) observed that lechuguilla is very common on most of the limestone highlands of southwestern Texas. Somewhat earlier Havard had made a rather detailed study of the flora of western and southern Texas. He observed that the distribution of the species began west of the Devil's River (about meridian 101) and occupied most of the limestone highlands of southwestern Texas in very dense patches.

It is common on the foothills and bluffs of the mountain region north of the Chisos Basin from the Santiago Range to Peña Colorado, thence nearly to Fort Davis. It besets the hillsides of the Chinate Mountains and is very common from these mountains to the Rio Grande Valley. Farther north, the high table land northeast of Pine Spring in the Guadalupe Mountain region was, for the most part, covered with this agave. Bray (19) observed that in the sotol country of Texas *A. lechuguilla* rivals sotol in the actual extent of territory covered, that in the Langtry district it occupies the lower round-topped points and ridges where the stony debris is coarser and the conditions more arid than where sotol prevails. Vernon Bailey has estimated that the lechuguilla association covers 20,000 square miles in Texas. It also occurs in the Big Bend region on the slopes of the Chisos Mountains (14:20; 61:470, 477, 489, 493, 518), and

along the Rio Grande as far east as Presidio, extending into Mexico and New Mexico (99:76).

It is found in southern New Mexico, being quite common in the Guadalupe Mountains in this state, and is abundant in the Franklin Mountains in the vicinity of El Paso and has been found sparsely at the north end of these mountains just on the boundary between New Mexico and Texas. Also it is said to occur along the southern border farther east. Mulford reported it from the Organ Mountains, but neither Wooton nor Standley has seen it from this range, although little collecting had been done in the southern end of these mountains at the time their manual was written (150:146).

Lechuguilla is of considerable economic importance in northern Mexico, where the fiber is extensively used for cordage, brushes, bagging, etc., and is exported as *ixtle*. The short caudex as well as leaves are used as a substitute for soap, being one kind of amole, and is used chiefly in the wild state; it is the most important soap species of southwest Texas and northeast Mexico. The plant has at times been used a good deal for fiber in Chihuahua near El Paso and has, from this standpoint, considerable economic importance, being preëminently the textile plant of northern Mexico. Martinez (92:254) estimates that in the mountain ranges adjacent to Aguanaval, Mexico, with 86,000 hectares of the plant, there is as much as \$36,120,000 worth of fiber. Like the agaves in general, each plant blooms only once, although propagation frequently occurs by young shoots arising from the base of the parent plant. The species first blooms when three or four years old (136:136; 150:146; 120:247; 92:251).

There are numerous species of *Agave* in Baja California, but the following are sufficiently abundant to have been of economic importance, although adequate information on distribution is not yet available to make possible an attempt to map them. Several species occurring in California extend southward into Baja California and the reader is

referred to descriptions of such for distribution on the peninsula.

Agave Nelsoni Trel., remarkable for the shortness and width of its glaucous leaves, is largely a north-central Baja Californian species, ranging from 1,400 to 1,800 feet, first collected at San Fernando. It was found abundantly by Goldman along the road from Pozo San Agustin to near Yubay. Its range is much the same as that of *A. Goldmaniana*, except that the latter is a little more to the south and a little more to the interior, but it is not so abundant as is *A. Goldmaniana* (101:97; 99:87; 54:318; 143:61).

This species is a plant of the interior hills and plateaus, and is common around Onyx (El Marmol) and south near Yubay, Jaraguay, and again appears on the hills between Punta Prieta and Bahia de Los Angeles. It also occurs near Calmalli. The references to its occurrence in southwest California, from Point Loma southward into northern Baja California, and along the coast from Ensenada to Rosario, are erroneous.

Agave Shawii Trel., doubtfully distinct from *A. Orcuttiana*, is confined to the coast of extreme southwestern California, barely getting into San Diego County near the coast, and extending from Point Loma southward into adjacent Baja California, covering thousands of acres between the International Boundary and Rosario. It is extremely abundant from a point fifteen miles south of Tijuana to below Santo Tomas, and it extends almost to San Quintín. Formerly it was abundant in the vicinity of the Initial Boundary Monument, but has been so depleted on the American side of the line by collectors of succulent plants that it is practically non-existent there now, although very abundant a few miles south of the border. In spite of hundreds of years of utilization by the aborigines, it is still a very common plant and is still used for food and for making the drink mescal in northern Baja California. In the vicinity of San Vicente it becomes less abundant and its place is taken by

Agave Orcuttiana Trel. (A. Shawii Brand.), which is found on the northwest coast of Baja California, having been collected also at San Quintín. It is a much larger plant than *A. Shawii*, but the two are quite similar in general appearance.

Agave Goldmaniana Trel. occurs in the northern desert region of Baja California. It is found in the western and central portions of the northern part of the peninsula. More specifically, it extends from about the vicinity of El Marmol southeastward to Calmalli and vicinity, where it fades out.

Agave subsimplex Trel. Found on the Gulf islands of Sonora. Collected at Seal Island in the neighborhood of Tiburon Island (143:60).

Agave cerulata Trel. This beautiful and distinctive species is limited to central Baja California from Calmalli southward. Collected at San Benito (143:55). It is abundant near Calmalli, but is not at all common south of San Ignacio.

Agave aurea Brandege is reported as occurring in eastern Baja California, having been collected at Purisima and Comondú, and quite abundant in the vicinity of the latter town from altitudes of about 600 to 1,200 feet. Brandege observed that this species was used for making the distilled alcoholic drink mescal. The most beautiful of the Baja Californian agaves (143:43, 49-50).

Agave Sebastiana Greene. The range of this species is the coast of west-central Baja California. It occurs at Bahia Sebastian Vizcaino, near Rosario, Santa Rosalia Bay, and on Cedros and San Benito Islands (143:47-8).

Agave promontori Trel. This species is confined to southern Baja California—the Cape region, having been collected on Sierra de La Laguna, at Cabo San Lucas, and San José del Cabo, where there are very few plants to be found at present (143:50). Goldman (54:318) found it sparingly at 2,200 to 4,600 feet on the warmer slopes of the Victoria Mountains in the Cape district, south of La Paz, and on the

road from San Bernardo to El Sauz. It is found growing intermixed with *A. Brandegeei*.

Agave Brandegeei Trel. Limited to southern Baja California. Found in the Cape region mountains, and at San José del Cabo, in company with *A. promontori* (143:57), from which it is doubtfully distinct.

Agave margaritae Brandegee and *A. connochaetodon* Trel., probably both forms of one species, occur in Baja California in sufficient abundance to have been of importance aboriginally. The former is quite common on the islands of Magdalena and Santa Margarita, while the latter occurs in the southwestern portion of the peninsula in the vicinity of Santa Maria Bay. A large *Agave*, that could easily fit Trelease's descriptions of the above species, occurs all along the margins and on small hills of the Magdalena Plains. It is still used by the natives and is abundant enough to have furnished a good deal of food for the pre-mission Indians.

Agave avellanidens Trel. is even larger than the last named form and grows farther east, from a few miles south of Comondú to well toward La Paz.

AGAVE AS FOOD

Mescal has commonly been associated with the Apache Indians and it is from the preparation of the food, known as mescal, that the Mescalero Apache derive their name. Their favorite haunts were originally to be found in the Sacramento, San Andres, and Guadalupe mountain ranges, although they now dwell in the White and Sacramento mountains of New Mexico. While agave has been a staple food among the Apache, its importance has often been exaggerated, and it is a mistake to suppose that they depended almost entirely upon it. Mesquite, screwbean, sotol, piñon nuts, yucca fruits, opuntia fruits, acorns, sumac berries, and juniper berries, as well as game, were also very important sources of food for them; moreover, the ceremonies and symbolism of the Mescalero and Chiricahua Apache do not apply specifically to mescal, but to all growing things.

Several native species of *Agave* were utilized by the Mescalero and Chiricahua Apache, but the most abundant one in the area was *A. neomexicana*. Even today numerous mescal "quids" are found in caves in the Guadalupe Mountains, and old mescal pits of the Mescaleros are abundant in the Sacramento Mountains.

Although not so extensively as formerly, the Apache women still make expeditions to regions where agave grows in abundance for the purpose of collecting the edible portions of the plant. The few families who still make a trip to gather and bake mescal on the Mescalero Reservation go to the canyons back of La Luz in the Sacramento Mountains.

These visits were usually made in late May or early June, when the reddish flower stalks began to appear and the plants were most palatable. Plants not blooming were known as "man" plants; those bearing a flower stalk were designated as "woman," and the Indians advised against using "man" plants for food since they were bitter and spoiled all mescal with which they were baked. This was because the "man" was smoking and the smoke permeated all the mescal in the pit. The "man" changed into "woman" when it flowered, then dried up and was gone.

The crowns of the mescal plants were dug out with three-foot sticks cut from oak branches and flattened at the end. This end, when pounded with a rock into the stem of the plant just below the crown, permitted the crown to be removed readily. A broad stone knife was used to chop off the leaves, two being left for tying the crowns together, thus making transportation more convenient. The naked crowns were bulbous, white in color, and from one to two feet in circumference.

Pits in which crowns were baked were about ten to twelve feet in diameter and three or four feet deep, lined with large flat rocks. On the largest rock, which was placed in the center, a cross was made with black ashes. Rocks were piled on the flat stones, but care was always taken that the top should be level. Upon this, oak and juniper wood

was placed, and before the sun came up was set on fire. By noon the fire had died down, and on these hot stones was laid moist grass, such as bunchgrass (*Sporobolus airoides*), side-oats grama (*Bouteloua curtipendula*), Texan crabgrass (*Schedonardus paniculatus*), big blue-stem (*Andropogon furcatus*), mesquite grass (*Muhlenbergia Wrightii*), marsh foxtail (*Alopecurus aristulatus*), *Muhlenbergia neomexicana*, or the leaves of bear grass (*Nolina microcarpa*), but bear grass was usually preferred since it did not burn readily. The largest mescal crown was selected and a cross made on it with tule or cat-tail pollen (*Typha latifolia*), when this was available, the pollen always being placed on the crown from east to west and from north to south. The Indians then prayed. Extending the large crown toward the opening of the pit four times, they tossed it in and threw the other crowns after it. Next the youngest child present stood at the east of the pit and threw four stones into it. It should be made clear that this little ceremony, held at the time of baking, varied among different family groups and the above description should be regarded as one of a type rather than a fixed performance. After the mescal had been covered with the long leaves of bear grass and the whole with earth to a depth sufficient to prevent steam from escaping, the crowns were allowed to bake the rest of the day and all night. Early in the morning the pit was opened and a crown examined and eaten. The pit was again closed and the Indians refrained from drinking until noon of this day so as to prevent rain. The following morning all the mescal was removed.

During the roasting process, the Apache women were supposed to stay away from their husbands, and if it were not completely roasted when removed from the pit, the Indians believed the women had disobeyed; also that the men should have known better. This is somewhat similar to the view held by the Pima (122:70) regarding the roasting of mescal, for when the crowns were not cooked thoroughly

the difficulty was attributed to the incontinence of some of the members of the party.

The pulpy centers of the black, roasted crowns were released from their charred leaf bases and pounded vigorously into thin sheets on a rock. This brown, juicy pulp was spread out to dry on "mescal cradles," very loosely woven shallow or tray baskets made from the leaves of *Yucca elata*, and in these the prepared mescal was carried home. Unfermented mescal juice was often sprinkled over mescal when being dried; this gave it a glaze and aided in preserving it. The product might be eaten as soon as baked, or dried and stored for future use in hide containers (parfleches). When utilized, the desired amount was cut off, soaked in water, then squeezed thoroughly and the mass eaten without further preparation. Sometimes a piece of crown was cut off and chewed, and the inner side of the attached leaves chewed and scraped, much as we eat globe artichokes. When the pithy center of the leaf was reached it was discarded. Mescal was sweet, having an agreeable taste somewhat like molasses, but with a smoky flavor, and having a mildly laxative effect.

Many are the combinations in which mescal was used. After the dried product had been softened by soaking, it was kneaded together with ground piñon seeds or walnuts (at present peanuts may be used) until the whole was of a doughy consistency; it was then ready for consumption. Mescal mixed with juniper berries (*Juniperus scopulorum*) was another favorite food, while the fruits of the three-leaved sumac (*Rhus trilobata*) were also ground with mescal and the mixture dried and stored for future use. The Apache at White River, Arizona, commonly pounded roasted mescal into a pulp, which was kneaded into large cakes two inches thick and perhaps three feet long, and dried in the sun. The rather sweet dried product might be eaten without further preparation, but was generally made into gruel. According to Curtis (30:I, 18-9), the berries of the three-leaved sumac, and frequently walnuts, were crushed with it

to give flavor, while among the Coyotero Apache, greens, such as species of *Amaranthus* and *Chenopodium*, were mixed with roasted agave. The roasted product was also made into a syrup (109:170). The Southeastern Yavapai ground mescal with walnuts and squawberries as the basis of a beverage (50:209, 212), while the Northeastern Yavapai mashed squawberries (*Rhus Emoryi*), and mixed them with mescal syrup to make a drink (52:257).

The above was the rather standard method of pit-baking mescal among the Apache (21), particularly the Mes-calero and Chiricahua, but there were many deviations. For example, Marcy (90:201), writing of Apache in the vicinity of the Guadalupe Mountains, made the following comment in the year 1849 concerning the preparation of mescal; “. . . we have this evening for the first time seen the maguey plant (doubtless *A. neomexicana*), which constitutes almost the only vegetable food that the Apaches and southern Comanches get for a great portion of the year. They prepare it by boiling it until it is soft, then mash it into a paste, and I am told that in this form it makes a very palatable, nutritious food.” In view of the fact that no record has been encountered elsewhere of mescal having been prepared by boiling, and present day Indians have no knowledge of such preparation, it is possible that Marcy’s observation was superficial.

As regards the western Apache, Sitgreaves (130:9-10) wrote in 1853 that he had sent Leroux in search of water, who reported he had come upon a large encampment of Yampai or Tonto (Apache) Indians. At a place which he supposed to be near the headwaters of the San Francisco Wash, Camp number 15, east of the San Francisco Mountains, his men took from these Indians, among other things, a cake of mescal (evidently *A. Couesii*). Also Woodhouse, surgeon and naturalist of the expedition, in his report, stated that at Camp 20, a little southeast of Bill Williams Mountain, they found the maguey plant, which he erroneously called *A. americana* (evidently *A. Couesii*), and which, to-

gether with pine nuts, afforded the Yampai Indians a large part of their food (130:37); and Whipple (117:III, pt. 3, p. 14) writing in 1853, and Möllhausen (100:II, 196), in 1858, observed that in the Pueblo Creek and Yampay valleys west of Bill Williams Mountain, the Tonto Cosnino or Yampay Indians, and the Coyotero and Pinalena Apache, lived a great part of the year on *Agave* (evidently *A. Couesii*). Similarly, Palmer observed among the Western Apache, that although the crowns were usually pit-baked after the above manner, they were sometimes baked in hot ashes, resulting in an inferior product. Moreover, it was common in uncovering a mescal pit, to gather the roasted leaves into bundles, which were pressed flat. They soon dried and were very sweet, but inferior in quality to the crowns. It was, however, a favorite food of the Western Apaches, who, after the coming of the horse, commonly carried packages of it around the body or on their saddles while at war or on hunting expeditions (107:406; 30:130; 17:49; 30:I, 17-8).

Reagan (116:293), writing in 1931 of the Apache of the Fort Apache region, Arizona, recorded how the women gathered the fleshy "beet-like" roots for food and pit-baked them in a manner similar to that described above (evidently *A. Couesii* and *A. Parryi*). The main difference here, as compared with the baking carried on by the Mescalero Apache, was that a fire was kept burning on top of the pit after the mescal had been covered with vegetation and earth. The White Mountain Apache of Arizona also utilized roasted mescal as food (115:145-46).

The Apache residing on the head-waters of the Gila, as well as the Mescalero and Jicarilla Apache, according to Cremony (29:216, 296) as well as Pattie (139:99), utilized the root (very probably the crown) of mescal as their chief native source of food. It was pit-baked, after which it was pared and eaten with great eagerness. Similarly, Bartlett (8:I, 291) reported that the Indians of the Gila River baked in ashes the roots of *A. mexicana* as food after first removing the bark. He also saw agave used as food by the Apache, the

Pima, and Coco Maricopa. Bancroft (6:I, 488), too, referred to the extensive use of *A. mexicana* as food by the Indians of New Mexico. Both of these men were evidently referring to either or both *A. Parryi* and *A. Palmeri*, as *A. mexicana* of various authors, has no taxonomic standing, being referable to *A. vera-cruz* Mill., a central and south Mexican species (136:123). Later Havard (62:123) mentioned *A. Parryi* as one of the staple foods of the Apache of New Mexico and Arizona, while Smart (131:417) in 1867 observed the use of mescal as food by the Tonto or Coyotero Apache. A San Carlos Apache tale relates how the women went to gather mescal, and according to the mythology of this tribe, agave was created by the gods for the people (together with thirty-one other kinds of fruits and vegetable food), and it was to be prepared with the use of fire (53:66, 417). Hrdlička recorded that the San Carlos tribe roasted agave in the usual manner, and also made a baby soup of agave (*A. Parryi* and *A. Palmeri*). The plant constituted an important food for them (71:488; 72:257) as it did for the Coyotero Apache, who pit-baked it in the usual manner (109:169). More recently, Goodwin (56:62) observed that roasted mescal constituted one of the two most important foods among the Western Apache, and is still a staple food (doubtless *A. Parryi*, *A. Palmeri*, and *A. Couesii*). The gathering and preparation of the product was entirely the work of the women. Spier (132:119) likewise refers to mescal as an item of some importance for the White Mountain and San Carlos Apache.

Abandoned mescal pits are common in central, east central, and southeastern Arizona, the western Apache being one of the groups which made use of them. Fewkes (43:550) reported numerous caves in the Oak Creek Valley near Court-house butte which seem to have been camping places for the Apache, as the walls were covered with soot, and the floors strewn with charred mescal fragments.

Any picture of the utilization of agave in eastern New Mexico and west Texas must be learned largely from docu-

mentary sources and archaeological investigations. Unfortunately, the archaeology of this region has not been worked in detail, although Sayles' (124) rather recent paper, "An Archaeological Survey of Texas," has thrown some light on the problem. He found evidence of two types of cultures in Texas, hunting—food-gathering and agriculture. The archaeological data suggest that Texas was first sparsely peopled by a hunting-fishing-plant-gathering people who occupied all of central and western Texas for a long period of time. Later an agricultural people spread over a large portion of the state and either absorbed or forced out the earlier inhabitants. These agricultural tribes were in turn disrupted by Uto-Aztecan peoples, followed by the marauding Athapascan newcomers on the scene who caused the villages in the northern and western parts of the state to be abandoned.

Throughout western Texas and eastern New Mexico were numbers of bands and tribes, many of whom belonged to the same linguistic stock, generally referred to as Athapascan. Of these there were three main tribes in Texas and eastern New Mexico: the Lipan, the Jicarilla, and the Mescalero. Opler (105:202) points out, that the country which the Jicarilla formerly claimed as their own, included the central and eastern portions of northern New Mexico and the adjoining portion of southern Colorado. They recognized the Arkansas River as their northern boundary, the Canadian River as their eastern limit, the region around the present town of Mora as their southern outpost, and a line extending north and south from where Chama now stands as their boundary to the west. The part of their territory to which they confined their actual homes lay between the thirty-sixth and thirty-seventh degrees north latitude, extending no farther east than the present site of Springer, and to Tierra Amarilla on the west. According to the Jicarilla, there was no mescal in their ancient range, although they do claim to have pit-baked sotol in the same way as the Mescalero did agave. Evidently they did not pit-bake sotol,

however, before they were stationed with the Mescaleros in the 1880's¹ and Spier's (132:119) reference to the Jicarilla Apache using agave evidently alludes to the practice while they lived with the Mescaleros. To the west and north of the Lipan were the Mescalero, who claimed as their aboriginal home the land which originally lay in what is now New Mexico, from east of Hondo to the Rio Grande, and from toward Santa Fe on the north to southwestern Texas, and perhaps northern Coahuila (21:5; 124:24, also ethnologic map; 26). Opler² has pointed out that the Northern Lipan, or literally, "No Water People," was a group of Lipan who moved north and therefore away from the Gulf area. Later they lived between the Rio Grande and the Pecos rivers, near the juncture of the two, where they became much mixed with the Mescalero. The "Big Water People" were those Lipan who tried to remain nearer their old home on the gulf, but who were finally driven over into Mexico.

These Apache tribes, except the Jicarilla who depended largely upon the buffalo, lived principally upon agave and other wild plants as well as small game. Havard (61:519) observed that *A. Wislizeni* (now *A. Havardiana*) was formerly prepared for food by the Indians of west Texas for pit-baking, and that some of these pits can still be seen in the Guadalupe Mountains. Mera (98:15-6), however, has found these are not pits dug below the ground level, but are specialized refuse heaps, which were not concerned alone with roasting agave, although small stone "ovens" or annular mounds were evidently built on what was the ground surface at the time of their erection. Jackson (75:171-72) has since excavated the largest mound in his Culberson County sites and confirmed Mera's observation that it was a midden circle, and in no sense a pit.

Mescal quids or chews are commonly found in the dry cave shelters of the Guadalupe Mountains and the Big Bend area. Thus Holden (68:70) found numerous quids of

1. Dr. M. E. Opler. Personal correspondence under date of Sept. 13, 1938.

2. *Ibid.*, *The Use of peyote by the Carrizo and Lipan Apache tribes.* Amer. Anth. 40:282f. 1938.

A. lechuguilla in his excavation of Murrah Cave in Val Verde County on the lower Pecos River, as did Mera (98:35, 47) in High Cave in the Guadalupe Mountains, the abundance of the quids indicating that mescal was a food of considerable importance in that portion of the mountains. In fact mescal seemed to rank first as food for the early inhabitants of the region investigated by Mera. Similarly, Jackson (75:165) in his exploration of sites in Culberson County, found numerous mescal quids although they were not so abundant as those recovered from a prehistoric rock shelter in Val Verde County, excavated by Pearce and Jackson (111:34, 40, 132).

Sayles (124:24, 62) points out that the use of *A. lechuguilla*, *Agave* sp., and sotol as food by all the groups of west Texas is well established, but the occupation of this area in early times by large numbers of Apache suggests that the name of the most prominent tribe of the group be applied to this sotol pit culture—the Lipan. His Map D, showing the distribution of the late food-gathering groups, and his Tables 3, 6, and 7 indicate that the Lipan phase in Texas, centering in the Big Bend country and to the north, as well as the Pecos River, Big Bend Cave Dwellers, Jumano, and El Paso phases, extensively made use of sotol pits, and of sotol. The Lipan also utilized *A. lechuguilla* and *Agave* sp. as food, and in culture these Lipan were like the other sotol users in the western part of the state. The occurrence of sotol pits among these groups does not mean that they were used only for sotol; they doubtless were used for agave as well. Sotol pits or mounds are commonly found throughout that part of Trans-Pecos Texas where sotol is indigenous. Almost every cave investigated in western Texas has yielded remnants of mescal in some form.

Nelson (102:64) reported that in his archaeological expedition in New Mexico, which extended from El Paso to Cochiti Canyon, he had observed mescal pits in the Rio Grande Valley. Although he does not state specifically where they were seen, the present natural distribution of *Agave* would suggest that it was in the Organ and San Andres

mountains, and perhaps used by the Mescalero Apache. Mescal pits are also to be found in southeastern New Mexico, at Cloverdale, and in both the Little and Big Hatchet mountains.

The occurrence of sotol and mescal mounds and pits is obviously very widespread in southeastern New Mexico and west Texas. Moreover, an enormous amount of quids, fiber, net, and sandal material has been recovered in this area, and described in the regional literature. Unfortunately, however, the great majority of it has not been identified, although it is very probable that upon investigation it will be found to be largely agave and sotol.

Garcés (25:II, 331, 333), while traveling, in 1776, among the Walapai Indians, on what is now the Hualpai Indian Reservation, referred to the Indians giving him mescal for food (evidently *A. utahensis*). A century later, Palmer (107:406) observed that the Hualapai (Walapai)

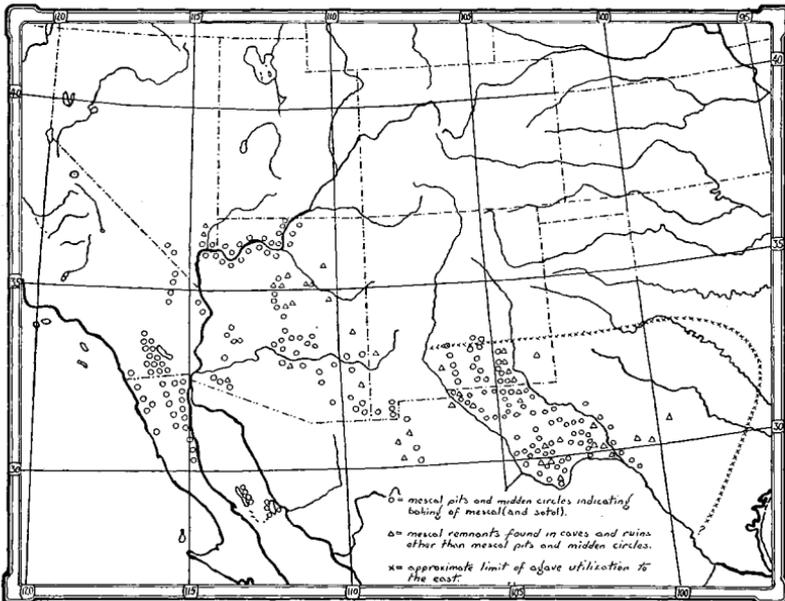


FIG. 4—Map showing the distribution of mescal finds, midden-circles and pits in the Southwest

Indians of Arizona pressed the roasted crowns and leaves of agave into large thin cakes which they traded to the Hopi for maize. The Walapai, dwelling in northwestern Arizona, were largely non-agriculturists, and there were very few places in their territory that could have been farmed. They did formerly grow scanty crops of maize, pumpkins, and beans, and these, together with piñon nuts, yucca, cacti, seeds of several unidentified herbs, and mescal, constituted the important staples. The species of mescal utilized was *A. utahensis*, as we determined on a visit to the Walapai country in October, 1937. This grew only in certain places at considerable elevations, and possibly on rocky slopes.

A dozen or more mescal plants were first chosen and marked with some object by each woman, then gathered in April when the flower stalk began to grow out and the top of the crown was red. These plants were severed from the roots by a five-foot stick, chisel-shaped at one end and hardened in the fire, by placing the blade against the base of the plant, and pounding with a rock to cut off the crown.

The size of the hole excavated by each group of four women depended upon the amount of mescal to be roasted, but was usually about six feet across and three deep. The crowns were roasted in much the same manner as that described above for the Mescalero Apache, the process differing only in minor ways. When cooked they were removed from the pit and the non-fibrous core eaten immediately, as it spoiled quickly. The outer fibrous portions were crushed into a pulp on the metate, then sun-dried by smearing the paste on a frame of sticks slanting away from the sun and allowing to stand for two or three days. The slabs were then folded and stored, later to be broken up, stirred in water, and the mixture drunk; or boiled and eaten, or eaten dry (86:30-2, 48-9, 52-3, 209; 30:II, 92; 72:260).

The Havasupai, close relatives of their neighbors, the Walapai, and very closely related to the Yavapai, but essentially an agricultural people, paid comparatively little attention to wild products. However, they did utilize to a fair

extent the agave which grew on the canyon benches of Cataract Canyon. It was gathered in May, when the flower stalk was 30 to 60 cm. tall. A load of thirty or forty plants was carried home, and the process of gathering and pit-baking was essentially the same as previously described for other tribes. The leaves of roasted mescal were either chewed at once to obtain the juice, or mashed and spread in a thin layer on an arrow weed mat to dry, then turned over, and while still flexible one edge folded back and the opposite edge folded over to meet the crease. This preparation would keep indefinitely, and when needed was soaked for an hour in cold water to make a sweet drink. The species was *A. utahensis*, which is common in the Grand Canyon region (145:I, 235; 132:105-06; 30:II, 99). Garcés (25:II, 344), who visited these Indians in 1776, was given mescal food among other things. Mescal pits are quite abundant in the Grand Canyon area all along the canyon and westward to Boulder City, the Havasupai being the most important group who used them.

Of the Yuman tribes, the Yavapai, though hostile to them, seem to have been quite similar to the Walapai. These Yavapai, also called Mohave-Apache and Yuma-Apache, dwell in Arizona and have much in common linguistically and culturally with northern neighbors, the Walapai and Havasupai. From the Colorado River Yumans, however, the Walapai and Yavapai are markedly different (86:10).

The Southeastern Yavapai were mountaineers, and therefore, like the seed-gathering tribes of California, subsisted wholly upon wild products, mescal being their outstanding food plant (*A. Couesii*, *A. Palmeri*, and *A. Parryi*). It was obtainable at any season of the year, and after cooking and drying kept for years. The crowns were gathered and roasted in the usual manner, each woman trimming her own, and placing them in the common pit in such way as to distinguish them after they had been roasted. This was also the custom with the Northeastern and Western Yavapai (52:259), the Walapai (86:49), and the Havasupai (132:106).

Although there was no praying, singing, or dancing, certain restrictions had to be observed in the roasting of the product, else the mescal would not taste right: (1) The fire had to be lighted by a girl or boy who had been born in summer (2) sexual intercourse was prohibited during the period (3) no one might scratch his head or body with his fingers. The roasted agave was beaten on a metate with a pounder in order to break down the fibers and to prepare the material for drying. The expressed juice was caught in a small basket held at the end of the metate, and this was poured over the mescal when spread out to dry. For drying, frameworks covered with grass were used; these were about two by three feet, with sticks laid across a foundation of two heavy projecting poles at each side for ease in handling. On these, mescal was spread in a layer about an inch in thickness, and the loaded drying frame then placed on a bush. Ordinarily the drying process required about two days, the slab of mescal being turned over onto another frame at the end of twenty-four hours. The dried slabs were then folded and stored on a stick platform, preferably in a cave. When used, a piece was cut off and soaked in a basket of water, then chewed to extract the nutriment, and the fiber discarded. The decoction in the basket was drunk. At the time of cooking, the center of the crown, being a delicacy, was always eaten at once. Mescal was, moreover, one of the principal foods carried on war expeditions (50:183, 205-07).

Among the Northeastern and Western Yavapai, agave (*A. Couesii* and *A. deserti*), which grew at high elevations, was probably the most important food plant and was utilized the year around. Beginning in November, parties of the Northeastern group sometimes remained in the hills three or four months gathering and preparing the mescal, although it was available the year round. The plant was obtainable from a number of places such as the mountains between Agua Fria and Verde rivers east of Cordes, Granite Peak, Black Mesa, Santa Maria River, and Harcuvar, Harquahala, Kofa, and Castle Dome mountains, all in western

Arizona. The Northeastern Yavapai at times visited the Navaho country with mescal and other articles for trade (52:253). The method of gathering and preparing by roasting was quite similar to that of the Southeastern Yavapai, which was, in turn, very much like the general practice as described for the Mescalero and Chiricahua Apache. About a dozen heads were gathered for each family, or about sixty for the entire party. Branches of *Ceanothus Greggii* were used for kindling fire in the pit, while dead juniper wood constituted the fuel. As was customary among many Indian groups who baked mescal, such as Southwestern Yavapai (50:206), a man, woman, or child born in summer, preferably July or August, was chosen to light the fire. If a winter-born person lit the fire, the product would cook white instead of brown, and be underdone. Moreover, in common with other Southwestern Indian tribes, such as the Southeastern Yavapai (50:206), Mescalero Apache (21:37), and Pima (122:70), sexual intercourse during the period that mescal was roasting, was forbidden, as otherwise the mescal might spoil; also the scratching of the head or body during the baking process was forbidden, unless done with a scratching stick. Infringement of this scratching taboo, particularly by menstruating women or new mothers, caused the mescal to be bitter, white, or not thoroughly cooked (50:206; 52:259). The handling and drying of the roasted product differed only in detail from that described for the Southeastern Yavapai. The litter for drying pounded mescal was made of two parallel mescal flower stalks, laid over with many stems of an unidentified grass, or *Sphaeralcea ambigua* (52:254, 259-60, 263). Some mescal was eaten during the period of preparation, the rest being transported or cached for later transport to more permanent camps. The roasted product was frequently eaten with meal and other foods, meats also being dipped in the juice of cooked mescal. The Western Yavapai lived chiefly on mescal while their cultivated plants were maturing, also both groups at times visited the Navaho country with buckskins, mountain

lion skins, and mescal for trade, and the Western Yavapai traded mescal to the Yuma, Mohave, and Papago (52:253-55, 259-60, 263).

Historically, the account of the Oñate journey to California relates that in 1604 the party encountered the Cruzados Indians (Yavapai) in the vicinity of the San Francisco Mountains, who "also use for food *mescali*, which is a preserve of the root of maguey" (14:270). Moreover, Fewkes (41:267) reported the occurrence of mescal pits in the Verde Valley of Central Arizona, which is in the neighborhood occupied by the Yavapai. Such pits have also been found in the Harcuvar, S. and H., and Harquahala mountains of western Arizona, and are undoubtedly of Western Yavapai origin, judging from the fact that only Yuman potsherds have been found in their vicinity.³ Fewkes' (41:267) reference to finding charred mescal pits at two ruins in the Red Rock country, part way between Prescott and Flagstaff, evidently applies to the Yavapai.

Leaving the Havasupai out of consideration for the moment, the shores of the Colorado River, from the territory of the Mohave to its mouth, were inhabited by a series of Yuman tribes, this river civilization coming to a sudden upstream stop with the Mohave. Their country was the Mohave Valley, above which is the great defile known as Eldorado Canyon. This tribe seems to have utilized mescal very little, as it did not grow in their immediate country, and their only means of securing it was by barter with the Western Yavapai and the Chemehuevi (48:6; 50:254). Their southern relatives, the Yuma, are reported by Forde (48:117) to have never collected or eaten mescal, as they disliked it, although Gifford (52:250) reports they obtained the product at times by trade with the Western Yavapai. Our own field studies among the Colorado River tribes in the fall of 1937 and 1938 revealed that agave was of little importance to the Mohave and Yuma, being used only in times of food shortage.

3. Dr. Malcolm J. Rogers, personal correspondence under date of Dec. 6, 1938.

Going on down the Colorado River we come to the Cocopa, whose culture was unquestionably of the same pattern as that of two other great Colorado River tribes of Yuman stock, the Mohave and Yuma, having very few deviations from the basic culture pattern, even though the Cocopa were at "chronic enmity" with these two tribes. Moreover, environment varied but little in the habitat of the three tribes, nearness to salt water being the only difference of note in Cocopa territory, and this had no great effect upon the tribe. They did eat a few sea foods, and had available the raw materials for making shell ornaments, but their culture remained essentially a river culture in spite of their proximity to the Gulf of California (51:315).

Agave deserti Engelm. ranges in southwestern Arizona and southward. From the basal slopes of the mountains of southeastern California it extends to the desert mountains of northern Baja California, occurring toward the summit of the Sierra Cucopas and against the base of the Sierra Juarez. The Cocopa Indians did gather *A. deserti*, beginning in April in the Cucopa Mountains. The plant was highly valued, and at the present time furnishes them food as well as distilled liquor. The crown was pit-baked as among many other tribes (80:54; 81:155, 218; 51:267; 12:263; 54:318; 136:126).

Another tribe of Yuman stock, the Kamia, are marginal to the southwest and are considered here because of their cultural affinities to other Yuman tribes. The Kamia, who were the inhabitants of the Imperial Valley in southeastern California, also resided at times on the west bank of the Colorado River in Yuma territory, which seemed to be their's to visit whenever they pleased. Linguistically they are little different from their neighbors, the Diegueño, but culturally they are intermediate between the latter and the Yuma, with whom they shared a large proportion of traits. It is assumed that they are a people of Diegueño origin, who moved down into the Imperial Valley, where they came under the influence of the Yuma, from whom they learned agriculture. At

least in historic times, the Kamia have been an agricultural people inhabiting the low-lying Imperial Valley and the banks of the sloughs connecting it with the Colorado River just south of the international boundary. Gifford, who is of the opinion that a century would be sufficient to account for this process of acculturation, regards it as an open question whether the Eastern Diegueño and the Kamia should be regarded as separate peoples. In fact, the extremely friendly relations of the Kamia with some of the adjacent tribes led him to refrain from delimiting any definite geographical boundary for the Kamia (49:1-3).

The Kamia of Imperial Valley traded, but never baked, mescal, an important food in the hilly parts of southern California. The Diegueños, who cooked the plant in the earth pit (*A. deserti*) traded it to the Kamia in the form of dried fibrous cakes (49:23). Forde (48:117) reports that the Kamia are known to have used mescal extensively, and this statement is probably based on a reference by Kroeber (84:723) that the Kamia or eastern Diegueño ate mescal like a hunting people. The "Quemaya" visited by Anza, Garcés and Font in 1775, descended from their own territory, which began in the mountains at latitude 33° 08', some one hundred miles to the northwest of the mouth of New River in northeastern Baja California, and extended as far north as San Diego, to eat calabashes and other fruits of the river. They were described as wearing maguey fiber sandals and as "very dirty" on account of the large amount of mescal which they ate (25:166-67, 196-97). Gifford (49:2) observes that these people were the eastern Diegueños, rather than the Kamia of Imperial Valley, although both designate themselves as Kamia.

The Diegueño pit-baked agave extensively.⁴ One of the areas of greatest concentration of mescal pits is in the desert mountains of eastern San Diego County, former home of

4. Spier has reported the use of mescal for food among the Southern Diegueño. Leslie Spier, *Southern Diegueño Customs*, Univ. Cal. Pubs. in Amer. Arch. & Ethnol. 20:297-358. 1923.

the Southern Diegueño. These pits were especially well constructed and were arranged on ridges in series as a trapper would set a trap line. As the lines were staggered and in rough country it was customary to mark the positions by placing "ducks" on nearby boulders so as not to miss any.

In this region, pits averaged six feet in diameter with nine feet as the maximum. They were dug in sandy soil and lined with boulders, the latter often extending high enough on the margin to form a raised rim. Upon this platform of boulders a hardwood fire was built, and after the boulders were sufficiently heated a matting of agave leaves was laid. Upon this the agave flower stalks or crowns were placed, and in turn covered with another layer of leaves. The charge was then banked over with sand. The Indians would return next day and go over the lines to collect the baked product, for to wait more than twenty-four hours would result in overbaking. The pits were used over and over again each season. Due to the clearing out of the pits and replacement of fire-cracked boulders with new ones, some pits have a marginal refuse dump of considerable size.⁵

On the west side of the Colorado Desert on the east slopes of the desert mountains, beginning on the north in the San Jacinto Mountains, is a north-south belt of *Agave deserti* which extends well into Baja California. Wherever these two species occur, mescal pits are very common to at least as far south as the latitude of Punta San Fermin on the Gulf of California.

Although the Paiute belong to Basin Shoshonean culture, they are here included in the Southwest because they represent the northermost utilization of agave in the general area; also because they are not unlike other southwestern peoples in culture. Thus, Kroeber points out that the Southern Paiute, north of the Colorado River, were much closer in culture to the Walapai than were their Yuman relatives, the Mohave. Although intercourse across

5. Dr. Malcolm J. Rogers. Personal correspondence under date of Nov. 23, 1938.

the great chasm was limited, the two were similar in land utilization and economy, in feebleness of social and religious organization, in general lowness of cultural intensity, and in personal disposition (86:10). These southern Paiute bands utilized *A. utahensis* Engelm. as a source of food, found on mountain sides in southern Nevada and northern Arizona, and quite abundant in parts of the Charleston Mountains. The crowns were pit-roasted in the usual way, and consumed immediately or powdered fine and pressed into long, flat, irregularly shaped cakes. The tender leaves baked with the crowns were pounded and pressed into flat cakes (108:648; 140:128; 27:356; 132:119). The Kaibab utilized mescal (*A. utahensis*) perhaps more than any other Paiute band. The plant, found only in Kanab Canyon and just below the rim of the Grand Canyon, was available the year round, but was gathered mostly in winter and spring when food was short. Preparation was the woman's task, while the men hunted rabbits and sat around. After the crowns were severed from the roots the outer leaves were severed with a stone knife and sucked to extract the juice, then discarded. These crowns were brought to camp in a burden basket and pit-roasted communally as described above. Each woman gathered the crowns individually and dumped them into the communal oven, but did not mark them. After the leaf bases were peeled off, the roasted crowns were pounded into sheets and dried on a bed of grass. This sweet product was a yellow-brown color "like pumpkin," which could be eaten immediately or dried for five days and stored. It was eaten by breaking off pieces, soaking them in water, squeezing in the hand, mixing with tansy mustard (*Sophia*) and drinking. The leaves peeled off, the crowns were dried, pounded, and ground, resulting in meal which was stored for future use. This was made into mush or mixed with cold water as a beverage. The Kaiparowits band utilized agave (*A. utahensis*), which grew in small quantities along the Paria River in southern Utah and northern Arizona, while the San Juan band

southeast of the Colorado River in the vicinity of the Kaibito Plateau also pit-baked the same species.⁶

That mescal has been used in the Paiute area for a considerable period of time is indicated by the finding of mescal quids or chews sometimes called "yants" in ruins such as Gypsum Cave, Nevada. Harrington (59:82, 164-65, 194) found quids of *A. utahensis* in the upper layers of Gypsum Cave and logically concluded that this plant had been used as a source of food. Although Harrington regarded certain objects unearthed in the excavations as of Basket Maker culture, he regarded the mescal quids as of more recent deposit. The scarcity of definite Paiute material in the ruin precludes the possibility of considering the cave as at any time inhabited by Paiute people. Similarly, Harrington (58:116) found quids in Paiute Cave, which is one and one-half miles south of Overton, Nevada. Moreover, abandoned mescal pits are found in the Charleston Mountains of Nevada, having been used by the Paiute (27:356).

The Chemehuevi, who formerly ranged in eastern San Bernardino County, California, utilized agave (*A. utahensis*), and numerous mescal pits used by these people are found at present in the Providence Mountains of that region. Kroeber (84:597) reported agave as being a very important food for this tribe. The Panamint, however, who dwelled in Inyo County, California, never utilized agave, as it did not grow in their neighborhood (27:355).

Although the Papago pit-roasted mescal, many of them secured it by trade and not at first hand. The eastern part of their home in southern Arizona and northern Sonora supported *A. Schottii* and *A. Palmeri*, the central and western portions *A. deserti*, while *A. americana* was to be found in places south of the present international boundary.

A careful field study of Papago utilization of *Agave* made by the authors in November, 1938, revealed that the plant was never of great importance to the members of the tribe living in what is now Arizona. Agave in southern

6. Dr. Isabel Kelly, personal correspondence under date of Sept. 15, 1938.

Arizona was to be found only in the higher parts of certain desert mountains, which were widely separated from each other. The Papago, dwelling in the desert and semi-desert areas, could obtain the product only by making expeditions to these mountains. When this was done, the crowns were gathered in the higher mountain levels and usually carried to the foot of the mountain for pit-baking. The labor and hardship involved in securing the product placed it in the category of a delicacy.

Mescal was gathered by Papago dwelling not too far distant from the Baboquivari, Santa Rosa, Table Top, Quijotoa, Santa Rita, and Santa Catalina mountains, all of which supported the plant at the higher elevations. Thus, Toumey (99:62) once wrote of finding a party of Papago Indians camped in the Santa Catalina Mountains north of Tucson, for the purpose of roasting crowns of *A. Palmeri*. Families living more distant from the source of supply never utilized the product unless it was obtained by trade.

In more recent times *A. americana* was gathered by parties from southern Arizona who went to Sonora to work during the winter wanderings, stopping for a week or two to gather and bake the mescal, and when necessary storing it in pits until they were ready to carry it home. Although agave was utilized by the Papago in Sonora, our investigations have thus far revealed little on the extent of such utilization.

Gathering was done by the men, since it was heavy work, although the women might help by gathering wood and fetching water, or they would remain below the slope where the agave grew and make pottery from the good clay found there. These species were gathered in much the same manner as described above for the Apache. The plants were hacked off with a digging stick pounded with a stone, and since the party was usually traveling, this stick was made of any hard wood available, but its end was always chisel-shaped and fire-hardened. The spiny leaves were chopped off with a mescal hatchet, a semi-circular stone blade of

granite or diorite, with the handle an extension of the stone itself. The prepared product was kept in jars to be eaten a little at a time, or traded as a delicacy.

Mescal pits are not very abundant in southern Arizona and adjacent Sonora, except toward the east, and are even less common in the southwestern part of the state and adjacent Sonora, where they are reported only from just east of the Tinajas Altas and Cabeza Prieta mountains. These were probably of Papago or Yuman origin or both. In the Tinajas Altas the mescal chisel is found in rock shelters, so the pits of this mountain area are probably of Yuman origin.⁷

The Pima Alto, close relatives of the Papago, utilized mescal in times of famine, and would have used it much more extensively had it not been for the danger from "the enemy," the Apache, who surrounded them, even though the plant is not found in their immediate neighborhood (72:261). These Pima frequently gathered agave crowns in Superstition Mountain, in the vicinity of Superior, and in the Picacho Mountains. Agave has always been a favorite food among the Pima, and it was gathered and prepared in a manner very similar to that described for the Apache. The roasted product is now secured from the Papago. It was eaten by chewing until the juice was extracted, then the fiber discarded. It was used alone or with pinole. Syrup was also extracted from roasted mescal by boiling until the juice was removed, and this thickened by continued boiling until a black syrup resulted. This was inferior to sahuaro syrup. The Pima also obtained by trade from the Papago agave syrup as well as the agave fruit in flat, roasted cakes (122:70, 93). Bartlett (8:11, 291), wrote, in 1854, of the Indians on the Gila River extensively pit-baking agave for food.

Fewkes (45:116), writing of his excavations at Casa Grande, Arizona, noted that he had found numerous circular areas of blackened soil which, when excavated, contained

7. Dr. Malcolm J. Rogers, personal correspondence under date of Nov. 23, 1938.

charcoal and other evidences of fire; also at a depth of about five feet were a number of stones affected by fire to a marked degree, and the floors and walls showed the effect of intense heat. Fewkes concluded that these pits were similar to those still constructed by the Quahatika for roasting agave, also that the number of pits indicated mescal was a favorite food of the people of Casa Grande. He observed that similar ancient mescal pits are found at the ruins near Tempe, Mesa, Phoenix, and elsewhere in the Salt and Gila river valleys. Such pits are also known to occur in the Superstition Mountains.

Although little is known of the extent of utilization of agave among the Pima Bajo of Sonora, Perez de Ribas (112:360) informs us that they cultivated the plant.

Writing of the Maricopa, Spier (3:55) recorded that mescal was little eaten by these people since it did not grow in their locality, and our own field studies among this tribe confirm his observation, although the baked product was sometimes secured from the Papago. A few plants grew on the higher parts of the Estrella Mountains to the south and it was more abundant beyond. Since it grew so far away it was gathered by the men, each of whom would bring home only six or eight plants because of scarcity. Its gathering and preparation was much the same as among other tribes. However, the edge of the wooden chisel used to dislodge the crowns was at one side rather than the end, and the leaves were trimmed short with a knife, the mescal hatchet being unknown to them as it was among such tribes as the Papago, Apache, and Havasupai. The roasting process differed in that stones were not placed in the pit, the hot coals were raked out, the ashes sprinkled, the heads laid on this, covered with dirt, then ashes and a little fire. If prepared in the morning the heads were allowed to bake all the following night. The head proper was eaten without mashing, but the short leaves on the baked heads were stripped off to be chopped up and pounded in a mortar. The mass was spread to dry on peeled sticks laid side by side,

or on a cloth, and when dry was rolled in a bundle. The product could be soaked in water and chewed, or the foamy sweet liquid drunk (133:55-6).

Occasionally the emerging mescal flower stalk was used as food by certain tribes, either raw or cooked. The stalks were removed, placed on a bed of embers and roasted for about fifteen minutes, after which the outer charred portions were stripped off. The central edible substance was white, soft, sweet, and quite palatable, regarded as the most delicious portion of the plant, and was eaten immediately. Another method of preparation was to gather the flower stalks just as they came into bloom, peel, and cut them into pieces, and boil them. They were then dried and stored to be used as a vegetable. This utilization of agave flower stalks was common among the Mescalero and Chiricahua Apache, the White River Apache, Walapai, Southeastern and Northeastern Yavapai, Kaibab, and the Papago (20:16; 21:35-8; 30:I, 15; 86:52; 50:206; 52:259), and was practiced occasionally by the Navaho. A plant called "big mescal" by the Yavapai had an edible flower stalk but inedible crown (52:259). Roasted agave leaf was a favorite, although inferior, food of the Western Apache (107:406). Small quantities of honey, the product of large wild carpenter bees, were occasionally obtained from agave flower stalks by the Maricopa (133:73), while in Havasupai territory wild carpenter bees had their hives in flower stalks of dead agave (132:108).

Agave leaves were sometimes eaten without cooking, and the jet-black seeds, pounded and ground into flour, were often added to mesquite pinole. In some species, especially the deep-flowered *A. huachuensis* of Arizona, the nectar was gathered and used as a syrup (103:218).

Agave plants were severed at the roots by Mescalero and Chiricahua Apache with three-foot oak digging-sticks flattened at one end, while the Walapai (86:48) used a chisel-shaped piece of wood. The blade was placed against the bottom of the plant and the end of the stick struck with a

rock to pry off the main stalk. The Western Yavapai digging-stick was of desert willow (*Chilopsis*), about two inches in diameter and chisel-shaped at one end. Incidentally, these people also had a hook of ash wood to adjust hot stones in the mescal pit (52:279). The Southeastern Yavapai used the chisel-ended digging-stick for gathering mescal but this was used secondarily for digging, as was the case among the Northeastern and Western Yavapai (50:221, 225; 52:259). A similar implement was used by the Havasupai, White Mountain Apache, Pima (132:119), and Papago (20:16), the Havasupai digging-stick being of buckthorn with the chisel-shaped edge at one side rather than the end (132:105).

Among the Walapai (86:49, 97) mescal leaves were trimmed off the crowns by means of a special knife made by inserting longitudinally a blade of flaked obsidian or quartz into a stick, the wooden portion constituting a handle. The Southeastern Yavapai (50:225) and Kaibab⁸ used the stone mescal hatchet, while the only one the Northeastern Yavapai knew was the steel hunting knife from the Lower Colorado tribes and the Navaho (52:279). That of the Southeastern Yavapai was a broad flint blade shaped like a pole axe, but without a handle, and was employed to saw rather than to chop. The Papago, however, used a mescal hatchet similar to that of the Walapai, but made of granite or diorite (20:16). The mescal hatchet was also utilized by the Havasupai, Mescalero and Chiricahua Apache, White Mountain and San Carlos Apache, but was unknown to the Maricopa (132:119). That of the Havasupai was a broad stone blade set in a slot midway in the length of a short handle thirty cm. long, sometimes of piñon wood, where it was held fast by pitch or glue and by lashings. Harrington (58:119-20) found a mescal knife in Paiute Cave, Nevada, but this showed contact with the whites, since the blade was of iron. Such mescal knives with iron blades have been collected among the Colorado River tribes, and specimens with

8. Dr. Isabel Kelly, personal correspondence under date of Sept. 15, 1938.

stone blades are reported from caves near Flagstaff, Arizona, and near Alpine, Texas.

The Kamia and Diegueño employed to a considerable extent two wooden implements in the preparation of mescal. The mescal chisel was very essential and took the place of the mescal knife of other parts of the Southwest. It was five feet in length, usually of ironwood, and was used to split off the sharp-pointed leaves which clustered about the flower stalk and crown. The second implement was a wooden shovel, usually of cottonwood which was employed in scooping out the sand from the pit. It was probably of post-Spanish origin.⁹

Agave was never of great importance among the Pueblo Indians since it rarely grew in their territory. Of the Pueblos, the Zuñi made most use of the plant, but because it does not grow within their present territory its use has greatly decreased, and the agave now utilized by them is secured by trade with the Western Apache, Havasupai, and Walapai. In former times, when the Zuñi did gather and prepare their own mescal, the methods employed in preparation and storage were very similar to those of other tribes. Crowds gathered, dances were celebrated, and the pits opened amid universal rejoicing. The group spent its time between riotous feasting and serious mastication of the baked product, and the paste thus formed was spread out thinly over large mats and dried, and could be conveniently rolled for purposes of transportation. If there were too much of the product for mastication, the crowns were pounded, moistened slightly to give a pulpy consistency, and thus spread and dried on plaited mats. The plant possibly rivaled *Yucca baccata* in importance among these people (31:235-36, 635). Many ceremonial objects were made from agave flower stalks which played some part in their religious ceremonies (39:199, 202). The use of the name for mescal in Hopi ceremonialism suggests that agave was at one time an item of some economic importance for them.

9. Dr. Malcolm J. Rogers, personal correspondence under date of Nov. 23, 1938.

Palmer (107:406), writing in 1870, observed that the Hopi traded maize to the Walapai for roasted mescal, and even today these Hopi secure the product by trade from the Havasupai. That the Hopi formerly used agave for textiles is shown by excavations at Awatobi (48:629-30). What they do utilize reaches them through trade with the Havasupai, who piled stones on the emerging flower stalk, thus forcing it to grow into a deformed ball. This as well as the crowns were pit-baked and constituted the mescal products traded to the Hopi.¹⁰ However, *Agave* does not occur at present in Hopi territory and the plant is, therefore, of little importance to them.

Since the Southwest extends into northern Mexico, certain north Mexican tribes will be considered. Agave was cultivated by the Pima Bajo of Sonora as was also done by the Indians of Sinaloa, as recorded by Perez de Ribas (112:6, 8, 237, 360) in 1645, who observed that the only condition necessary to cultivate *Agave* was to plant it. Icazbalceta (74:II, 303), however, denied that it was cultivated in Sinaloa, although he is doubtless in error. Bandelier later noted that the Mayo and Yaqui Indians of Sonora improved the agave varieties (7:I, 48), and Bartlett (8:II, 484-86), in 1854, wrote of plantations of agave in Coahuilla in the vicinity of Parras.

The Mendoza-Lopez expedition to the Jumanos in 1683-84 recorded that coming north along the south bank of the Rio Grande, from a few leagues below El Paso, they passed numerous rancherias of the Suma Indians, a nation of poor people who lived chiefly on baked mescal (14:321).

Although the Opata did not cultivate agave they at times did pit-bake it extensively for food (32:3rd ser. (4), 523; 113:I, 94-5) as did the Concho and Jumano in Chihuahua (89:50, 60). The Cabri of this same region also used agave, although there is no record of pit-baking (104:276). Luxan's account (89:31, 50, 60, 67) of the Espejo expedition records that the Conchos Indians along the Con-

10. Alfred Whiting, personal correspondence under date of Sept. 15, 1938.

chos River, below its junction with the Florido in Chihuahua, lived on fish, mesquite, and mescal. Also that mescal was presented to members of the expedition by the Jumano as well as by the Otomoacos or Patarabueyes along the Rio Grande in Chihuahua. Bolton's (14:170) translation of the account of this expedition refers to the Conchos as living on "*mescales* which are the leaves of lechuguilla. They cook the leaves of this plant and make a preserve like quince jam. It is very sweet and they call it *mascale*." Likewise Perez de Ribas, who observed the Indians of Sonora and Sinaloa, while they were still relatively untouched by European influence (although Sinaloa was overrun and colonized by Spaniards 1530—), wrote of these Indians using mescal for food. Similarly, the author of the Rudo Ensayo wrote of a mescal being used as food by the Opata Indians of Sonora. The tender leaves and shoots were eaten half-roasted by sucking the sweet juice from the pulp, and it sometimes constituted an important food. The leaf stalk also was mashed and eaten but was regarded as inferior. The natives, particularly those of Saguariipa, carried but few provisions when this food was in season (121:151-52; 112:8, 237). Pfefferkorn (113:I, 94-5, 141-42, 158), writing in 1794-95, observed that the Indians of northern Sonora utilized mescal for food. The men gathered roots (probably crowns), trimmed and pit-baked them in the usual manner. The roasted product had a reddish yellow color in contrast to the white of the raw material, was mild, sweet, and agreeable to the taste. He states that the Apache, who occupied the territory to the east of Sonora and stretched to the Gila and the land of the Hopi, used baked mescal as almost their daily bread. Agave was less common in Sonora, but even so, the Sonoran Indians, who looked more to their ease than their needs, regarded the preparation of mescal as somewhat tiresome work, and therefore seldom had a supply.

Among the Seri, agave as a food was very much limited because of the supply available, the use of the plant being confined largely to fiber (85:44).

Bennett and Zingg (11:148-49, 163-64) pointed out that the Tarahumara of the Gorges in northern Mexico obtained both food and drink from *A. Patonii* Trel. The sweet, juicy crown was eaten, as was the succulent flower stalk after boiling or roasting in ashes. The Tarahumara utilized *A. Schottii*, a characteristic plant of the lowlands, by pit-roasting the crowns in a manner very similar to that described above for the Apache, and the product is still considered a delicacy greatly enjoyed among these Indians. Moreover, the roasted mescal deprived of its fiber is an article of commerce between the barrancas and the sierra. Another, more tender species, sweeter and more easily prepared, required only one night of pit-roasting, and could be boiled in an hour, after which it was eaten with pinole. Also *A. lechuguilla* was used for food. The species of Agave constituted a very important food for these people (72:266). The "portions of the Yucca or a similar plant" which Blackiston (13:31) reported from a cliff-dwelling in the Sierra Madres, may have been mescal quids. He found these well chewed and still with teeth marks on them.

Although the Indian culture of Baja California is not Southwestern, neither is it Central Mexican nor Californian, and is considered here largely because of agave utilization quite similar to that of the Southwest.

Baegert, a German missionary to Baja California, published in 1773 a book describing the peninsula and its original inhabitants. His mission was located under the twenty-fifth degree and twelve leagues distant from the Pacific Coast. He wrote of the natives using mescal for food and of the existence of many kinds of the plant in that country, not all of which were edible. The preparation of the food required much time and labor. The roots (probably crowns) were roasted for some hours in a strong fire, then buried in groups of twelve to twenty in the ground and well covered with hot stones, hot ashes, and earth. The crowns were thus baked for about twelve hours, and when removed from the pit were of yellowish color, quite tender

and palatable. He observed that the product acted at first as a purgative on persons who were not accustomed to it, and also left the throat rough for a few hours after eating (3:363, 366). Similarly Kino (15:1, 353), in the latter part of the seventeenth century, wrote that the Guimies, and Edues or Laimones Indians of the peninsula did not cultivate such plants as maize and beans, but that their food was game, deer, hare, mountain goat, pitahaya, tuna, mescal, and other wild fruits. Similarly, the Cochimi, in the region of the Bahia de San Geronimo and Port San Quintín, pit-roasted agave for food (14:75; 32:3rd ser., I, 17). One of the species used was evidently *A. Goldmaniana*.

Meigs (97:16-8, 41), writing of the Dominican missions in the northern part of Baja California, observed that cultivation of the soil was not practiced by Indians anywhere west of the Colorado River lowlands prior to the coming of Europeans. Also that Indian economy was entirely of the "gathering" type, the principal vegetable source of food being several species of *Agave*, which were rather well distributed throughout the southern California-northern Baja California area except in the western half of the Alamo region. The Alamo region lies west and north of the San Pedro Martír Sierra, but does not extend to the coast, and is a country of rough hills and mountains, interspersed with broad valleys, basins, and smooth plains. Lying west of the Alamo region is the Terrace region, which extends to the coast and is characterized by a series of mesas which rise in broad steps from the sea level to an altitude of more than 2,000 feet. These marine terraces fringe the Alamo region in almost continuous, roughly parallel strips. In most places these terraces are uninterrupted by mountains, but from San Vicente to Socorro a broken mountain chain, parallel with the coast, breaks the terraces into a seaward strip and a series of connected landward reëntnants behind the mountain barriers.

The mission system of the Californias, beginning with the foundation of Loreto in 1697, gradually grew under the

efforts of the Jesuits, until it included the entire Peninsula as far north as Santa María. In 1768, Franciscans replaced Jesuits as directors of the Californian establishments. The first mission founded by these Franciscans, San Fernando de Velicatá, only slightly extended the area governed by their predecessors. Instead of gradually continuing north, the Franciscans organized their second mission, San Diego, a great distance to the north, leaving the intervening gap open. The Dominicans reached Northern Baja California in 1773 and naturally established missions in the more populous centers (97:1-5, 12), but eventually gave up the peninsula in favor of the Dominicans.

On the mesas in the Terrace region, the southern part of which seems to have been well populated, was an abundance of mescal, and the roasted crowns constituted a principal food source for the Indian population (97:18). One of the species abundantly utilized was *A. Shawii* Trel., which extends from the international boundary almost to San Quintín, and which Shreve (129:262) lists as among the dominant plants in the northernmost part of the desert on the Pacific Coast of Baja California. Also utilized was *A. deserti* Engelm., which ranges southward from the basal slopes of the mountains in southeastern California to the desert mountains of Baja California and is common on the Alamo Plain (54:318).

Meigs (97:54, 58) observed that in the Terrace Region, in the vicinity of Rosario, the "valley chamiso" association merges at the valley sides into the "mescal chamiso," in which agave is dominant. Here, even in good years, parties were sent out regularly to gather mescal, and this constituted a supplementary food. While one cannot be positive of the identification of the species, the location would seem to indicate that *A. Shawii* was one of the important ones.

Sauer and Meigs (123:292), writing of the ruins of the Mission San Fernando de Velicatá on approximately the thirtieth parallel in Lower California, near the northern limit of the San Borja Desert, noted that the Indians in that

vicinity formerly roasted the crowns of agave as an important food and Serra (125:405-06) recounted, in 1769, that these Indians were living on roasted agave and fish.

In the vicinity of the Santa Domingo Mission, north of San Quintín Bay, the high mesa tops are covered with a modified mescal chamiso association, less xerophytic than that at Rosario, in which mescal is one of the principal plants. However, on the San Quintín Plain, San Ramón Valley, and Camalu Mesa, mescal is, on the whole, rather scarce, and perhaps as suggested by Sauer and Meigs (123:274) for the San Fernando area, Indian food requirements have thinned out the agave. At any rate the San Quintín area was originally one of the most densely settled parts of Baja California (97:70).

Similarly, farther to the north, mescal abounds within five miles of the coast in the vicinity of San Vicente, and constituted a source of food for the Indians in that region (97:86). Farther inland and more to the north, in the vicinity of Santa Catalina Mission, roasted agave crowns were also a staple food, as on the coast (97:121).

Meigs (97:157) points out that whatever else the missions in northern Baja California may have handed down, they left an area nearly cleared of Indians and prepared for unopposed occupancy by settlers. Thus, systematic exploitation of such wild food products as mescal is now carried on only in the region still predominantly occupied by Indians, namely in the Santa Catalina and Guadalupe mission areas.

Mescal pits are very poorly defined as a rule on the Pacific side of northern Baja California and extreme southern California. Moreover, the technique of preparation and nature of the implements used are little known. Based on the archaeological data, it seems the heated rocks of the pit were insulated by a layer of agave to prevent charring, and the pit roofed over with a layer of dirt.

On the west side of the Colorado Desert, on the east slopes of the desert mountains, is a north-south belt of *Agave deserti*. This begins on the north in the San Jacinto

Mountains and follows the desert slope of the Peninsular Range southward to an unknown distance below the international boundary. Wherever this species occurs in this area, mescal pits are very common, and they have been traced as far south as the latitude of Punta San Fermin on the Gulf of California. As indicated above, edible species of *Agave* occur throughout the peninsula and on the Pacific and Gulf islands, and mescal pits have been found on the large Gulf islands.¹¹

AGAVE AS A SOURCE OF BEVERAGE

In addition to the food product known as mescal, certain Indian tribes prepared from agave an alcoholic beverage known also as mescal. Among the Mescalero and Chiricahua Apache, the agave crowns were roasted as described above, then the inner portion cut into pieces, pounded until soft, and the pulp placed in a pouch made of animal hide. This was buried in the ground where it was usually allowed to remain for two days, although the Indians claimed that the longer it was buried the better it became. When removed from the ground, the juice was squeezed from the pulp into a container and allowed to ferment for two or three days, when it was ready for use. Thus prepared, the drink was quite potent, and occasionally an Apache would allow the juice to spoil (change to a high percentage of acetic acid) before getting drunk on it. Cremony (29:217), in 1868, reported that the Apache residing on the headwaters of the Gila River, and the Mescalero and Jicarilla Apache made a drink by macerating the mescal root (probably the crown) in water and allowing the mixture to ferment for several days, after which the liquid was boiled down to produce a strong intoxicating beverage.

The Apache, in the Fort Apache region of Arizona, prepared an intoxicating beverage from the crown of the plant. The crowns were pit-baked for about fifteen days, and when thoroughly cooked this semi-gelatinous mass was crushed,

11. Dr. Malcolm J. Rogers, personal correspondence under date of Nov. 23, 1938.

the juice collected and allowed to ferment, thus producing an intoxicating beverage (116:293-94, 298). The White Mountain Apache also prepared an alcoholic beverage from agave, the flower stalk usually being used for this purpose (115:145-46; 4:58).

Palmer (107:406) recorded that the western Apache, as well as the Papago, prepared an alcoholic drink from roasted agave crowns. They were cut into small pieces and placed in hide containers or earthen jars with water to ferment, and after a week the fermented liquid was distilled. It has been impossible to confirm this observation of distillation among the Indians mentioned. Although the Papago did ferment agave to produce an alcoholic beverage, and at times secured mescal and sotol from Mexico, the study of these people by Castetter and Underhill failed to reveal any practice of distillation even in post-Spanish times (72:28; 88:93). Pattie (139:99), in the early part of the nineteenth century, found the Indians of the headwaters of the Gila River pit-roasting agave and then fermenting it to make an alcoholic beverage. The Gila Pima often made an intoxicating beverage by fermenting agave, although the product was not distilled, and this seems to represent the northwest limit of the use of alcoholic beverages (85:46; 121:175). Moreover, the Mescalero and Chiricahua Apache, at least, seem never to have distilled fermented agave or sotol juice or any other alcoholic beverage (21:53). In fact, distillation of any fermented beverage aboriginally evidently never took place in the Southwest, an opinion supported by Hodge (67:I, 846).

The Havasupai, Yavapai, White Mountain Apache, and Maricopa dried mescal in large cakes on a layer of sticks and made a decoction of the dried product (132:106, 120; 30:I, 18-9), while the Walapai mixed it with water to form a beverage, or boiled and ate it (86:49). The Kaibab ground dried, roasted agave leaves to meal, which they mixed with cold water to make a beverage. They also soaked portions of roasted crowns in water, squeezed them in the hand,

mixed the product with tansy mustard (*Sophia*) and drank it.¹ The Southeastern Yavapai (50:209, 212) ground mescal with walnuts and squawberries (*Rhus Emoryi*) as the basis of a beverage, while the Northeastern Yavapai mashed squawberries and mixed them with mescal syrup to make a drink (52:257). The Coyotero Apache made a syrup of roasted agave (109:170). Among the Maricopa, mescal was not used for fermented drinks as was done by the White Mountain Apache, who fermented the flower stalk (133:58; 54, 158). The Zuñi formerly made an intoxicating beverage from the fermented juice of agave, but this practice has long been discontinued (31:635).

Perez de Ribas (112:8-9, 237), writing as early as 1645 of the chronic intemperance of all the Indians of Sonora and Sinaloa, observed that one of the materials fermented to make an alcoholic beverage was the pulpy leaf of the silver mescal (species undeterminable). Alegre (1:I, 232) observed the same for the Sinaloa, saying "De todas estas plantas, y principalmente del maguey, destilabon vinos ó licores fuertes para sus solemnidades, y celebracion de sus victorias." This reference to distillation is doubtless not aboriginal. The Piastla and Acaxee of Sinaloa are also reported as having used maguey as a source of alcoholic beverage (pulque) (74:II, 451; 1:I, 395, 401; 112:471-72), and in this same connection the author of the *Rudo Ensayo* wrote in 1763 of a sort of "rum" being made from the leaf stalks of a species of mescal in the Opata country of Sonora. It was made by mashing the leaves and steeping them in water. A similar situation was reported in the "Documentos para la Historia de Mexico" (32:3rd ser. (4) 523). Evidently *A. lechuguilla* was similarly used by the Opata and contained a greater quantity of pulp than the other species (121:151-52). Pfefferkorn (113:I, 92-5; II, 66-7), wrote in 1794-95 of the tendency on the part of the Sonoran Indians to use alcoholic drinks extensively. Their native drinks were fermented maize, tuna, and pitahaya fruits, with no

1. Dr. Isabel Kelly, personal correspondence under date of Sept. 8, 1938.

knowledge of any other. By contact with the Spaniards, however, they learned to know distilled mescal, and even among the Opata and Eudebes there were individuals who learned from the Spaniards to distill mescal, but grain and grape distillation were unknown to them, the only materials used for distillation being mescal and pomegranate. Since the distillation required equipment, knowledge of the technique, and considerable effort to gather, prepare, and roast agave, Pfefferkorn regarded the use of the distilled product as of little danger to these Indians, even though they had an almost insatiable taste for alcoholic beverages. It is evident from the above that distillation was not aboriginal with these Indians of Sonora.

The Tarahumara, according to Lumholtz, fermented baked agave crowns, of several species, to make an intoxicating drink. The baked crowns were placed in water in natural pockets or hollows in rocks, without covering, the root of a certain plant known as *frijolillo* being added as a ferment. After two days the juice was wrung out in a blanket. An intoxicating drink, made from a species of agave was, according to Tarahumara tradition, the first plant God created, and the beverage made from it was considered as indispensable to certain ceremonies. It was also of importance among the Tepehuanes (87:I, 256; 32:4th ser. III, 219; 72:28). More recently Bennett and Zingg observed among the Tarahumara that two species of *Agave*, one of them *A. Schottii*, were used to make alcoholic drinks in the lowlands where *Agave* is plentiful and maize scarce. The crowns were pit-roasted and pounded in a hollow rock with an oak maul. Several ollas of water were added and mixed with the pulp by treading on it with the feet. The mescal pulp was then piled on a framework of sticks over the hollow in the rock and allowed to drain, after which it was twisted in the typical fiber net to free the remaining liquid. The root *gotoko* was pounded and placed in the liquid, possibly as a ferment, and the liquid strained through the basket-sieve into large ollas, boiled for several hours,

cooled, and allowed to ferment four or five days. Often the agave was mixed with maize. Also the bark of *Randia echinocarpa* was sometimes added as a ferment. *A. Patonii*, in addition to the two species mentioned, was used as a source of beverage (11:148-49, 163-64).

Bartlett (8:II, 290-91) wrote in 1854 of observing the Indians of northern Mexico, on his journey from Arispe to the Copper Mines, pit-roasting agave and placing it in leathern bags to ferment, after which it was distilled. There is little likelihood that this practice was aboriginal. Similarly, Bancroft (6:I, 586) writing of northern Mexico said that drunkenness prevailed to a large extent among most of the tribes, their liquors being prepared, among other things, from agave.

The practice of making a fermented beverage from the fresh juice of agave was not pursued in the Southwest as it was and is in making *pulque* in Mexico. This may be attributable to the fact that the native agaves in the Southwest do not yield an abundance of sap as do the larger Mexican species.

AGAVE AS A SOURCE OF FIBER AND WOVEN OBJECTS

The Papago commonly made rough cordage of sotol or agave. In making the kiâhâ, the Papago used agave, and the Pima sotol plants which were either boiled or pit-baked over night, then the pulp scraped away with a deer scapula, leaving the free fiber of a foot or two in length. These dried rolls of fiber were an article of trade between Pima and Papago, and spinning the kiâhâ thread was a social event among Pima women (122:106, 142-43; 79:229). Many years ago, Palmer observed that the Indians of Arizona (and southern California) extensively used agave fiber, prepared by drying the leaves and beating the pulp free from the fiber, or by using fresh leaves which they soaked in water until the rotted pulp fell away from the fiber (107:406). Professor Toumey, of the University of Arizona, wrote of finding in May, 1894, a party of Papago

Indians encamped in the Santa Catalina Mountains, roasting mescal (evidently *A. Schottii* or *A. Palmeri*). In eating the product, the discarded fiber was washed, cleaned, and separated, and twisted into ropes with the aid of rope-twisters. These were pegged to the ground and left to dry for several days (99:62-3).¹

The Northeastern Yavapai used stout mescal fiber rope made from long mescal leaves, preferably dead ones since these had the strongest fibers. The leaves were macerated with a stone, dried for a short time in the sun, bent back and forth to soften the fibers, then sunned again. When sufficiently dry, the waste was shaken off and the fiber utilized. Mescal-fiber string was made by two men working together, on a wooden "spindle," consisting of a stick of desert willow with a crosspiece at one end. Among the Western Yavapai the string was also made on the "spindle," but by one man, although three-ply and two-ply string was rolled on the thigh. Among both tribes mescal-fibre rope was used especially for tying bundles of dried, cooked mescal pads, and for tying up slain deer. The Northeastern Yavapai used the rope for a pack strap, while among the Western group the hunter carried rope wound around his waist (52:245, 266, 281). The Southeastern Yavapai at times also made ropes of dead mescal-leaf fiber and these were thrown over the shoulder for carrying the gourd water bottles (50:218). The Walapai made large ropes by twisting four or eight rovings of fiber obtained from the dried tips of mescal (*A. utahensis*). The fibers were freed by pounding, then soaked in water for a day or so, and rolled into strands on the thigh. Rope made from these strands was further twisted by means of sticks inserted in loops in the cord. This gave the appearance of being braided (86:81-4). Among the Cocopa, near the Sierra Cucopas in Baja California, mescal fiber (*A. deserti*) was used for cordage and stout ropes (51:275, 277; 22:203-04).

1. The rope-twister was probably not aboriginal. The native method seems to have been solely that of rolling the fibers together on the thigh.

The Papago utilized sotol or agave for rough cordage, and this two-ply string was the regular cord for making both the women's carrying net and the men's carrying bag. The carrying net, no longer used, was of lace coiling, made in the shape of an inverted truncate cone, the stitch being called by Mason "coil without foundation" (95:248; 88:66). The frame of the carrying net was so constructed that the rear portion of it could rest flat against the woman's back, protected from the net by a matting or apron of sotol fiber, while she supported the front poles of the frame by a plaited headband of sotol or sometimes of agave fiber. A four-ply sotol, or at times agave, cord was used to attach the carrying net to the headband (20:55, 61-2; 95:520-21; 79:138). The above applies equally to the Pima except that the net and the well-made cord attaching the net to the headband were usually of sotol fiber (122:142-43; 94:469). A bag of knotted netting without a frame served the Papago men for carrying deer meat. This was usually of sotol fiber, but might be fiber of agave. After advent of the horse, these nets were used as saddle bags, or two of these bags, stuffed with grass, formed a saddle (20:55, 61-2). The Pima, however, made nets of sotol fiber for carrying bulky objects upon either pack or riding saddles (122:113). Among the Maricopa heavy ropes were made to tie up firewood and the like, and the strongest were of agave fiber. Bundles of dried agave leaves were pounded, the softer tissue shaken out, and the fibers rolled into rope (133:127).

The Mescalero and Chiricahua Apache also used long strips of agave leaves for binding material (21:19), while the Mohave made a carrying basket largely of agave fiber (94:468); the Maricopa dancer sometimes wore a strong belt of agave fiber rope (133:232), but they also made fiber ropes for other purposes (132:319).

The weft of wrapped weaving was sometimes made by the Papago of split leaves for coarse objects like the house frame (20:53). Men always made the expeditions

for collecting agave leaves and fiber, the cutting and roasting of which was heavy work.

The Papago used for a combination hair brush and comb the fibers of agave, sometimes of sotol (20:55; 79:147), while Pima women now make hair brushes of sotol fiber, *Yucca baccata* fiber, and *Agave lechuguilla* fiber if obtainable (122:166-67; 79:147). For a brush six inches long, the fibers were cut twelve inches. They were tied a little to one side of the middle and the fibers of the longer section turned back over the binding so that their ends formed one bunch with those of the shorter section. Another binding was then put on at the handle end of the brush to hold down these long fibers. The Havasupai also made hair brushes from the stiff fibers of mescal leaves (*A. utahensis*) (132:193), while the Walapai hairbrush, used chiefly by women, was made of a small bunch of dried mescal leaf fibers (*A. utahensis*) about a foot long, doubled over in the middle and tied there, then covered with piñon pitch. A buckskin sack was slipped over as a sort of cover and handle (86:104, 109-10). The Mescalero and Chiricahua Apache, after the coming of the horse, used grooming brushes of mescal and sotol leaves (21:19).

Since the Papago had little cotton or weaving, they supplied the lack of fabrics partly by plaited articles made of sotol (*Dasyllirion Wheeleri*), such as the large tough sleeping mats, about six by three feet, which could be rolled up and carried about. Cradle mats were also made of agave or of sotol (20:55). According to Russell (122:147) sleeping mats are now made of agave by the Papago for trade with the Pima. The Pima, after the advent of the horse, utilized sotol fiber in saddle blankets (122:105), and the Walapai made mats for drying baked mescal by twisting together dry mescal flower stalks (*A. utahensis*) (86:83). Although the Mohave made little use of agave as a source of food, because of its scarcity in their country, that it was well known to them is indicated by the fact that a Mohave chief was called *Mescal*. These Indians did make good cord from

the leaves of the plant as well as an agave fiber net (117:Pt. III, p. 17, 52; 85:46).

In a series of excavations in Canyon Creek on the present Fort Apache Indian Reservation in east central Arizona, Haury found the range of cutting dates of timbers in the ruins was 1326-48 A. D., and thinks that by about 1350 the site and the whole region were abandoned, the next arrival on the scene being the Apache. From these ruins, Haury described (60:69-70) two cradles in which the framework consisted of two parallel slats made of split agave stalk. He also found that the sharp ends of agave leaves, which also provided fibers for cordage, were ingeniously adapted as needles. To prepare cord, the outer covering and the pulp of the leaf were freed from the fibers, but the spine was not detached. When the fibers were twisted into the required twine, it was ready for use with the fiber attached, and when the cord was exhausted the point was cut off and discarded (60:85).

Fewkes (43:629-30), writing of objects found in excavations at Awatobi in Arizona, noted that fragments of both cotton and agave were secured, and that a woven rope of agave fiber and many charred strings of the same material were found in a niche in the wall of a house. He also found ropes of agave fiber in several rooms on his expedition to the cliff villages of the Red Rock Country, Arizona (40:564, 574), and a study of two other ruins in the Red Rock Country in the Verde Valley of northern Arizona, in some of the rooms of Palatki, revealed fragments of agave leaves, agave fiber, nets of agave fiber, also cloth of cotton and agave (41:269, 270, 272). He wrote in 1896 that the pueblo ruins near Winslow, Arizona, yielded evidence that these people made garments of agave (42:534), while in his field work on the ruins at Mesa Verde National Park he found a pottery-rest made of agave fiber core wound with feathered string (46:61). Similarly, Fewkes (45:148) reports that at Casa Grande the most common fiber used in weaving was agave, a combination

of agave and cotton fiber also being in rather general use. In this same connection, Hough (69:24) found numerous mescal quids as cave refuse in the Gila-Salt river valleys. Such quids were evidently remains of scraped and chewed mescal leaves so treated in an effort to yield fiber. As seen above, it was not uncommon for southwestern Indian peoples to chew the fibrous portions of roasted agave to extract the edible material, and use the remaining fiber for cordage. The numerous quids found in ruins may represent the discarded fiber from baked mescal, remains of leaves deliberately scraped and chewed to yield fiber, or a combination of both. Harrington (58:116) observed in Paiute Cave, near Overton, Nevada, a mass of coarse fiber, evidently the remains of some ancient Pueblo's quid of cooked mescal.

The ancient Hopi commonly made ceremonial masks of agave fiber which was plaited on "forms," and H. R. Voth has secured one or more modern specimens of these forms from Oraibi (44:608).

Setzler (128) reported on a prehistoric cave culture in southwestern Texas, comprising eight cave excavations in the Big Bend region, bounded on the east by the Pecos River, on the north by the Panhandle and New Mexico, on the west and south by the Rio Grande and the states of Coahuila and Chihuahua, Mexico. He concluded that the caves were used only as temporary shelters by a semi-nomadic people who cultivated maize, beans, and pumpkins extensively in the western part of the area, although no evidence of maize was found in the Pecos River part of the Big Bend. These people depended to a large extent upon the fauna, berries, and yucca. The excavations yielded an abundance of loose lechuguilla (*A. lechuguilla*) and apocynum fiber cordage. Lechuguilla cordage was used as warp elements on some of the sandals, and fur robes were made by twisting narrow strips of fur around a lechuguilla cord foundation. This same investigator (126:56) found in his excavations of prehistoric cave dweller sites in the Chisos

Mountains, Texas, a great variety of lechuguilla and apocynum cordage, while excavations in the Pecos River Valley (127) yielded large nets wrapped around a human body and tied with lechuguilla cordage and split leaves, as well as similar cordage used for apron strings. In this connection Martin (91:42-3, 54-5, 59), excavating caves in the vicinity of Shumla in southwestern Texas, found abundant twisted lechuguilla cordage, sandal tiecords of lechuguilla strips, short twisted cords of single lechuguilla leaves, butts of the same leaves used as paint brushes, fish stringers of the butts of such leaves, basketry materials, and braids of lechuguilla. Also a great abundance of lechuguilla fiber cord, a net of the same material, bundles, numerous agave knots, braids, matting, and bundles of split lechuguilla leaves constituting coiled basket foundations, were recovered by Pearce and Jackson from a prehistoric rock shelter in Val Verde County, Texas (111:65-66, 89-92, 103, 115). Similarly, Fletcher (47:39-40) reported from the Bee Cave Shelter in west Texas fiber remains of *A. lechuguilla* that had been used for clothing, as well as bunches and bundles of the same fiber, the use of which is undeterminable. Jackson (75:157) found a fragment of fabric in his explorations in Culberson County, Texas, with the warp of grass, the weft a two-ply cord of lechuguilla fiber. Likewise, Holden (68:61-2) found in his excavation of Murrah Cave along the lower Pecos River, in Val Verde County, Texas, numerous pieces of lechuguilla fiber cordage, as well as a net with a lechuguilla leaf blade forming the center, while Mera (98:47) believes the numerous matted masses of fiber, so prominent a feature in his cave excavations in the Guadalupe Mountains, are very probably derived from the breaking down of mescal quids.

The "Quemaya" visited by Anza, Garcés, and Font in 1775, wore sandals of maguey (agave) fiber. They descended from their own territory, which began in the mountains at latitude 33°08', some one hundred miles to the northwest of the mouth of New River in northeastern Baja California,

and extended as far north as San Diego, to eat calabashes and other fruits of the river (25:I, 165-66, 196-97). Gifford observes that these people were the Eastern Diegueños, rather than the Kamia of Imperial Valley, although both designated themselves Kamia (49:2). Sandals made of agave were not nearly so common in the Southwest as has been supposed, most of the sandals reported as having been made of agave being in reality yucca. According to Mason (94:359) the sandal soles of the cliff dwellers and New Mexican mound and cave men were of *Apocynum*, species of *Yucca*, and species of *Agave*. Peoples such as the North-eastern and Western Yavapai, Yuma, and Kamia, never made sandals of agave (52:275; 49:84). However, Spier² reported the making of mescal fiber sandals, as well as a number of other objects from this fiber, among the Southern Diegueño. Sayles (124:108, pl. XXVI, XXVII) reports that the Pecos River Cave Dwellers, the Big Bend Cave Dwellers, and the Hueco Cave Dwellers made sandals, as well as other miscellaneous fiber material, of *A. lechuguilla*, sotol, and yucca leaves, while Setzler (128) found lechuguilla cordage used as a warp element in sandals recovered from caves in southwestern Texas. Similarly, Jackson (75:154) in his exploration of sites in Culberson County, Texas, recovered sandals of split leaves of *A. lechuguilla*, as did Martin (91:69-73) in excavating caves near Shumla, Texas, and Pearce and Jackson (111:34, 96, 101) secured, from a prehistoric rock shelter in Val Verde County, the framework of a sandal made of lechuguilla leaves, as well as many made wholly of leaves of lechuguilla, some of which had tie strings of fiber of the same material. The Tarahumara of northern Mexico also made sandals of agave fiber (11:96, 358, 377).

Headrings used among the Pima were supposed to have been adopted from the Papago. These rings supported round-bottomed water jars and other heavy burdens upon the heads of Pima women. These should be classed as twined

2. Leslie Spier, *Southern Diegueño Customs*, Univ. Cal. Pubs. in Amer. Arch. & Ethnol. 20:297-358. 1923.

basketry, and were usually made of agave or sotol leaves (122:113; 20:55). At present sotol is the only plant in the entire Papago region employed for plaiting sleeping mats, headrings, headbands, and kiâhâ mats (79:138).

The Pima made rectangular trinket baskets of agave leaves, although these were usually obtained from the Papago and Apache, and medicine baskets of the same material and style as the trinket baskets (122:93, 114, 134, 145). The Pima commonly obtained baskets made of agave leaves from the Papago by barter (122:93).

Hrdlička (70:73) observed that Opata women made ropes and thongs of both maguey and yucca, from which they made snares for trapping deer and tepary. Tilmas as well were woven from these fibers. Similarly, the Seri commonly made cordage for purposes other than apparel from fiber of mesquite root or agave leaf and stipe, retted in lagoons or barrancas. The supply of agave was considerably limited in their region, hence it was little utilized for food, the use of the plant being confined largely to fiber for making cord, loose baskets, and net (85:44; 96:228-30).

According to Perez de Ribas (112:12, 285, 472, 594), Alegre (1:I, 401, II, 124, 184), and Obregon (104:156, 157, 173) the Acaxee, Sinaloa, Mayo along the Rio Cedro, Pima Bajo, and Tarahumara of northern Mexico wove articles of maguey fiber, although the species are indeterminable. Similarly, Bancroft (6:574, 583) observed that the Tarahumara and Acaxee women had petticoats reaching to their ankles made of soft chamois, cotton, or agave fiber. Also that the Ahomoa, Eudebe, Jova, Yaqui, and Poata wove fabrics out of cotton or agave fiber. In this same connection, the author of the Rudo Ensayo observed that the Opata secured a good thread from the leaves of a species of mescal (121:151). The Tarahumara had blankets and sandals of agave fiber, and headbands of the same fiber have been unearthed in the excavations (11:96, 358, 377). The Cahita (Tehueco, Mayo, and Yaqui) wove rough garments of agave, and at present the fiber is woven into

carrying bags on a loom by the Nahuatl-speaking peoples of Sinaloa.³

Although the native home of *A. cantala* Roxb. (*A. vivipara*) is not known, Rose (120:245-46) reports that it is the most common species seen in west Mexico. It is seen as far north as Guaymas and yields considerable fiber for local consumption in making thread, twine, knitted articles and rude handbags. Also, the Indians of the Sierra Madre Occidental obtain from *A. americana* a fine soft fiber used for thread.

Baegert, writing in 1773 of the Indians of Baja California, observed that they understood how to prepare from the fibers of mescal a white thread which served them for making thread, string, and cord. On these they strung hundreds of small sections of water reed, like beads, and then attached these strings by their ends to a girdle, placing them very close together to form two aprons, one for the front, the other for the rear of the body. Also bags were made from agave fiber (3:354, 361-62). They made sandals of flat pieces of untanned deerskin attached to the feet by coarse strings of mescal passing inside the great toe and around the ankle. The Waicura and Seri both made a net-like carrying bag of agave fiber, while the Cochimi had an agave fiber net hung from the forehead or from a pole to carry children, as well as an agave fiber net for carrying fruit. Agave was also used in Baja California to make fringe-aprons (85:22, 44-5).

MISCELLANEOUS USES OF AGAVE

Bartlett (9:39-40) describes and figures from the San Francisco Mountains a Pueblo II medicine-box made from a section of mescal (*A. utahensis*) stalk, the objects in the box being undoubtedly Puebloan in culture. Another find of a similar box in a Pueblo III burial in Sycamore Canyon, Arizona, indicates this type of box to be rather definitely

3. Dr. D. D. Brand, in 1929-30, observed Nahuatl communities in Sinaloa making cordage, bags, hammocks, etc., of ixtle.

Puebloan. In view of the fact that all other materials found in the cave, with one exception, were P II, it seems that the medicine-box must have been P II also.

Although the Northeastern Yavapai never specifically made armor of mescal slabs, the warriors carried such slabs, which sometimes intercepted enemy arrows, but which they piled in one spot when the fighting began (52:288, 303, 329). The Southeastern Yavapai warrior, however, wore over his buckskin coat an armor made of cooked, pounded mescal, molded and dried into two plates, each about two inches thick. These plates were the width of the body and somewhat pliable, one being worn in front, one behind. Although this type of armor suggests influence from ancient central Mexico, where troops wore quilted cotton armor later adopted for Spanish soldiers in the Southwest, it may have been a Yavapai invention suggested by the transporting of pads of dried mescal for food (50:225).

Some of the Western Apache (107:406; 109:166) mixed the charred portions of roasted agave crown with water to make a fine black paint which they used to blacken their faces. Also the washed dried leaves were smoked. Similarly, among the Havasupai, mescal paint was made from the dried juice which coated the stones in the mescal pit after the crowns were removed. The stones were boiled for a few minutes to remove the black deposit and the liquid poured off and boiled until thickened. Then red paint was stirred in to thicken it further, and the mixture boiled again. When reduced to a doughy consistency, the small quantity obtained was rolled into a ball (132:106). Sienna paint or the dried juice of mescal was applied with a stick or small bundle of yucca fiber rubbed on a lump of paint and moistened with saliva (132:197). The Northeastern Yavapai applied brown mescal syrup as a face and body paint among both sexes (52:277), and the Walapai made brownish dye from burnt mescal (*A. utahensis*). They resemble the Havasupai in their preference for red paint and in their use of the juice of burnt mescal (132:207).

In Indian economy it was frequently found necessary to render some baskets and vessels tight for holding liquids by applying a sort of coating. The Havasupai did this by applying mescal juice or cornmeal mush to their baskets (132:127), while the Western Yavapai caulked their water bottles by boiling pine pitch in water and applying with dry mescal fiber, while the Northeastern Yavapai water-proofed the inside of some of their coiled baskets, used as containers for cold decoctions, with juice from cooked mescal (52:282). Among both Havasupai and Walapai, parching trays and trays intended to hold very fine seeds were coated on the interior with the sticky tissue of mescal, while agave leaves were sometimes crushed in the hands and rubbed over the inside of parching baskets to prevent burning (132:132; 86:50). Mescal juice was used by the San Carlos Apache to render their woven ollas water-tight (119:208).

Among some tribes agave was used as a source of soap, this being especially true of *A. Schottii* and *A. lechugilla* (61:518; 87:243; 99:59; 103:219). *A. Schottii* has marked detergent properties, and the pounded roots when moistened with water lather very freely.

The Apache in the Fort Apache region of Arizona, the San Carlos Apache, and Southeastern Yavapai made a one-stringed violin of a piece of light, hollow wood, preferably a flower stalk of agave (71:488; 50:230; 16:10); the Mes-calero and Chiricahua Apache also made a curious one-stringed fiddle of sotol flower stalk, although this may have been of Spanish origin (21:20). The Walapai made a toy musical instrument of a notched stick or rasp of mescal flower stalk (86:121).¹

Among the Northeastern and Western Yavapai, the buckskin ball used in shinny was stuffed with mescal fiber (52:289).

The Walapai hearth for the fire drill was sometimes made of split mescal stalk (86:48), and agave root was part of the Hopi fire-making apparatus, and incidentally the

1. Dr. Leslie Spier thinks the violins mentioned are probably not aboriginal.

Hopi Agave Society is associated with Nadir (137:1080, 1280). Similarly, Jackson (75:166) unearthed at a site in Culberson County, Texas, an unsplit fire hearth stick of lechuguilla flower stalk, while Setzler (128) recovered from prehistoric caves in the Big Bend region of southwestern Texas a number of split lechuguilla and sotol flower stalks used for small fire hearths, as well as cane tubes containing minute seeds, with one end of the tube closed by the septum of the cane and the other plugged with lechuguilla fibers. Likewise, Fletcher (47:39-40) reported from the Bee Cave Shelter in west Texas, lechuguilla flower stalks, perhaps used as parts of lances, and Roberts (118:9) found spear shafts of agave flower stalks decorated with streamers, balls, and braids of lechuguilla fiber.

Several species of *Agave* are pit-baked and pounded up with water, then used as a common cure for people, fields, and animals among the Tarahumara. The medicine is used alone or in combination with sotol (*Dasylirion* sp.) prepared in the same way (11:165, 238-40, 246, 248, 279, 281). In this same connection, Bancroft (6:I, 589-90) observed that the Indians of Northern Mexico made excellent balsams for curing wounds out of the leaves of maguey and lechuguilla. Among the Opata, if bleeding resulted after childbirth, a cloth dipped into warm mescal wine was introduced into the vagina as far as possible, and this was sometimes regarded as effective in stopping the bleeding (70:81). In Arizona the younger agave leaves are often chewed as a tonic, which may simply be a method of replacing a vitamin lack. Compresses are also made out of wet macerated pulp and used on local infections or bound on the chest to relieve congestion (103:219).

Pfefferkorn (113:I, 90-5), writing of the Indians of Sonora, observed that a number of the native plants were used medicinally, although he wrote only of the ones which he knew best. The leaves of the mescal were commonly used as an antiscorbutic by baking in hot ashes, and strongly pressing to remove the juice. Although bitter and tasteless

when drunk, this cured the patient in a few days. The root was also regarded as a splendid cure for wounds. A cloth, soaked in the juice of the root was placed on the wound, and although somewhat painful at first, brought quick relief. Pfefferkorn noted that distilled mescal strengthened the stomach, stimulated the appetite, and aided digestion. He reported that it cured him of a prolonged stomach ailment which had prevented him from taking any appreciable amount of food for a period of six months.

SUMMARY

In the Southwest, agave was used for a considerable variety of purposes: food, alcoholic and non-alcoholic beverages, syrup, fiber, cordage, nets, bags, basketry, mats, blankets, clothing (particularly aprons), sandals, pottery rests, headrings, braids and other miscellaneous woven objects, hair brushes, paint brushes, needle and thread, fish stringers, armor, lances, fire hearths, musical instruments, paint, a gum-like caulking material, soap, for smoking, medicine, and ceremonial objects.

Of these uses, food and fiber were most important and most widespread. The use of agave as a source of alcoholic beverage was not nearly so important as in central and southern Mexico, and the only Southwestern peoples who fermented agave to any appreciable extent were the Apache, Papago, Pima, and most of the tribes of northern Mexico. However, most of the references to tribes in that portion of the Southwest which lies in Mexico apply to post-Columbian distillation.

Agave fiber, including various objects made from it, was quite generally employed throughout the entire Southwest, except by the Pueblos, (the Hopi did use it somewhat), Navaho, Mohave, Yuma, Cocopa who used it occasionally, and Maricopa. However, clothing and sandals of agave were not nearly so common as has been thought, inasmuch as most references to agave garments apply in reality to *Yucca*. Northern Mexico, including parts of Baja California, is the only part of the Southwest where agave clothing was used extensively. Sandals are reported as having been made of agave only among the Diegueño of Southern California, in west Texas and the Guadalupe Mountain area of New Mexico, and among the Tarahumara of Northern Mexico. However, sandal tiecords of agave were more widely distributed. Sandals were usually made of yucca.

The most important use of agave in the Southwest was for food. As regards any wild plant, it is extremely worthwhile to know the extent of correlation between its distribution and the degree of utilization. Spier (132:119) has mentioned this in connection with agave, at the same time rightly suggesting that pit-roasting of the plant was probably absent from the Basin and Plains, and from California except among the southern desert tribes. In this same connection, Beals (10:102-3) is of the opinion that the use of the plant extended to the farthest limits of its range, and that pit-roasting of agave quite likely extended everywhere the plant was used. Moreover, he is of the opinion that agave was evidently cultivated, particularly in the western part of northern Mexico, perhaps as far north as the Pima Bajo, although the evidence is conflicting.

For several reasons, however, the utilization of agave cannot be expected to be coextensive with its distribution: (a) some species of the genus are inedible or of so little food value as to be useless for pit-baking (b) in some areas, the presence of an abundant food supply, particularly where cultivation was practiced, made reliance upon agave unnecessary or of minor importance (c) agave might be distributed over an area but the scarcity of the plant be such as to render its utilization impracticable.

Agave in the Southwest is essentially a plant of the lower mountain and foothill areas. A composite map of its distribution shows the genus to occur through much of the southern portion of California, southward throughout most of Baja California, and in the large Gulf and Pacific coast islands along the peninsula. One species, *A. utahensis*, is found in southern Nevada and the extreme southwest corner of Utah. The genus is rather common throughout all parts of the state of Arizona except the northeast quadrant, and even there it does occur sparsely in some of the higher stretches. Going eastward, *Agave* is found in fair abundance in the western and southwestern parts of New Mexico, ranging from about 107°30' west to a little north of

34°, as well as in the San Andres, Sacramento, Tortugas, Organ, Las Cornudas, and Guadalupe mountains, and the canyons of the more mountainous parts of the present Mescalero Apache Reservation. The genus also abounds in western Texas. *Agave* is well represented in species and numbers in the higher portions of the north Mexican states, but it is impossible to give details of their distribution because of the present state of knowledge.

As regards utilization of agave within the limits of distribution described above, the evidence indicates the following: mescal was most extensively used by the nomadic and semi-nomadic tribes of the Southwest (Navaho excepted), being of outstanding importance to all the Apache, except the Jicarilla within whose ancient range the plant did not occur. It played a very important part in the economy of the early inhabitants of the Big Bend country, a large portion of the Trans-Pecos region of west Texas, and the Sacramento-Guadalupe Mountain area of New Mexico. *A. utahensis* grows in the western part of the present Navaho Reservation, and is reported as formerly having occurred sparsely near Lupton, Arizona. These Indians did sometimes bring mescal from the Grand Canyon country and at times secured it by trade from other groups, but on the whole it was of very little significance in their economy. The Walapai in northwestern Arizona used mescal extensively, while it constituted the most important food plant for all the Yavapai, a people who dwelled largely in west central Arizona. The Havasupai, relatives and neighbors of the Walapai, but essentially an agricultural people, utilized to a fair extent *A. utahensis* which grew on the benches of Cataract and Grand Canyons.

Of the Yuman tribes of the Colorado and Gila rivers, the Mohave and Yuma used agave very little as it did not grow in their immediate vicinity, and their only means of obtaining it was by barter with the Western Yavapai, or occasionally the Chemehuevi. Our own field studies fail to confirm Hodge's (67:I, 846) statement that mescal was a

valuable food of the Mohave and Yuma. The Cocopa, particularly those south of the present international boundary, did pit-bake *A. deserti* to some extent; however, the Maricopa made little use of mescal since it did not grow in their locality, but did sometimes secure the baked product from the Papago. The Kamia of Imperial Valley, a people marginal to the Southwest, secured mescal by trade, but never baked it; it was, however, baked by the Southern Diegueño.

A number of bands of the Paiute, a people of Basin Shoshonean culture, pit-baked *A. utahensis* as a food, the Kaibab perhaps employing it more than any other band. Similarly, the Chemehuevi, who formerly ranged in eastern San Bernardino County, California, rather extensively utilized *A. utahensis*.

Considering now the Papago, we find the eastern part of their home in southern Arizona and northern Sonora supported *A. Schottii* and *A. Palmeri*, the central and western portions *A. deserti*, while *A. americana* was to be found in places south of the present international boundary. These people pit-roasted mescal to some extent, many of them securing it by trade, as the labor and hardship entailed in getting the plant from the higher levels of certain mountains in southern Arizona greatly restricted its use among them. Agave was and is eaten by the Papago of Sonora but it has been impossible to ascertain the extent of such utilization. Although baked mescal was a favorite food of all the Pima, the Pima Alto utilized it largely in time of food shortage as it did not grow in their immediate neighborhood, and to go in search of it subjected them to attack by "the enemy," the Apache. Little is known of the extent of agave utilization among the Pima Bajo, but one Spanish account published in 1645 relates that they cultivated the plant.

There is a distinct parallelism between the lack of information bearing on the distribution and the utilization of agave in northern Mexico. Hence, because of incomplete knowledge, it is at present impossible to reconstruct the

aboriginal picture for that area. We do know that mescal was a common food throughout the length of the Californian Peninsula, and in parts of Sinaloa, Coahuila, Sonora, and Chihuahua. More specifically, the Jumano, Suma, Concho, Opata, Cabri, Otomoaco, Mayo, Yaqui, and Tarahumara employed the plant as food, although the extent of utilization is indeterminate.

As *Agave* does not grow within the present Pueblo portion of the Southwest, it was little used by these tribes. The Zuni used the plant for food (and drink) most extensively among the Pueblos, although the Hopi occasionally obtained it by trade. No other Pueblo people seems to have had it, except by sporadic trade with outlying tribes.

As regards the utilization of agave for food in the Southwest, we may say in brief that the only peoples who did not use mescal rather extensively for food were the Pueblos, Navaho, Pima, Papago, Mohave, Yuma, Maricopa, and some of the Cocopa, and this because of its scarcity or absence in their territory. The only people who could have been expected to employ it more widely were the Havasupai, the reason for its limited use by them being that they were essentially an agricultural tribe who ordinarily did not need to rely upon wild products.

Indications of ancient utilization of *Agave* in the Southwest are found in the occurrence of mescal pits, midden circles, or cave remains in the Trans-Pecos—Big Bend region of west Texas, and the Guadalupe, Sacramento, Organ, and San Andres mountain areas of southern New Mexico. Likewise, mescal pits occur in extreme southwestern New Mexico and are common in central, east central, parts of south central, and southeastern Arizona, as in the Verde Valley, in the vicinity of Tempe, Phoenix, Mesa, Superstition Mountain, Casa Grande, and elsewhere in the Salt and Gila river valleys. They occur abundantly in the Grand Canyon of the northern part of the state, all along the canyon westward to Boulder City. In the western part of the state, such pits have been found in the Harcuvar, S. and

H., and Harquahala mountains. Apart from the mescal pits found in the vicinity of Phoenix, they are not very common in the southwestern portion of the state and in northwestern Sonora, having been reported only from just east of the Tinajas Altas and Cabeza Prieta mountains.

Mescal pits are common on the east slopes of the desert mountains of southern California and northern Baja California. These extend from the San Jacinto Mountains on the north to at least as far south as the latitude of Punta San Fermin on the Gulf of California, and are also found on the large Gulf Islands. One of the areas of greatest concentration of such pits is in the desert mountains of eastern San Diego County, California. Going northward, abundant mescal pits are similarly found in the Providence Mountains of eastern San Bernardino County, as well as in the Charleston Mountains of southern Nevada, while mescal quids have been recovered from Gypsum and Paiute caves in the southern part of this state.

Although agave was extensively utilized on the Pacific slope from the vicinity of San Diego southward for an undetermined distance, but certainly as far as San Quintín, mescal pits as a rule are very poorly defined in this region.

The most important species of *Agave* known to have been utilized in the Southwest were: *A. utahensis* in extreme southwestern Utah, southern Nevada, northern Arizona, and a portion of southeastern California; *A. Couesii* in central Arizona; *A. Palmeri* and *A. Parryi* in southeastern Arizona and southwestern New Mexico; *A. deserti* in southwestern Arizona, southern California and southward into northern Baja California. Although agave was a very important food in Baja California, comparatively little is known of the species used. However, aside from *A. deserti*, *A. Goldmaniana* and *A. Shawii* are known to have been important. As regards the rest of northern Mexico, *A. Patonii*, *A. Schottii*, and *A. lechuguilla* were rather extensively utilized, although there were doubtless others. *A. neomexicana*

was used to a considerable extent in parts of southern New Mexico and southwestern Texas, while *A. Havardiana* and *A. lechuguilla* were of marked significance in western Texas.

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