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Willis Harvey Bell

Edward Franklin Castetter

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To David C. Ekkele  
with the compliments of  
E. Castetter

The UNIVERSITY of NEW MEXICO  
BULLETIN

ETHNOBIOLOGICAL STUDIES IN  
THE AMERICAN SOUTHWEST

VII. *The Utilization of Yucca, Sotol, and  
Beargrass by the Aborigines in the  
American Southwest*



By

WILLIS H. BELL  
*Associate Professor of Biology*

and

EDWARD F. CASTETTER  
*Professor of Biology*

UNIVERSITY OF NEW MEXICO

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# The University of New Mexico Bulletin

Ethnobiological Studies in  
the American Southwest

## *VII. The Utilization of Yucca, Sotol, and Beargrass by the Aborigines in the American Southwest*



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

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THE UTILIZATION OF YUCCA, SOTOL, AND  
BEARGRASS BY THE ABORIGINES IN THE  
AMERICAN SOUTHWEST

INTRODUCTION

The various species of the genus *Yucca* inhabit large areas of the arid Southwest and southward far into Mexico, the Rocky Mountain region and the Great Plains as far north as the Dakotas, as well as xerophytic sites in the more humid southeastern states. Within the Southwest, yucca ranked foremost among the numerous wild plants entering into the economy of the aborigines, and had almost as great utility among certain tribes bordering on this area. It owed its importance to the great diversity of uses to which it was adaptable as well as to its naturally widespread occurrence.

The edible fruits of some of the baccate species, as well as the young flower spikes of most species, made an agreeable addition to the diet. The root and stem were macerated to produce one of the common soaps known to the prehistoric peoples of the Southwest, and Hodge states that the Kiowa added the roots to a preparation used in the tanning of skins (75: II, 1003). The dried flower stalks furnished an excellent material for the manufacture of fire drills, and thin strips of leaf were employed as brushes for decorating pottery, masks, tablets, dolls, prayer sticks, etc. The leaves were employed in the basketry industry to produce trays, plates, bowls, and mats for household use as well as for enshrouding the dead. The most useful product to the Indian was fiber which might be used in straight bunches or bundles or twisted into cord for making nets, snares, bowstrings, sandals, cloth, and the warp for rabbit skin and feather robes. Where coarser cordage was to be employed, whole or split leaves might be used, as in sewing or tying material.

Doubtless as a corollary of its economic importance, one finds the use of the plant penetrating deeply into ancient

ceremonial life. Due to the limits within which it has been thought well to confine this paper, the great ceremonial import of the plant as seen among such tribes as the Isleta, Zuñi, Hopi, Navajo, and many others, is largely deleted.

After observing the important role which *Yucca* played in the Indian life of the Southwest, it is at first surprising to note how its use has been ignored in the industries of modern civilization. Whatever utility it has today is largely as a range plant. At the season of the year when yucca is in bloom, the authors have observed cattle eating the flower stalks in preference to other forage, and because of this it is difficult in many areas to find fruits later in the year. It is also true that cattle come to watering places less frequently during the period when they are feeding on the flowers. In periods of drought, yucca has proved to be a fairly good maintenance food. In preparing the plant for feeding in these cases the dead leaves are first burned away from the stem, as their low nutritive value and high fiber content make them undesirable as feed. The plants are then chopped or shredded, the nutritive value being made more available with increased chopping (49; 157: 1-7)

Digression is made in the next few paragraphs to show to what extent the economic possibilities of yucca as a commercial source of fiber have been explored. Considerable detail regarding its extraction and properties has been included in order that the reader may more clearly understand the reason for the failure of this fiber to attract commercial attention.

Dodge (35: 330) states that various members of the genus often have been the subject of correspondence with the United States Department of Agriculture and that had it not been for the shortness and nature of the fiber it would doubtless have become commercially important long ago. He (35: 330-34) adds that up to 1897 there were no records to show that the use of these fibers in modern industry had ever progressed beyond the experimental stage, and even today the same statement might be made. Trelease (35:

330-31) is on record as stating that an English newspaper established a mill in the Southwest intending to make paper pulp from the stems of the arborescent species but the enterprise was shortly abandoned. At times the leaves have been used in various parts of this country for making seats for chairs and locally as tying material for hanging hams, etc., and the leaves of *Y. Trecaleana* Carr., with coarse fiber, and *Y. Schottii jaliscensis* Trel., with fine fiber, have been used in the interior of eastern and western Mexico. In preparing the fiber the leaves were thrown into barrels of hot water, brought to the boiling point, after which they were crushed between two cylinders to remove non-fibrous tissues. The crushed mass was then placed upon hurdles in such a manner that the fibers might be kept straight and separate. The bundles were then let down into an alkaline bath composed of ashes and water and heated to the boiling point. The leaves remained in the solution four hours, though good judgment was necessary in order that the leaves might not be over or underheated. After removal from the bath the fibers were washed, dried, and combed, the result being a delicate, strong lustrous and white fiber known as *Xtuc*.

*Yucca* fiber possesses generally a moderate tenacity, but is somewhat brittle, and cannot be made to lose its harshness. The filaments are usually white in color, glossy and stiff, composed of irregular bundles, most of which are large. By rubbing briskly between the fingers these bundles break up into finer fibers, but as a rule retain a great deal of stiffness. The walls of the fibers are usually thick and the central cavity very apparent. The ends become slender regularly and are rounded at the extremities.

The leaves of *Y. aloifolia* L., an arborescent species occurring in Florida, are too difficult to secure and too short to be of value for fiber production although the fiber is of fair quality. About forty pounds of leaves gave a product of one pound of dry fiber, not over twelve to fifteen inches long, or the equivalent of fifty-six pounds to a ton of leaves. Pineapple fibers with the same yield would be three or four

times as valuable while the leaves could be gathered at one-fourth the cost.

*Y. filamentosa* L. fiber attracted attention in the South during the latter part of the nineteenth century, and specimens of the fiber and a rough fabric resembling matting were sent to the Department of Agriculture by Mr. Stoner, of Stonypoint, La., who patented a machine for the extraction of yucca fiber. After being macerated in the machine the leaves were subjected to thorough washing. In spite of the efforts of Mr. Stoner the industry did not succeed. Further experiments were made by Walter T. Forbes in 1890, and it was claimed that 85 per cent of pure fiber could be secured at very low cost. In 1893, a quantity of the leaves of this plant were procured by the Department of Agriculture in Georgia and sent to J. C. Todd, of Patterson, N. Y., to be cleaned on the Todd sisal hemp machine. The cleaning was successfully accomplished, and a sufficient supply of the fibers were thus obtained for examination and testing. The fiber was very dark, yellowish in color, harsh, and somewhat brittle, inferior in strength to the commercial cordage fibers and quite inferior to Manila and common hemp. Bernadin speaks of *Y. filamentosa* as *henequen* from which it may be inferred that yucca has been at times exported with sisal fiber under the commercial name *henequen*. It seems certain that the cargoes of *pita* which reached European markets contained, at times, a more or less considerable portion of yucca fiber.

The authors have had the opportunity to examine fiber extracted from the leaf of *Y. glauca* Nutt. It has been found that the fiber can be extracted best from the leaves of the current year's growth, and that fibers from leaves suffering from injury are of inferior length. The fiber as extracted from the leaf is glossy white in appearance and of a length equal to the leaf itself. In texture it is quite harsh and resembles the fiber comprising commercial binder twine. So suggestive is it of this material with regard to tensile strength and texture that one is inclined to look upon it as

a possible material from which bindertwine might be manufactured. When closely examined it is found that the fibers split badly, and ultimately tend to become reduced to fine, stiff, short, lint-like fuzz. These represent the limits of length of the fiber to be secured from the leaves of *Y. glauca*. From a commercial standpoint a coarse cordage could be manufactured from the long fiber but it would have the disadvantage of splitting badly so that the outer walls of the fiber would be very ragged in appearance. After observing the lint-like particles to which the long fibers tend to be reduced, one is at a loss to discover a use for which cordage made from them would be in demand.

From this discussion of the fiber of various species of yucca, it is seen that one is at first impressed by the great length of the raw fibers which can be extracted. This optimism, as to the commercial possibilities, is rapidly lost as one discovers the tendency of the fiber to become reduced in length. It is undoubtedly this latter tendency, coupled with the cheapness with which similar or better fibers are today produced, which has caused yucca to be neglected as a fiber source.

#### USES AS A FOOD

As a result of lack of interest and observation with regard to yucca fruit during excavation, in addition to its perishable nature, practically nothing can be said as to the role which *Yucca* played as food among Basket Maker and early Pueblo peoples.

Fletcher (46: 38, 39) found seeds and pods of yucca in the prehistoric ruins of Bee Cave Canyon, Texas, and infers that the fruits of *Y. Torreyi* Shafer, *Y. elata* Engelm. and *Y. Thompsoniana* Trel. were probably all used as food. From certain sites in Culberson County, Jackson (88: 165) recovered yucca seeds which probably indicates that the early occupants of southwestern Texas made use of the fruit for food. It would seem that *Yucca* was quite important as food among the Cave Dwellers of western Texas (56: 38,

116). Alexander and Reiter (1: 63) found that yucca fruit was used as food by the early inhabitants of Jemez Cave and Morris reports that yucca fruits were extensively utilized by the aboriginal inhabitants of southwestern Colorado (115: 15). Aside from these scattered reports the archaeological evidence of the utilization of yucca fruits is negligible. Haury (65: 60), Gladwin (56: 38), and Hough (81: 24) mention finding "yucca leaf chews" or "yucca quids." The former infer that the leaves were chewed for sustenance or pleasure, while Hough considers these "yucca quids" to have been formed in the process of removing the fibers from the leaves for cordage. Haury adds that the practice of chewing yucca is widely spread over New Mexico, Arizona, and the western part of Texas. In their ethnobiological work among the various tribes of the Southwest the authors have never had an informant who made any mention of chewing the leaf of any species for the nourishment which it might contain or for the pleasure derived therefrom. It seems, therefore, open to question what such finds actually represent.

Early Spanish accounts likewise fail to record the utilization of yucca fruit by the southwestern tribes with whom they came in contact. This was due in part to their contacting those tribes in whose area the palatable baccate species failed to grow or occurred at considerable distance from the site of the aboriginal villages, and partly to the fact that little contact was made with those tribes among whom yucca might be regarded as a staple. The authors conclude, however, that where it has been of importance during the historic period it was of equal or greater importance in pre-Columbian times.

Maize, beans, and pumpkins were the staple vegetable products used by the agricultural pueblo peoples, with wild fruits furnishing pleasant variation to the normal diet, as well as helping them to maintain themselves when drought curtailed the production of cultivated foods. From the foregoing it must not be inferred that wild fruits were not

relished and extensively gathered. For example, the authors observed in the summer of 1935 that it was very hard to collect fruits of *Y. baccata* in the Sandia Mountains near Albuquerque; due to the assiduity with which the Pueblo Indians in the area had gathered this palatable food.

*Y. baccata* Torr. (106: 30-49) is an acaulescent broad-leaved, fleshy-fruited species extending in its northern limits from the mountains of the eastern Mohave Desert of California across southern Nevada, southwestern Utah and southwestern Colorado as far east as Trinidad. From this northern boundary it extends south and southeast across northern and central Arizona and the greater part of New Mexico into southwestern Texas. This extensive range made it accessible to all the tribes of southwestern United States with the exception of the Colorado River tribes and neighboring peoples in California. The banana-like fruits of this species were wholesome and nutritious and of agreeable taste. Because the pollination of the yuccas depend upon certain moths, the number of fruits maturing upon a plant was sometimes quite scant, although at times the stalk might bend with its burden of fleshy fruits. As deer, birds, and insects also were fond of the fruit, the Indians of the Southwest often gathered the pods while still green and allowed them to mature in their dwellings or in the sun.

The tribes occupying the Rio Grande drainage had access to *Y. baccata* Torr. and *Y. glauca* Nutt., while the Hopi were in contact with *Y. baccata* Torr., *Y. Harrimaniae* Trel., and *Y. angustissima* Engelm.

*Y. glauca* Nutt. (159: 59-64) is a subacaulescent, capsular, narrow-leaved species, extending from central South Dakota southward through southeastern Wyoming and Colorado to central New Mexico, and eastward through the panhandle of Texas and Oklahoma to extreme southwestern Iowa and northwestern Missouri. The acaulescent, capsular, narrow, or broad-leaved *Y. Harrimaniae* Trel. (159: 59) is found from southwestern Utah and western

Colorado to northeastern Arizona and northwestern New Mexico. Occupying southeastern Nevada, southwestern and southeastern Utah, northern Arizona, and perhaps extreme northwestern New Mexico is *Y. angustissima* Engelm. (159:58) an acaulescent, capsular, narrow-leaved species.

The dry capsular-fruited species were less attractive as a source of food and consequently much less used than the fleshy-fruited *Y. baccata*. The former were used at periods of the year when agricultural reserves had dwindled, or were gathered for the sake of dietary variety. *Y. baccata*, on the other hand, was much sought after and used by many tribes, due to its palatability and its wide distribution in the lower elevations of the mountains throughout much of the Southwest. Indeed, this account of the utilization of yucca as food in the Southwest, is, practically speaking, an account of *Y. baccata*.

Through their informants the authors have traced the utilization of yucca as food from Taos and Picuris on the north, to Isleta on the south, and Zuñi on the west. Within the Pueblo area, its extent of utilization varied, while its method of preparation remained rather uniformly the same.

Through informants at Taos the authors learned that, in the early days, the ripe fruits of *Y. baccata* were eaten raw, or the rinds might be removed, the seed ribbon discarded and the pulp cooked to a paste, which was afterwards dried and stored for winter use. At Picuris, the fruit was eaten raw, or more commonly the partially ripened fruits were gathered and roasted in coals overnight. They might be eaten immediately thereafter or spread on the ground and allowed to dry, after which they were ready to be stored for winter use. Although the fruit was not extensively used at Taos it seems to have been quite an important wild product at Picuris.

Informants at San Juan were very familiar with the fruit, which they stated was received in trade from the Apache. The ripe fruit might be eaten at the time of gathering, or more often the fresh fruit was split open and the

seeds and rind removed, after which it was dried in the sun. The dried pulp might afterwards be eaten with or without cooking. At Nambé, the fruit of *Y. baccata* was preserved in much the same way. When used the dried pulp of the fruit was boiled in water and the sweet liquid drunk. The authors were told at San Ildefonso that the pulp was often mixed with chokecherries and made into a cake. After drying, the cake might be eaten dry or mixed with water and the sweet liquid drunk. Prepared in this manner the fruit is still relished by a number of the inhabitants of the village. Harrington (132:50-1) states that the fruit when eaten in excess was apt to cause diarrhea, and that the San Ildefonso used a portion of the plant as a ritual emetic.

At Santa Clara, the fruits were prepared and used in the manner described above while informants at San Felipe stated that the fruit was eaten raw or dried and made into a cake. This cake was sometimes eaten without further preparation or more often was broken up and mixed with water. When partially ripened fruits were gathered, as was often the case, they were cooked and the pulp dried and stored for winter use.

The fruit was formerly extensively used at Jemez, and although it is still used, its importance has declined greatly. One informant stated that *Y. baccata* was the most important of all wild fruits. He recounted another method of preparation known to all the pueblos which consisted of splitting the fruit into halves, removing the seeds, and allowing the halves to dry. Much the commoner method, however, was to peel the fruit and dry the pulp, which was afterwards worked into a cake and dried further. The Jemez boiled the pieces of cake with water and drank the sweet liquid.

The San Felipe ate the fruit raw or gathered the partially ripened fruits and cooked the pulp to the consistency of a thick paste. This paste was dried for winter use and when eaten was soaked in water and the sweet liquid drunk.

At Sandia and Isleta, the fruits were often eaten raw



or baked. Quantities were prepared for winter use by baking, and afterwards drying the pulp in the sun.

The fruit is still used at Acoma and Laguna although not nearly so extensively as formerly. It was eaten raw when thoroughly ripe, although the major portion of the fruit gathered was dried in the fall and stored for winter use. Gathering expeditions were made in September and October. The partially ripe fruits were baked until the skin peeled off and the fiber and seeds could be removed. The pulp was then boiled down to a firm paste, and this was often spread on a layer of corn husks to dry; afterwards it was made into cakes about an inch thick which might be dried further by hanging on racks. When dry, these cakes were rolled into loaves and stored. During the winter and spring, the preserved fruit was prepared for use by soaking the cake in water and cooking to make a thick syrup, which was relished as a sauce-like dessert or as a sweet drink.

*Y. baccata* grew in the mountains south of the Hopi country. Fewkes (40:17) and Hough (79:143; 78:38) noted its use by these people, and Whiting (164:18, 71) states that the fruit was eagerly gathered when available and played a minor role in the aboriginal economy. The fruits were baked in ovens and, no doubt, dried and stored for winter use as was the common practice in the Southwest.

The Zuñi were very fond of yucca fruits and also the roasted hearts of *Agave*. Both were gathered in their season although the latter were less used since they were not native to the present habitat of the tribe. So important were they considered as sources of food that they (yucca and agave) were both credited with having been living personages in the past and possessed of extremely jealous dispositions (32:230).

In an elaborate account of its preparation and use by the Zuñi, Stevenson (155:72-3) and Cushing (32:230-35) state that quantities of the fruit were gathered by men and piled in shaded places, and there peeled by the women. It might then be eaten raw or boiled, or, again, might be cooked

in the skin and the pulp afterwards removed with a knife. Though greatly relished in this way, it was still more highly prized as a conserve. To prepare this conserve the fruit was pared and heaped into large bowls by the women of the household assisted by their female friends. The pulp was bitten off close to the ribbon containing the seeds and the latter discarded. After being chewed, the pulp was ejected from the mouth into a bowl by those immediately around this receptacle, while those at a greater distance discharged the masticated fruit into their hands and thereby conveyed it to the vessel. Chewing continued until late in the night, and after the work was done a supper was served. The bowl of chewed fruit was covered with a stone slab and deposited on the roof for the remainder of the night, during which time the fermenting mass acquired an agreeable pungent taste and the action of the saliva increased the sweetness. In the morning it was emptied into a large vessel and cooked over a pile of embers without any addition of water. The fruit was constantly stirred and when sufficiently cooked transferred to large bowls. Upon becoming cold the sticky mass was made into thick cakes about three inches in diameter, and these dried in the sun on stone slabs placed atop the houses. During the three days required for the drying process someone slept on the roof to keep watch that no harm might befall them. When sufficiently dry several cakes were taken in the hands and squeezed together, the mass then worked on a polished stone slab into rolls about twelve inches long and three and one-half inches in diameter. These rolls were deposited on stone slabs and again placed on the roof, where they underwent five or ten days additional drying or until they became perfectly firm. The dried rolls of pulp might be stored by placing in niches in the walls of the dwellings and covering with stone slabs, or deposited in pottery jars covered with stone slabs. The preserved fruit might be used as a conserve, or a piece about the width of four fingers cut from the roll, broken into a bowl half filled with water, and manipulated with the fingers

until thoroughly dissolved, producing a liquid or syrup which was regarded as delicious and frequently used to sweeten native beverages. The dried rolls of pulp commanded a prominent place among material bartered with surrounding tribes (32: 233-35; 155: 72-3).

The other yuccas of the pueblo areas bore dry capsular fruits which when mature could not be regarded as palatable. However, the young flower stalks and green immature fruits were eaten occasionally. Most informants who considered *Y. baccata* as of importance were not acquainted with the use of the capsular species for food. From this one can deduce the importance of the latter species. The Acoma and Laguna sometimes roasted the crowns of *Y. glauca* in time of food shortage. Occasionally, the dry fruits were prepared for use by roasting and the tender flower stalks which appear in the spring were sometimes eaten after being boiled or baked.

Whiting (164:18, 71) considers that *Y. angustissima* was an important wild plant food of the Hopi, but gives nothing on its manner of preparation.

During the early summer the Zuñi gathered the unripe, non-fleshy, seedy pods of *Y. glauca*, a quart or two of which might often be gathered from a single plant. The seed pods, which were slightly sweet, were boiled in water after which they were made into a sort of pickle. The young pods were considered superior as food to the old ones and the seeds usually were eaten with the pods. These were not combined with other foods and were never eaten warm or with meals, as they were said to cause disturbances in the stomach if eaten in this manner. The dry-fruited species were less sweet than the fleshy varieties, which were much more highly prized by all southwestern tribes (23:55-6; 32:229; 155:73).

The Papago were forced to exploit the vegetable resources of their desert environment and gathered a variety of wild foods as they matured. The authors, while among the Papago, sought to determine to what extent yucca fruits were utilized as compared with other wild products. It

should be mentioned in this connection that the extent of utilization of any wild plant by a tribe depended upon whether or not these people were agricultural or nomadic, and the abundance and accessibility of the plant. Informants among the Papago were united in their opinion that the most accessible, most abundant, and most reliable wild vegetable products were cholla buds (*Opuntia* spp.), sahuaro fruits (*Carnegiea gigantea* Br. and R.), and mesquite beans (*Prosopis chilensis* (M) St.). Baked mescal and yucca fruit ranked next in importance although they were not gathered nearly so universally throughout the Papago country as were the foregoing. In some portions of the country mescal, because of its accessibility in the mountains close by, enjoyed major importance, while in other areas yucca fruit, due to its abundance, was relied upon extensively.

Two yuccas were present in the Papago country, *Y. elata* in the lowlands and *Y. baccata* in the mountains. Neither is general in its occurrence over this territory nor equally accessible to all members of the tribe. The utilization of *Y. baccata* fruits is well known by all informants, but their extent of utilization by a village depended upon its nearness to mountains where the fruits were to be had in quantity, and upon how luxuriantly it happened to fruit. Thus there were villages where *Y. baccata* was gathered regularly, and others where extended expeditions were made to gather the fruit when it was known to be exceedingly abundant and the necessary effort would be justified. *Y. baccata* was of secondary importance not only because of its absence from parts of the Papago country, but also because of its failure to fruit abundantly in certain years.

Quantities of the fully ripened, fresh fruits of *Y. baccata* were eaten by members of the expeditions which went into the mountains to collect them. Beds of dry grass were piled high with partially ripened fruits, which were then covered with another layer of grass. After completing their ripening here the fruits were removed, split open, and the seed ribbons withdrawn. The halves of the ripe fruit

were preserved by drying further in the sun, after which they were carried home in burden baskets and stored in this form.

Castetter and Underhill (24:23) describe another method of preparation which consisted of splitting open the ripe fruits and removing the seeds and fiber as detailed above. The seeds were dried at home by being spread on racks of sahuaro ribs (*Carnegiea gigantea*) and when perfectly dry were beaten on a mat to remove the fiber. Seeds were then stored in baskets and ground into meal when needed. The pulp was scraped from the fruit halves by women with their fingers, while still in the field, patted into cakes, and then dried on a hot stone. Since this drying was not sufficient for storage, the cakes, after being taken home, were spread on the roof, and when thoroughly dry, stored in jars. The pulp was commonly prepared for use by cooking with cornmeal (24:23). The dry fruit of *Y. elata* occasionally was pounded to a pulp in hollows of rocks (24:45) and probably later eaten as a gruel.

Mesquite beans (*Prosopis chilensis*), cholla buds (*Opuntia* sp.), and sahuaro fruits (*Carnegiea gigantea*) were also of great importance among the wild vegetable products utilized by the Pima, while the fruit of *Y. baccata* was of secondary importance. The latter occurred in the mountains of the territory inhabited by the Pima, and informants stated that expeditions were made to gather the ripe fruits although frequently the preserved fruit was received in trade from the Papago. The halves of the fruit or the pulp, which had been dried and made into cakes, were eaten without further preparation, cooked in water and the sweet liquid drunk, or ground on a mealing stone and made into gruel by cooking with cornmeal. Russell (136:72) states that the ripe fruit was also eaten raw and as such was said to have cathartic properties.

*Y. baccata* was abundant in the mountainous country inhabited by the nomadic Yavapai and was one of the wild crops to be gathered in its season. When well matured the

fruit became soft and dropped from the stalk, although usually the Southeastern Yavapai bent the stalk over and plucked the fruit before it had entirely ripened. The ripening process was then speeded up by placing the fruit on a fire, after which it was soaked in water and the scales on the outside removed by rubbing. The fruit was split open lengthwise, seeds discarded, and the pulp, with the rind still attached, allowed to dry in the sun for two or three days. Fruits were often stored but even when dry did not keep well. The dried fruit was prepared for use by soaking in warm water until the pulp could be dissolved, after which the sweet liquid was drunk (53:213). The Northeastern Yavapai ate the fruit after boiling in water and in addition gathered the tender flower stalks before blossoming and prepared them for use by roasting in the fire (54:258).

*Y. baccata* fruits ripened on the plateau above the Grand Canyon and were gathered by the Havasupai at the end of September. A layer of the fruit was spread on a bed of dry sticks and the sticks burned until the rind of the fruit turned black. The fruit was then removed with tongs and thrown in a pile on which water was sprinkled. The burned rinds and seeds were removed and the flesh mashed and spread to dry in a thin sheet on a mat of Mormon tea (*Ephedra* sp.) twigs, care being taken that rain did not fall on the drying pulp. This sheet was then folded for storage and would keep for half a year. When used, bits of the sheet were broken off and eaten dry or were boiled in water (97:51-2).

This species also occurred in the mountains roamed by the Walapai, who gathered large quantities and prepared it in a manner quite similar to that of the Havasupai. The ripe fruits were placed on a pile of brush which was allowed to burn to ashes. Water was then poured on the baked fruits and the rinds removed. The fruit was then opened, and, after removal of the seeds, was spread on a lattice or mat of mesal stalks and turned from time to time to facilitate drying. When thoroughly dry the slabs of yucca were folded

and stored for winter use. Pieces were later broken from the sheets and eaten dry or cooked with water. The fruits were often mixed with water and the liquid drunk.

The fruits of *Y. schidigera* Roezl. ex Ortgies (106:92-104) were also gathered, the higher fruits being clubbed from the plant with a pole. This caulescent, broad-leaved, fleshy-fruited desert species, often referred to as *Y. mohavensis* Sarg. extends from the valleys of the Coastal slope of San Diego, Riverside, and San Bernardino counties of California, east and northeast across the deserts west of the Colorado River, into northwestern Arizona and southeastern Nevada. The fruit was not baked first but was cooked after drying, and although it could be eaten dry most people preferred it cooked and made into a drink (97:51-2).

The Apache in New Mexico made use of several species as food. They secured the fruits of *Y. baccata* on the slopes of the mountains, while *Y. Torreyi* Shafer (106:104-17) was abundant in the southern part of their territory extending from the Uvaldi and Devil's River regions of Texas across the southwestern part of that state and into the mountainous portions of southern New Mexico as far west as the vicinity of the Rio Grande. *Y. elata* Engelm. (159:56-8) was to be had as far north in Arizona and New Mexico as the thirty-fourth parallel, whence it extended southward into Mexico, eastward into the Big Bend country of Texas, and westward through the Papago and Pima Indian reservations. The Mescalero and Chiricahua Apache will be used to illustrate the various methods by which these species were prepared for use as food. They gathered the partially ripened fleshy fruits of *Y. baccata*, as well as those of *Y. Torreyi*, and spread them on a layer of grass, whereupon they were covered with a second layer and allowed to complete their ripening in the sun. The fruits were then roasted in hot ashes and the hard blackened rind stripped off, the fruit split lengthwise, and seeds removed. The white pulp was then ground and made into large cakes which could be

stored for future use. Sometimes the baked fruit was pounded to a pulp on an animal hide and allowed to drain into a basket placed over a jar. The juice might be drunk or poured over the cakes of pulp. The pulp was spread on yucca leaves to dry for two days in the sun, being always adorned with sunflower blossoms. Some ceremony attended this as the sunflower was a symbol of the fructifying influence of the sun, and this use of the plant constituted a prayer that the sun should continue to make the yield of fruit plentiful year after year. The Mescalero Apache tell of a yucca which grew near El Paso and had a "white" fruit and sweet sticky buds. They were picked, cut open, dried on sticks, and used for sweetening different foods (25:39-40).

These Apache gathered the young flower stalks of *Y. glauca* and roasted them on a bed of embers for about fifteen minutes, after which the charred portion was scraped away and the central, white, edible portion eaten. These stalks, which were sweet and quite palatable, were regarded as the most delicious portion of the plant, and might also be boiled or eaten raw. The stalk was removed from the plant just as it came into flower, peeled, cut into pieces, and boiled. It might then be dried and stored to be used later as a vegetable (25:38).

The crowns of *Y. elata* were gathered any time from the middle of March until the end of summer and the portion of the stem between the ground and the leaves was peeled and baked overnight in an underground oven in a manner similar to that in which the mescal was prepared. The yellow or brown product was then dried in the sun, broken into pieces, and, after softening in water, the rather sweet product was ready to be eaten. The tender central leaves of *Y. baccata* were cooked in soups, boiled in meat, or used in various other similar combinations (25:39).

The large flowers of *Y. elata* were boiled and eaten as a vegetable, but the less palatable ones of *Y. baccata* were eaten only if they could be obtained before the summer rains, since the Apache maintained that they were bitter thereafter (25:39).

*Y. baccata* fruits were a staple of the western Apache (58:62), and the White Mountain Apache women gathered the fleshy fruits and roasted them over a fire or in the ashes. After the rind was removed the pulp was eaten. The pods were also split open, dried, and later boiled in water (129:147).

Reagan (130:294) states that the Indians of the Fort Apache region gathered yucca pods and roasted them before the fire or in ashes. The pulp was said to have a burned squash taste but was relished by the Indians. The pod was also split open, the seeds removed, and the pulp dried. The pulp was later boiled when needed.

The Navajo used the fruit of *Y. baccata* very extensively and when at war they carried only a limited amount of food, which usually consisted of dried yucca fruit, grass seeds, and jerked venison (73:89). The Slayer of Enemies is credited with having slain the Tracking Bear Monster whom he told that upon death he must furnish sweet food to eat, foam for cleaning, and thread for clothing. The Slayer threw a piece of the Bear's head to the west and it became *Y. baccata*, and another piece he threw to the south where it grew into *Agave* (2:118). In the ninth dance of the last night of the Mountain Chant, *Y. baccata* is made to grow from the root through buds and flowers to the ripe fruit (102:439).

The Navajo ate the ripe fruits as they were picked, cooked them, or, after cutting into halves, dried and stored them for winter use. The fruits were sometimes baked on coals or hot stones, or were dried on a flat stone by the fire. After this the pulp was macerated and made into small cakes, which were again roasted. Small pieces were then broken off and allowed to dry in the sun, after which they were sprinkled with water and shaped into cakes and perforated so as not to sour. As such they were stored for winter use, and when required as food, the cakes were broken into small bits and mixed with water to make a thick syrup, which was eaten with meat, bread, or other dishes (50:20;

149:452). Sometimes the pieces were boiled with cornmeal to make a gruel, and at times made into a jelly (23:54-5).

The fruits of *Y. glauca*, although not considered as palatable as those of *Y. baccata*, were eaten by the Navajo after baking in ashes, or were sliced and dried for winter use (23:56).

*Y. schidigera* grew in the desert to the north of the territory inhabited by the Maricopa. The authors were told by their informants that it grew too far away to have been of great importance, although expeditions were known to have been made to secure the fruit. Spier (148:55) states that the fruit of *Y. baccata* was eaten fresh as well as split and dried for storage. The Kamia, who were marginal to the Southwest, had contact with yucca through the Diegueno from whom they secured yucca fiber sandals in exchange for various agricultural products. The authors have been able to uncover no utilization of yucca in their interviews with members of the lower Colorado River tribes. Indeed, among the Yuma, the fact that yucca sandals were unknown (48:92-3) may be evidence of their lack of contact with the plant. Mohave informants knew of yucca but stated that the fruits were not a food of their tribe but were gathered and eaten by tribes inhabiting the mountainous country.

It is readily seen that throughout the Southwest the utilization of yucca fruits was important. The species with non-fleshy capsular fruits were always considered inferior to the fleshy-fruited *Y. baccata*. The latter, because of its wide distribution in the mountains, was especially important among the nomadic peoples and yet was gathered by such sedentary peoples as the Pueblos and Havasupai whenever their villages fell within its range. Because of its presence and accessibility on the plateau above the Grand Canyon the Havasupai made greater use of the fruit than did many of the Pueblo tribes. In the Pueblo area the Zuñi were located in a region where the plant grew abundantly, and they rank, therefore, as one of the Pueblo tribes mak-

ing extensive use of the fruit. Along the Colorado River yucca was scarce and not easily secured.

*Y. baccata* was by all odds the most important species of the genus contributing to the food supply of the aborigines of the Southwest. The plant has a wide range and its presence coincided with the territory inhabited by most of the nomadic tribes which used wild foods in abundance. The California people of the Mohave Desert utilized the fleshy fruit of *Y. schidigera* while other southern California tribes utilized the fruit of *Y. whipplei* Torr. (159:39-41). Other yuccas, no doubt, were used by various tribes and to varying degrees, but the foregoing discussion faithfully presents the center and tribal importance of yucca utilization for food by the aborigines of the American Southwest.

#### USES FOR SANDALS

The principal yuccas available to the prehistoric people of northeastern Arizona, southeastern Utah, southwestern Colorado, and extreme northwestern New Mexico were the acaulescent, capsular-fruited *Y. Harrimaniae*, *Y. angustissima*, and the widely distributed acaulescent, fleshy-fruited *Y. baccata*. The people in northern and central New Mexico also had contact with *Y. glauca*.

The sandals commonly found in the cave and cliff dwellings of the San Juan drainage of northeastern Arizona are roughly divided into two classes, those made of yucca leaves, juniper bark, and other coarse materials, and those from finely twisted cords, the latter square-toed, scallop-toed, or sharp-toed (93:618). Kidder describes a sandal from this area in which the warps were of three-ply yucca cord about one-sixteenth of an inch in diameter and when finished the sandal was of a tightly woven nature. The amount of three-strand yucca cord used in the warp would, if dissected out, measure about thirty-five feet, while about four hundred and twenty-four feet of what he identifies as two-ply *Apocynum* string was used as weft (93:618-32). As can be seen here from an analysis of the amount of material used in

these fiber sandals, as well as others described later, one can readily realize the tremendous amount of work involved in their manufacture, since the raw materials had to be collected, the fibers extracted from the leaves, cleaned, combed, twisted, and woven by hand.

Kidder and Guernsey consider sandals to have been the standard footgear of the Cliff Dwellers in northeastern Arizona. One type of sandal was produced by a coarse twilled weaving of whole yucca leaves (92:101), the square heels having a pad made by turning back the butts of the leaves after the actual weaving had been completed. Eight or nine leaves were used in the manufacture of a single sandal, these being doubled to make sixteen or eighteen elements. The leaves were laid side by side and braided together until the desired length was attained. The length was necessarily limited to half the length of a single leaf and as a result they were seldom found more than eight inches long.

Another type found in this locality was made of whole yucca leaves. It differs from the above in that specimens are much more firmly woven and also the component leaves do not run the entire length of the sandal. As the weaving progressed a number of the ends of leaves were left on the underside, and when finished they were all trimmed off evenly, leaving about half an inch, which became somewhat shredded by wear, to form a soft, strong layer of fiber covering the entire sole (92:101-02). One specimen of this type has yucca fiber cords woven into the lower surface in a geometrical pattern. This probably gave extra wearing quality to the sole, and also, perhaps, the ridges gave a better grip when walking over smooth surfaces (92:102).

Wickerwork sandals described by Kidder and Guernsey (92:103) of whole yucca leaves were found woven over two heavy yucca-leaf warp strands and tied together at either end, while wickerwork cord sandals were fashioned over a four or six-strand warp made by looping either two or three cords, the open ends of the loops being at the heel, the closed ends forming the toe. The warps were of heavy, well-

twisted, two-strand yucca cord, the weft being very much heavier and more loosely twisted of the same cord. The resulting sandal was a strong heavy fabric three-eighths to one-half inch thick. It was more flexible than the whole leaf sandal and must have had far greater wearing quality (92:103).

In addition to the foregoing types, sandals were found twined of twisted fiber (tentatively identified as *Apocynum*) over a many-stranded warp of yucca string (92:103).

The sandals discussed above were attached to the feet by edge loop or by toe and heel loops. In the first case, loops or strings of yucca leaf were fastened all around the edge of the sandal, and by running strings through these loops and lacing over the toes and instep and about the ankle the footgear was held in place. Edge loop attachments are found on all sandal types except those of coarse yucca leaf wickerwork, which had no edge suitable for such attachment. The loops and tie-strings were generally of yucca cord, of whole yucca leaves, or less commonly, of braided yucca, feather cord, or rags of cotton cloth (92:107).

One type of Basket Maker sandal described by Kidder and Guernsey (92:158) consists of a cross-weaving of whole yucca leaves over yucca leaf warps. They were made in the same general manner as the corresponding type of Cliff Dweller sandal, by lacing the leaves back and forth across the warps and bringing out the large ends on the underside, where they were shredded into a pad. They have four warps, each one made of yucca leaf, the small ends being brought to the heel where they are tied together, while the attachment at the toe is made by shredding out a bunch of the fiber of each leaf and fastening these bunches together, the rest of the ends protruding to form a toe fringe.

Another Basket Maker sandal consisted of cross-weaving of crushed yucca leaves over warps of the same material (92:158). The crushing of the leaf before weaving did not entirely remove the tissue between the fibers but it rendered the elements fibrous and easy to manipulate, and the com-

pleted article was probably softer to the foot than a sandal of natural leaves.

Cross-woven sandals with plain soles and square heels and toes constituted a third kind of Basket Maker footgear from northeastern Arizona. They had ten or more warps consisting of stout, two-strand yucca fiber cord, the weft being thin one-strand yucca cord (92:159).

Lastly were found cord sandals with reinforced soles in which the warp was yucca cord and the weft of yucca or sometimes a softer fiber (92:159).

Pepper (126:93-4), in excavating Pueblo Bonito, found sandals of braided leaves of broad-leaved yucca possessing yucca strands for fastening the sandals to the foot. He also found sandals of split yucca leaves with two-strand yucca cords for this purpose. Two sandal fragments of yucca were also unearthed, one having a buckskin strap at the toe end and the other loops of yucca leaves on the side, with two-strand yucca cord passed through these loops. There were several fragments of woven plaited sandals, and a partly completed one shows how the basal end of the yucca leaf was carried to the under part of the sandal. One of the most ornate sandals was made of three-ply yucca cord and the woof was some kind of very fine white vegetable fiber.

Judd (91:148) in his observations north of the Colorado River, in the neighborhood of Cottonwood Canyon, found a pair of Cliff Dweller sandals woven from yucca fiber, a braided Cliff Dweller sandal, and a past Basket Maker sandal; and in excavating two pit houses at Chaco Canyon he encountered specimens in which the weft was a twisted thread of fine fiber over parallel warp cords of yucca (90:411).

Fewkes (45:73) found the sandals in Mesa Verde Cliff Palace to be ordinarily made of plaited yucca leaves, their upper sides being sometimes covered with corn husks for protection of the foot. The thongs that passed between the toes were made either of yucca or other vegetable fiber, or of hide. In excavating the ruins of the Red Rock country



of Arizona he found many specimens of sandals manufactured from yucca fiber (39: 565) and yucca leaf sandals were excavated during the expedition to Arizona in 1895 (42: 573).

A sandal in the Museum of the University of Pennsylvania is from the cliff dwellings of Arizona (100: 357) and consists of a sole of yucca leaves diagonally woven and plaited. On top of the sole was an insole or lining of corn husks. The lacing consisted of a series of loops around the margin of the sole, through which a tie of yucca string passed. A second specimen from a cliff dwelling of Arizona was of shredded yucca fiber (100:360) and Mindeleff reports sandals of yucca fiber from excavations in the Verde Valley of Arizona (109: 228).

Bartlett (8: 46), in discussing the material culture of Pueblo II in the San Francisco Mountains of Arizona, mentions finding a yucca cord sandal. The weft was of thicker, loosely-twisted yucca cords woven back and forth around and under the four warps.

In the Aztec Ruin, Morris (113: 49-50) found sandals plaited from strips of yucca leaves worked while still fresh and pliable. When finally worn through at the heel, or under the ball of the foot, they were occasionally patched with the same material with which they were made. Toe cords and lashings were often of yucca cord.

Opposed to these plaited sandals were cloth sandals (113: 50-1) in which both warp and woof consisted of yucca fiber macerated from the leaf, freed from the parenchymatous connecting tissue, and spun or twisted into cord. The mere elaboration of this material consumed more time than would have been required for the complete manufacture of a plaited sandal and demanded a greater degree of skill on the part of the artisan. These twined sandals were of excellent workmanship, the finest specimen having twelve four-ply warp threads and about fifty-seven two-ply woof threads to the inch. The workmanship was so fine that when held before the light not a single ray shone through. Morris

(115: 13) also reports yucca leaf sandals from the La Plata district of southwestern Colorado.

Mindeleff (110: 133), in his study of Pueblo architecture in Tusayan and Cibola, found a number of partly finished specimens of yucca fiber, with the long unwoven fiber carefully wrapped about the finished portion, as though the sandals had been temporarily laid aside.

Haury, in his work on the Canyon Creek Ruin and the cliff dwellings of the Sierra Ancha, found square-toed and pointed-toed sandals manufactured of loosely twisted cordage of yucca fiber or shredded yucca leaf (65: 64-8).

The inhabitants of Gypsum Cave, Nevada, made use of yucca, namely *Y. brevifolia* and *Y. schidigera*, in the weaving of their sandals (63: 159-61). In the Peabody Museum there is a sandal from southern Utah consisting of a coarse bundle of yucca fiber three feet long doubled in the middle, and upon this as a warp the sole of the sandal is woven of yucca fiber (100: 358). The same museum contains a Ute sandal of coarse yucca fiber collected by Palmer in an abandoned camp (100: 357) as well as others of the same material (100: 357).

In the United States National Museum is an old sandal from Utah made of coarse yarn of yucca fiber woven on a warp of two strands of the same material (100: 357), and a Paiute sandal, collected by Palmer, is likewise of yucca fiber (100: 357).

The yuccas available to the prehistoric people of Utah and Nevada, as well as those available to the Paiute, in addition to *Y. brevifolia* Engelm. (106:119-42) and *Y. schidigera*, were *Y. baccata*, *Y. Gilbertiana* (Trel.) Rybd. and *Y. angustissima* in Nevada and Utah, and *Y. Harrimaniae* in southeastern Utah.

In discussing material from Mexico no attempt has been made to identify the species utilized since the nomenclature of the genus and the distribution of its members are known but sketchily.



Sandals of yucca have been removed from the cliff dwellings in the Sierra Madres (12:74), and a child's sandal from Acatita Cave, Coahuilla, Mexico, (100:358) is made from unshredded yucca leaf. For warp, a leaf was bent in the middle, the two shredded ends projecting at the heel, while the weft was a very coarse wicker of yucca leaf. Another sandal from Mexico (100:358) is built upon two yucca leaves bent double in front, the one overlying the other. In each the under half was warp, the upper half being doubled down on top to strengthen the whole. In Coyote Cave, Coahuilla, Mexico, were found old sandals composed of yucca fibers carelessly laid along side one another and held together by means of cross sewing of the same material (100:358-59, 360). Mason mentions another sandal from Acatita Cave in which the thick sole is woven of twisted yucca fiber in checker pattern and the bottom soaked in pitch or gum (100:360). In his archaeological survey of Chihuahua, Mexico, Sayles reports round-toed sandals of juniper bark or similar material on a twisted yucca fiber frame, as well as pointed-toed sandals formed from a wickerwork of braided yucca leaves (139:74). Lumholtz excavated sandals of plaited yucca leaves in Cave Valley near Pacheco in northeast Chihuahua (98:I, 68), and Blakiston found woven yucca leaf sandals from cliff dwellings of northern Mexico (11:359).

In extreme southeastern New Mexico and southwestern Texas and southern New Mexico, *Y. Torreyi* and *Y. elata* are the most abundant species, with *Y. carnerosana* (Trel.) McKelvey (106:24-8), *Y. Faxoniana* (Trel.) Sarg. (106:18-24) and *Y. Thompsoniana* Trel. (27:33) also present in the Big Bend country.

In prehistoric cave dwellings of southwestern Texas have been found sandals of yucca leaves used either whole or shredded (140:107), and Mera, excavating caves in southeastern New Mexico, found sandals plaited of whole yucca leaves (108:54), while Roberts observed that narrow-leaved yucca, *Y. elata*, furnished the best material for their

manufacture by the prehistoric cave-dwelling inhabitants in the region about El Paso, Texas (133:6, 8-9). The sandals found by Roberts were of long oval outline and seem to have been shaped for use on either foot. The sandals were a wickerwork of whole leaves woven over a warp of two bundles formed from several of the leaves. The warp leaves were frequently shredded at the heel to form a pad and at the toe several of them were tied to make a fastening loop and the remainder allowed to protrude to form a slight fringe.

Sayles (138:92, 96, 108, 112) states that yucca square-toe sandals were common to all Texas Cave Dweller groups, while round-toed varieties were common to both Hueco and Big Bend culture, some manufactured of narrow, others of broad leaves, and some of yucca fiber. Likewise Jackson (88:147, 154, 178) found sandals of yucca in his archaeological explorations in Culberson County, Texas.

Hough (81:21) reports yucca leaf sandals from prehistoric sites in the Upper Gila and Salt River valleys.

Yucca was employed in a child's sandal from a cave near Silver City, N. M. (100:358), where the accessible species were *Y. elata* and *Y. baccata*. Another sandal from a cave in the same region is coarsely plaited of yucca fiber, all the lacing above being of one continuous string (100:360).

In the pueblo area the archaeological evidence conclusively shows that yucca was extensively used. A Zuñi shoe collected by Powell was made from yucca leaves, split and woven diagonally (100:362). The early type of footgear of the Navajo was sandals of yucca and grass, and in snowy weather a sort of snowshoe made of skin sewed with yucca,<sup>1</sup> and the San Carlos Apache in early times fashioned a kind of sandal out of yucca leaves.

The sandals of the Walapai were of yucca fiber, combed out to the shape and size of the foot, and the sandal was held in that shape by the insertion of transverse fibers (97:100).

1. Stephen, A. M., "The Navajo Shoemaker." *Annual Report, Smithsonian Inst.* for 1888, pp. 131-33. 1889.

This type of sandal was worn by the poorer hunters. Coiled sandals were made of *Cowania* bark and bunches of yucca fiber. On the combed yucca fiber sandals the toe-string was also of yucca and pitch was sometimes applied on the underside. Such sandals were made and used by poor hunters in the absence of buckskin.

The Walapai say that Mohave sandals were of dead cottonwood bark, braided, then woven with cords. Forde (48: 92-3) states that among the Yuma sandals of yucca were unknown, while the Diegueño made yucca fiber sandals which were among the products traded to the Kamia (52: 38).

In former times the Pima manufactured sandals from yucca if rawhide was not available and likewise the Tarahumara used a portion cut from the heart of *Y. decipiens* (136: 117; 10: 47). It took the place of rawhide and was attached to the foot in the same manner.

#### USES FOR BASKETRY

The use of yucca in basketry was fully as widespread as its use in the sandal industry, and the archaeological finds discussed here cover in general the same area as that where sandals were abundant. Kidder and Guernsey (92: 108-11) in the course of their work in northeastern Arizona procured many samples of Cliff Dweller baskets. Perfect specimens as well as fragments of yucca ring baskets were excavated. These were, in reality, nothing but pieces of matting attached to rings of willow or other pliable wood and may have been woven as small mats and then fastened to, or woven on, the rings directly. The mats were of yucca leaves or yucca strips of twilled weave. The strands were manipulated to produce a woven pattern of concentric diamonds, the center of the pattern always being the bottom of the basket. Some of the baskets, eight to ten inches in diameter, were bowl-shaped and woven tightly enough to hold corn or beans, but too loosely to carry meal, grass seed, or other fine materials. Large ones, fifteen to twenty inches

in diameter, were so shallow and so open in weave that it seems probable they served as winnowing trays. Fragments of coiled basketry were recovered in which the rods were of peeled or unpeeled willow, while the bundles were strips of yucca leaf partly shredded into fiber and the sewing strands were fine splints of wood, probably willow or sumac.

In the Basket Maker culture of this region Kidder and Guernsey were unable to determine whether twilled ware, in the form of yucca ring baskets, was present or not. In the coiled basketry, however, the rods were thin, round twigs with pithy center, and the bundles usually of yucca fiber. They described coiled baskets from Basket Maker caves which were made over a foundation of two slim osiers laid side by side with a padding or welt of yucca fiber or shredded roots (59: 59), while a specimen of twilled basketry was a flexible bag-like container made of entire leaves of *Y. angustissima* (59: 63).

Fragments of yucca ring baskets were described by Bartlett (8: 44) as coming from the Pueblo II culture in Arizona and consisted of a twill plaiting of whole yucca leaves. Since only fragments were found, it is a question whether they were mats or baskets as all but the edges of these two articles would be identical.

In the San Juan area, Cliff Dweller material includes fragments of shallow coiled trays and yucca ring baskets. Weltfish (161: 5-6) states that yucca ring baskets predominated in this culture, the coiling being far more rare than in Basket Maker sites. These ring baskets were made in over-two-under-two twill plaiting of yucca strands as a mat which was fastened to a wooden ring for a rim.

A yucca ring basket was collected by Fewkes at Betatakin (161: 6-7) and a twill-plaited cylindrical basket from Canyon del Muerto is likewise of yucca (161: 9). Material of the Pueblo III period from this site includes a coiled bowl and four yucca ring baskets (161: 9-10).

In Canyon de Chelly, the twill-plaited technique is found in yucca ring baskets and one jar-shaped specimen

was probably made from the mouth to the bottom, and has a false bottom of bunched yucca leaves fastened together by twining (161: 11).

Excavations at Grand Gulch in southern Utah yielded baskets made of yucca leaves. A yucca ring basket present in this collection, as well as another basket of yucca leaves, suggests a cradle, since it has legs (161: 13).

A twill-plaited yucca ring basket is reported from Butler Canyon in San Juan County, Utah (161: 16), and twill-plaited yucca ring baskets were excavated at Spruce Tree House at Mesa Verde (161: 16). Cliff houses in Navajo Canyon, in the same district, yielded yucca ring baskets (161: 17-8), as did, likewise, those in Mancos Canyon (161: 19, 20). In cliff dwellings east of the Mancos River, in southwestern Colorado, Morris found a net-like container made of yucca leaves fastened on a wooden ring (161: 21). Sewing threads of yucca were used in some of the baskets from southern Utah and southeastern Colorado (161: 25), and the same sewing material was found on baskets excavated near Las Cruces, N. M. (161: 32). Yucca ring baskets are reported from the region of the upper Gila (161: 30; 55: 159), and similar baskets sewn with the same material have been recovered at Sityatky (161: 34), while yucca is employed in the manufacture of the coiled bowls from Battle Canyon (161: 41) which are of Basket Maker type.

At Pueblo Bonito, Pepper excavated a small basket made of split yucca leaves, with a twig for the rim (126: 96). A second basket of split yucca leaves was perfectly preserved (126: 107).

The sandals in the cliff dwellings of the Sierra Madres were of yucca fiber (12: 38), and it is probable that the basketry discovered in association with them was of the same material. From a Chihuahua site comes a basket frame of yucca leaves (139: 68). The rim is composed of several leaves about which the warp elements were wrapped and tied and then twisted and bound together. An untrimmed basket of yucca leaves with checkerwork bottom

and twilled sides comes from the same state, as does also a small twilled basket and tray (139: 68).

Setzler (140: 106), working in southwestern Texas, excavated coiled baskets sewed with yucca thread and yucca leaf, while Mera (108: 50) found the fiber similarly employed in the manufacture of baskets excavated in southeastern New Mexico. Indeed the use of the split leaves and fiber were very important in the coiled baskets of the Pecos River Cave Dweller, the Hueco Cave Dweller and the Big Bend Cave Dweller (138: 108; 88: 157, 185).

Morris (113: 57) found basket-like containers in the Aztec Ruin. A withe bent into an oval or circular form, with its ends bound together with strips of yucca leaf, constituted the foundation, and a more or less complicated lacing of yucca strips formed the bottom. The sides consisted of a loose meshwork of strips of yucca and carried vertically upward, or progressively more constricted and gave the container a cylindrical or truncated appearance. Yucca ring baskets are also reported from the La Plata district of southwestern Colorado (115: 14).

The Zuñi made baskets of small willows and yucca leaves (153: 335, 391). The broad leaves were woven or plaited crosswise and wrapped at the rim with leaves of the same plant. They commonly wove coarse yucca leaf baskets over a wooden hoop with the ends of the warp and weft cut off about an inch above the hoop (101: 261; 155: 79).

The Hopi, likewise, made extensive use of yucca in their basketry (26: 6; 9: 3-5; 79: 146). The warp and weft of their twilled baskets were often formed of the narrow unsplit leaves of *Y. angustissima*, thinned by the removal of a strip from the back of the leaf (101: 214), and in the coiled plaques the sewing material consisted of narrow strips split from the leaves. The outer surface of the leaf gave various shades of green and greenish-yellow, or, in the case of young leaves, white, or they were dyed in several colors. The stems of the grass, *Hilaria Jamesii*, were used to form the base of the coil of the plaques which they manufactured, but, in the

first few turns of the spiral, the packing was composed of the shredded leaves of *Y. angustissima*. They wove meal trays, the base or foundation of the coil of which was composed of shreds of yucca stems and the sewing material of strips of the leaves. When the coils were left open they were said to have been made by an unmarried woman (101: 364). Yucca baskets and trays were made in plain checker, the two sides of the leaf being used to produce variation in color (101: 506). Dorsey (36: 30) states that the Hopi both wove and coiled shallow trays and baskets from the split stems of yucca to serve as sieves, grain receptacles, carrying baskets, etc.

Informants at Jemez recall the use of *Y. baccata* leaves in the manufacture of baskets, and Parsons (124: 16) states that the Jemez wove baskets of yucca leaves for the storage and washing of grain, although the authors have observed that these baskets were much more commonly of beargrass (*Nolina microcarpa*). Indeed this latter condition seems to be true for the Rio Grande Pueblos in general, although informants at Taos and San Juan state that *Y. baccata* leaves were used for the manufacture of baskets in the past, but that the technique has long been neglected.

The Acoma and Laguna, likewise, recount the use of *Y. glauca* in the manufacture of baskets and plaques, and the San Felipe and Isleta state that the leaves of *Y. glauca* formerly were used in the manufacture of small baskets.

The authors were told by the Papago that the material employed for the foundation elements in coiled basketry was ordinarily of beargrass (*Nolina microcarpa*), or occasionally of *Y. baccata*, while the binding element in coarse coiled ware was the leaf of *Y. elata* or the bark of mesquite. Kissell (94: 135, 139) made similar observations on the coiled basketry of the Papago and adds that the fiber extracted from agave or *Y. elata* was employed in the manufacture of a light and airy basket. One of our Pima informants stated that *Y. baccata* was sometimes employed in basketry although other materials were much more commonly used.

This informant added that the leaves of the plant sometimes were woven into mats and *Y. elata* fibers were made into carrying nets.

Yucca leaves were used extensively in the basketry of the Apache. *Y. baccata* and *Y. Torreyi* were employed by the Mescalero Apache for the main portion of their baskets, and their roots were used to produce a red pattern. To the foregoing, Standley (149: 453) adds *Y. elata*. From the interior of the leaf was taken the nearly white fiber which formed the groundwork of the basket, while the geometrical designs with which the baskets were commonly decorated were worked in with strips from the outer greenish-yellow coarse part. The San Carlos Apache also used the root of *Y. baccata* which combines the toughness of *Martynia* with an even finer grain to give a rich flat red or maroon pattern to their basketry (134: 141-42). At the age of five or six years a girl was taught the art of basketry by her grandmother or mother. Baskets of the San Carlos were sometimes caulked with pitch applied with a yucca brush, the pitch being smeared over the basket in the small streams (134: 135, 163).

Conical, twine burden baskets were used by the Northeastern Yavapai for gathering acorns, wood, etc. The warp and weft was of *Rhus Emoryi* stems with red decorations secured from the inner bark of yucca roots (54: 282). This was also used in securing the design for coiled basketry (54: 283). The root was likewise favored for coloring by the Walapai (97: 81).

The root of the Joshua tree (*Y. brevifolia*) was used by the Owens Valley Paiute (156: 271) to secure a brown design, and in Mexico the Tarahumara of the highlands were almost completely dependent upon *Y. decipiens* for the fiber necessary to weave their twilled baskets (10: 87).

The Navajo made considerable use of yucca in the manufacture of baskets (50: 295). Matthews (103: 203, 205-07) states that the most important Navajo use of the basket was as a drum. In none of the ancient Navajo rites was a regu-

lar drum employed. The drumstick was of yucca, being formed from the stout leaves of *Y. baccata*. Not every plant was worthy to furnish the material, and hours were spent in search for the proper plant. Four leaves only were used and all had to come from the same plant, one leaf being removed from each of the cardinal points of the stem. All had to be of the proper length, absolutely free from wounds, withered point, or blemish of any kind.

#### USES AS MATTING

Cliff Dweller material in northeastern Arizona (92: 108) yielded a portion of a screen composed of large reeds held together by twined weaving of yucca strips.

Morris (114: 179), in southwestern Colorado, found matting made by lacing the stems of rushes together with fine yucca cord, while a leaf matting, from Chihuahua, is made of yucca in two-over and two-under twilling (139: 68), and matting from Chaco Canyon has been tentatively identified as *Y. glauca* (19: 52). From Roosevelt 9: 6, a Hohokam site of the Colonial Period, bits of charred yucca leaf matting, as well as impresses of the same in clay, were found on the floors of some of the houses (64: 109), and the prehistoric inhabitants of the Upper Gila and Salt River valleys used yucca leaves in manufacturing bed mats and mats for carrying vegetable products (81: 21). Yucca leaves and fiber extracted from the leaf were manufactured into matting by the Pecos Cave Dwellers, the Hueco Cave Dwellers, and the Big Bend Cave Dwellers (108: 52, 53; 138: 108; 143: 60).

The Zuñi split the leaves of *Y. baccata* and plaited them into mats for covering hatchways, grain vases, and other vessels. *Y. glauca* was also woven into mats (155: 79). The Hopi, likewise, used yucca leaves, twilling them into matting, and, prehistorically, at death coarse wicker matting of yucca was placed in the bottom of the grave and on this mat was deposited the body (101: 509). The Northeastern Yavapai

made a bedding mat, using the inner bark of the willow for warp and yucca leaf string for weft (54: 272).

The Pima occasionally used the split leaf of *Y. baccata* in weaving mats although sotol was much more frequently employed.

#### USE AS CORDAGE

No material was in greater use for cordage in the prehistoric Southwest than the fibrous leaf of the yucca, prepared and used in a variety of ways. Its use as a common material for sandal ties has been discussed elsewhere in this paper. It was the most important of all cordage material employed in the Cliff Dweller and Basket Maker periods of northeastern Arizona (92: 113-14, 171, 172), and probably nine-tenths of all twisted cord was made from it. In this region the common species is *Y. angustissima* and this was apparently the case in former times. From these early cultures every stage in the production of yucca string has been found, including sheaves of whole leaves, chewed or pounded leaves with the parenchyma partly removed, and lastly, hanks of the cleaned fiber. Yucca string was stout and many specimens that have withstood decay compare favorably with modern string as regards their tensile strength. The majority of cords vary from one-twentieth to just less than one-fourth of an inch in diameter, specimens over one-fourth of an inch being rare. These strings seem to have been made very long, rolled into hanks or balls, and cut off in lengths as required, one roll containing about 200 yards. An interesting specimen is a piece of pottery which has been mended with gum and reinforced with yucca string (92: 24). Other finds indicate that the leaves were used as a tying material for corn and other products (92: 98).

From Pueblo II, in the San Francisco Mountains, Bartlett (8: 45) records pieces of narrow-leaved yucca used for tying, as well as yucca fiber cord, and in the Canyon Creek ruin and the cliff dwellings of the Sierra Ancha, in Arizona, the majority of the cordage was of yucca (65: 84). It was

used wherever stout twine was needed as in netting bags, in fastening matting and lattice work in cradles, sandal ties, tying material, etc. Both loosely and tightly twisted cords occur. To prevent the untwisting of freshly made cords it was customary to treat the ends by worming with a few filaments of the fiber, the wrapped ends being cut off and discarded when the cords were used. This same site yielded a ceremonial arrow flint point lashed with a strip of yucca leaf and smeared with pitch (65:108). Everywhere in the refuse heaps there occurred knotted pieces of beargrass and yucca, as well as folded hanks and coils of the same material (65:87).

Hough (81:24) states that the prehistoric inhabitants of the Upper Gila and Salt River valleys in Arizona and New Mexico made use of whatever fiber plants happened to occur in the area. Yucca leaves were of greatest importance, and from them were secured sinewy strips for tying, or commonly the fiber was extracted and twisted into cord.

Fewkes (42:572) in his expedition to Arizona in 1895, found knotted wisps of *Y. baccata* fiber at Palatki and Nonanki, and Pepper (126:29) found yucca cord used to fasten the featherwork paraphernalia used ceremonially at Pueblo Bonito. Yucca cords of various degrees of fineness were found, such strings being used to attach the small poles which formed the roof of dwellings (126:31, 40). Yucca leaves were used as tying material and a portion of an olla shows a handle which still retains the yucca carrying cord, while in the other cases it was used in mending pottery or as tying material for feathers and arrows (126:101, 109, 156). As in most other sites the fiber was not always extracted, but instead portions of the whole or split leaf were used (126:96, 105), as in hanging corn to the ceilings.

Mindeleff (110:126-27) found that split yucca leaf was used to hold in place the horizontal reeds which were arranged like lath to the stonework of the kivas which he studied, and in a Mesa Verde Cliff Palace Fewkes (45:76) found several specimens of yucca strings.

Two-strand yucca cord was used in sewing a thick skin robe which wrapped a mummy discovered in Jemez Cave (1:54), and the tying of sandals to the foot was usually accomplished with unprepared or split yucca leaves (1:55, 56).

Of over a thousand pieces of cord recovered from the Aztec Ruin (113:47), only about twenty were of cotton, the rest being of yucca fiber. The cord ranges in size from that of modern coarse linen thread to small cords one-half inch in diameter and may be classified as one-, two-, three-, and four-strand twisted cord. One heavy cord, three-eighths inch in diameter, consists of two smaller cords, each in turn made up of three two-ply strands, making a total of twelve strands for this small rope.

Yucca fiber was used to mend pottery and as tying material by the prehistoric people of southwestern Colorado (114:176, 180), while *Y. schidigera* and *Y. brevifolia* were the common plants from which cordage was made by the inhabitants of Gypsum Cave, Nev. (63:159-60).

The Hueco Cave Dwellers, the Pecos River Cave Dwellers, and the Big Bend Cave Dwellers all made extensive use of yucca cordage (138:67; 143:58; 77:61, 62; 84:11; 88:148-51, 157). Mera (108:54) reports the use of yucca fiber for cordage by the inhabitants of southeastern New Mexico.

Our informants at all the Rio Grande pueblos stated that split leaves or fibers extracted from *Y. baccata* and *Y. glauca* were extensively employed as tying materials. Other authors have noted likewise its use as a tying material in the economic and ceremonial life of the Hopi and other pueblos (38:288; 79:146; 163:95; 125:334; 78:40). Harrington, in discussing the preparation of cord and rope from *Y. baccata*, states that the fleshy leaves were chewed and the fiber extracted and twisted into cord, or the fibrous leaves of *Y. glauca* and *Y. baccata* were often merely split and used as tying material without twisting (132:50, 52).

Yucca thread was known to the cave dwellers in south-

western Texas, for two-ply twisted cord was used to bind the thin twigs that formed the cradle (140: 107), and it was used for bowstrings and other types of tying by the prehistoric inhabitants of Chihuahua (139: 72).

The Zuñi boiled and chewed *Y. baccata* leaves and from their fibers made a twisted cord of two strands by rolling on the right knee with the right hand and then doubling and twisting again. After the cord was finished it was sometimes chewed to bleach it and also rubbed with white cornmeal to intensify the whiteness. Fabrics were woven of yucca cords and they were used to tie the prayer plume offerings together and for other ceremonial purposes. Split yucca leaves frequently took the place of cords or rope for many domestic purposes (155: 79). Like the Zuñi, the Hopi used the leaves or fibers of *Y. angustissima* for tying material (79: 146; 78: 40).

Informants among the Papago stated that the leaves of *Y. baccata* often were split and used as tying material, while the Pima related that fiber extracted from the leaves often was twisted to make cords or ropes. In former times, the mesquite poles constituting the framework of Papago houses were fastened with yucca twine (83: 636), and Russell (136: 146) observed that the Pima made regular expeditions to gather the leaves of *Y. elata*.

The Yavapai often bound their slow-burning match of shredded juniper bark with yucca fiber (53: 205; 54: 269), and the Northeastern Yavapai used the fiber to tie the twigs of willow, oak, or elderberry into tongs with which to gather yucca fruit, or used it to tie a crook in the ends of walking canes (54: 279). They obtained the fiber by macerating the green leaves on a rock and used the resulting fiber for cordage without spinning (54: 281). The fiber was tied around the abdomen of a mother at birth of her child so the abdomen would not sag (54: 299).

After a deer was killed, the Walapai butchered it on the spot, cut it into a few large pieces and carried these home tied in bundles with yucca rope (97: 69, 73). For en-

trapping wild pigeons, a snare was fashioned out of a running noose of yucca twine and tied to a bush in such a way as to tighten up on the bird's leg (97: 69). Yucca was used also to bind together the posts which formed the framework of the winter home and to tie the thatch of the roof (97: 78), and loops of braided horsehair or yucca were used as carrying cords for water bottles, as well as to secure curvature for the seed beater (97: 80, 81). In elaborating cordage from the long leaves of the yucca, the fibrous inner surface was stripped off and these strips simply tied end-to-end to form a knotty cord, or if something stronger were required three of them might be braided together (97: 82). Women, in winter, wore a blanket over the head and shoulders, belted at the waist with a three-strand yucca braid (97: 97). Yucca was used likewise to wrap the slow-burning match of *Cowania* bark (97: 106).

The Havasupai made ropes of yucca fiber, but tanned hide was also used for this purpose. The inner leaves of a dead broad-leaved yucca were selected, pounded singly between two stones and flexed with the fingers to remove the connective tissue. The leaves, which had been softened in water, were continually bent back and forth until the fibers were finally separated. The ropes, prepared from this fiber, were three- to six-ply and braided from the bundles of the fiber, new lengths being introduced as required by simply laying them between two crossing elements, and if the fiber were dampened the rope would shrink tight. Three-ply ropes were about four meters long and one and one-half centimeters in diameter (147: 146).

Opata women manufactured ropes from the fiber of agave or yucca and employed it in the making of snares for deer and peccaries (85: 73), and the Tarahumara split the leaves and twisted the fibers into string. These strings, tied around the neck and over the mouth of water jars, served as a handle (10: 80). *Y. baccata* and *Y. angustissima* leaves were split into the desired size by the White Mountain Apache and used as string, or the leaf might be reduced to



fiber and made into cloth, ropes, or cords (129: 147-48). Similar use of *Y. baccata* and *Y. glauca* was common among the Navajo (50: 207, 208, 457; 5: 176).

#### USE IN FEATHER CLOTH AND FUR CLOTH

Bits of string wrapped with feathers or strips of fur were found in great quantities in the Cliff Dweller and the Basket Maker cultures excavated in northeastern Arizona (92: 118, 174-5). The base upon which the feathers were wrapped was a medium weight, two-strand yucca cord one-eighth to one-quarter of an inch in diameter. Kidder and Guernsey found a great preponderance of feather string in Cliff Dweller material, this cordage even being employed in the manufacture of leggings (92: 100), while the same preponderance was found of fur string in Basket Maker culture. In preparing fur cord, the yucca base was wrapped with narrow strips of small animal hides applied raw with the fur on, although when deer or mountain sheep skins were used the hides were generally dressed. The strips were applied spirally to the yucca cord base, the ends of one piece holding down the beginning of the next (59: 74).

From Pueblo II in the San Francisco Mountains, Bartlett (8: 46) reports a piece of feather-wrapped yucca cord. In its manufacture fine turkey feathers were split and wrapped around yucca fiber cord. Fragments of blankets manufactured from such cord have been excavated from the cultures of Pueblo I, II, III, and IV.

A small feather-string blanket was excavated from Jemez Cave (1: 52). The blanket was composed of one two-strand yucca cord about forty-four feet long covered with white and brown turkey feathers. The Chaco Canyon ruins (16: 37) have yielded small amounts of yucca fur cord, and Hewett, at El Rito de los Frijoles, found a body wrapped in a yucca fiber fur robe (72: 663). Similarly, Setzler recovered yucca fiber fur cords from caves in southwestern Texas (140: 108).

Numerous individual strands of feather cord taken

from the refuse heaps of the Aztec Ruin (113: 47-8) indicate that feather cloth was known and used by these people. In addition to this feather cord there was found yucca cord wrapped with rabbit skin, and other cord wrapped with what appeared to be gut. Morris also mentions finding feather cloth in his preliminary account of excavations between the Mancos and La Plata rivers in southwestern Colorado (114: 179).

Fur robe garments made on a base of yucca fiber cord were excavated at Gypsum Cave, Nevada (63: 156-57). All the yucca cord, probably secured from *Y. schidigera* and *Y. brevifolia*, was two-strand, twisted in a right spiral, the fur strips being twisted about the cord base in a left to right spiral. Since Guernsey has shown that the type found here was used by Basket Maker II and III and by Pueblo I, Harrington concludes that the Gypsum Cave material probably dates from both Basket Maker and early Pueblo cultures. Harrington also recovered similar fragments from Pueblo Grande de Nevada.<sup>1</sup>

Coronado found fur string and feather string garments in use at the time he made his expedition into New Mexico and Arizona in 1540. Since yucca is prevalent in this region it probably was employed in the manufacture of these textiles. Casteñada, the chronicler of the Coronado Expedition, in writing of the seven villages of Cibola, says, "They wear long robes of feathers and of the skins of hares, and cotton blankets" (166: 517). Winship noted, in 1896, that mantles of rabbit skin were still worn at Moki, but that those of turkey plumes were no longer used (166: f 517). In 1890, Fewkes found that a few fabrics of white man's make were in use at Oraibi, but that native blankets and rabbit skin rugs still predominated.<sup>2</sup> Colton (26) adds that these rabbit skin textiles were woven by the women. Bandelier (5: 157-58) considered the common materials for Pueblo

1. Harrington, M. R., "Excavation of Pueblo Grande de Nevada." *Bulletin Texas Archaeol. and Paleontol. Society.* 9: 130-145. 1937.

2. Cushing, F. N., F. W. Fewkes, and E. C. Parsons, "Contributions to Hopi History." *Amer. Anthropol.* 24: 253-98. 1922.



dress to have been cotton, deer skins, buffalo robes and, particularly among the Hopi and Zuñi, rabbit hair or skin.

Rabbit skin blankets were made by the Western Yavapai of either jackrabbit or cottontail skins cut spirally in strips while fresh. These strips were twisted on yucca fiber so that the fur side of the skins was turned outwards (54: 272). Similar use of yucca fiber was important among the Navajo (50: 457).

Although the Walapai had no true fabrics they did use yucca fiber in manufacturing rabbit skin and rat skin robes which were used both as sleeping mats and as protection against the cold (97: 82, 85-6).

#### FABRICS AND NETTING OF YUCCA

Kidder and Guernsey found fragments of twined bags made over warps of yucca in the Basket Maker culture of northeastern Arizona (92: 172), and an apron at White Dog Cave had a yucca fiber waist cord over which were hung yucca strings (59: 46). Another apron or skirt from a Canyon de Chelly Cliff Ruin was of yucca fiber of sufficient bulk to give a thickness of one to two centimeters when hanging loose (61: 54).

Wrapped about the bones of a human at Pueblo Bonito was a mass of burnt cloth, the greater part of which was simply woven of finely spun yucca cord. One specimen seems to have had a design stamped upon the cloth (126: 138). Fewkes (44: 97) found in the Little Colorado ruins evidence that yucca fiber was employed extensively in the manufacture of fabrics, and mentions that yucca fiber was often combined with cotton in the fabrics of the Red Rock Country (42: 573) and, in writing of the pueblo ruins near Winslow, states that these people made garments of yucca, agave, cotton, and juniper bark fibers (41: 534).

A fragment of slit tapestry from the Upper Salt River Valley has a cotton weft over a yucca fiber warp. The yucca fiber was twisted into a thick even cord and the weft coiled back and forth over the foundation (151: 458).

Morris (114: 180), working in southwestern Colorado, found a wooden hoop with a net-like attachment of yucca, and Jemez Cave (1: 54) yielded small fragments of a bag or net of twined yucca string woven in coiled netted pattern; similarly two fragments of a network bag were found by Haury (65: 86-7) while excavating the Canyon Creek Ruin and the Cliff Dwellings of the Sierra Ancha in Arizona. The material used was two-ply twisted yucca cord and the meshes of the net into which it was woven were approximately five-eighths of an inch square. The bottom of the bag was drawn shut and tied with a yucca rope. At Hawikuh, Hodge (76: 10) found a crypt containing prayer sticks wrapped in a fabric of yucca fiber.

*Y. baccata* fiber was widely used by the Zuñi before the introduction of sheep and was woven into skirts and kilts (155: 78; 5: 158). The central or new leaves were gathered and, after being folded into about four-inch lengths, the leaves were placed in boiling water and a small quantity of juniper ashes added. When sufficiently cooked the folds were removed and placed in a basket or bowl. When cool the epidermal layers were peeled off and the leaf afterwards chewed, first from one end and then the other until the entire leaf had been sufficiently macerated so the fiber could be removed. The fibers were separated and laid on the floor, after which they were gathered in bunches, tied with fiber string, and hung to dry. Before weaving they were soaked in cold water and worked into thread-like cords, spun and woven into a variety of garments (155: 78; 146: 65). It was from this fiber, according to Zuñi tradition, that they made their first garments upon their emergence from the underworld (137: 216-17). Similarly the earliest fabrics of the Hopi were said to have been of cotton and shredded yucca fiber (82: 252), and this latter was employed to manufacture the textiles of the early Navajo (50: 457; 5: 176).

The Tewa made fish nets of *Y. baccata* which they stretched across the river and weighted down with stones but kept floating by gourds and inflated skins. In preparing

thread for weaving these nets, the governor sent out men to cut the leaves of the plants and gather them into "hands." Fire was built in a hole in the ground, and after the ground had become thoroughly heated the embers and ashes were removed, the leaves placed carefully in the warm pit and covered with a layer of dirt and thus baked over night. The leaves were afterwards carried to the pueblo and the fiber extracted by chewing. The fiber was twisted into thread and finally woven into a net. The whole procedure was undertaken and enjoyed as a community enterprise (132: 51).

The only net made by the Coyotero Apache, used to carry cooked agave, was manufactured from split yucca leaves (120: 169). The Pima recounted to the authors similar use of the fiber of *Y. elata* to weave a net-like fabric which was used in carrying crops such as pumpkins, etc. In fashioning the article, two ribs of the giant cactus were bound together in the form of an X. Extending upward divergently at the intersection were fastened the ends of two shorter ribs held in position by a hoop attached to them and to the upper ends of the crossed ribs. A frame, resembling an inverted pyramid, was thus formed and the woven yucca net was suspended inside the framework from the hoop. This carrying frame was supported from the head by a band fastened to the upper portion of the crossed frame-poles.

In making *patcili*, a kind of tesvino, from corn stalks the Tarahumara used a net woven of yucca fiber to squeeze the juice from the pounded stalks (10: 47).

The Quahatika women wore a short skirt of yucca fiber (33: III, 41), and the village Indians of Durango, Mexico, who occasionally extended into Sonora, used cotton and the fiber of yucca in making their garments (5: 93). The Walapai (97: 99, 106) often used buckskin for clothing but a skirt was sometimes made by doubling pieces of bark on themselves and twining these together with yucca leaf strips, and an apron was often made on three strips of braided yucca fiber.

#### USE FOR HEADRINGS AND STRAPS

In the Cliff Dweller material reported by Kidder and Guernsey (92: 114), braiding was made of both yucca fiber and leaf, corn husks, juniper bark, etc. One of the commonest types was a narrow three-strand flat braid of shredded yucca leaves, making a stout cord which was employed for rafter loops, net harness, burden bands, etc. A strap or head band from a kiva (92: 117) has a weft of cotton cord while twenty-four to twenty-six yucca strings form the warp. They found the Basket Maker specimens of this sort of article to be very scanty, consisting of a large strip of raw yucca leaves that bore evidence of having been used as a carrying strap, another strap-like object of raw yucca leaves with a bit of human hair string attached to one end, and a length of flat-braided yucca fiber (92: 172). Jar rests from the Aztec Ruin are of cedar bark wrapped with yucca strips (113: 60).

A jar rest from Pueblo Bonito, measuring about fifteen centimeters in diameter, was made entirely of yucca cord over which feathers had been bound, while a second jar rest was of braided yucca leaves (126: 96). A jar rest of shredded yucca leaves bound together with strips of yucca was excavated in southwestern Colorado (114: 178).

The Zuñi used a carrying pad made of the dried leaves of *Y. baccata* split and plaited, or of the leaves of *Y. glauca*. This pad fitted over the head and was used to carry water jars. Rings of this type were found in use by Coronado and sent by him to his superior in Mexico (100: 465, 466; 155: 79). Bands of yucca leaf were worn by impersonators of the gods and in other ceremonial ways (155: 99).

The Hopi, likewise, wove head rings, head straps, and breast bands of yucca fiber for carrying or dragging loads (101: 339) and employed them in ceremonials (38: 282).

Among the Seri, the women were the water bearers and balanced their ollas on the head with the aid of a circular

cushion fashioned of yucca fiber.<sup>1</sup> Straps or belts of yucca were in general use by the Walapai. The broad maternity belt worn after childbirth and the narrower belt worn by a girl during her first menstruation were of loosely twined yucca cord (97: 82, 136-37). A belt was made of braided yucca leaf to hold up the breech cloth or apron (97: 84, 106). Upon birth of the Walapai baby a yucca rope belt was tied above the umbilical scar (97: 130). Dead rabbits were carried by slipping the heads under one's yucca rope belt (97: 205).

#### USE FOR CRADLES

Cliff Dweller material in northeastern Arizona (92: 107-8) yields cradles made by binding a stout twig into a loop which was laced across and across with an open mesh of yucca leaves. The Basket Maker cradles in this area were frequently made of grass and yucca leaves. In a flexible type of cradle, the rim, or what corresponded to a wooden hoop, was a continuous roll of grass stalks bound tightly with yucca. The front and back of the cradle consisted of coarse-meshed yucca nettings attached to the grass rim (92: 164, 165). Specimens, of Basket Maker design, employing cedar bark were made by weaving a mat of cedar bark strips, laid parallel to each other and held together by twined rows of yucca leaves at intervals of about three inches. Yucca netting drew up the sides of the mat and inclosed the cradle (92: 166). A double yucca cord sometimes found stretched across the upper surface of these cradles has been interpreted as being used to hold the diaper bundle of bark or fiber in place (59: 55-6).

Cradles excavated by Haury (65: 69) consisted of a framework of two parallel slats of split agave stalk with yucca cordage used to bind and reinforce the mat work, which was usually of beargrass (*Nolina* sp.). In this same connection may be mentioned bed heaps, found at Tularosa

1. McGee, W. J., "The Seri Indians," *Ann. Rept., U. S. Bur. Amer. Ethnol.* 17, pt. 1, p. 184. 1898.

Cave, New Mexico, rudely constructed of soft grass inclosed in a mat-like net of yucca leaves (92: 165).

There was a great variety in the delicacy, number of warp strands, and minor details of Hopi cradle floors. The matting was a band of wicker basketry, longer than the cradle was wide, securely fastened to the frame sides by lashings of yucca fiber or string.

The Walapai cradle was a frame of cat's claw (*Acacia* sp.), bent into an oval or U-shaped. Across the parallel sides of this round sticks were laid and tied in place with buckskin or yucca fibers (97: 81).

#### USE FOR BRUSHES

In the Cliff Dweller period in northeastern Arizona, brushes were made by binding together a quantity of tough straight grass stems and tying them near one end with a bunch of yucca string (92: 108). Similar brushes were used, in more recent times, by the Navajo, Rio Grande Pueblos, and the Zuñi. The short ends served in dressing the hair, the longer flexible ends for cleaning pots, dusting baskets, and meal trays, and for sweeping the floor.

At the Aztec Ruin were found aboriginal hair brushes resembling those still in use in part of the Southwest. Each brush was a cylindrical bundle of narrow strips of yucca leaves, or stiff grass stems, bound and tied in the middle. Both ends of the brushes retain combings and show about equal wear (113: 61).

The authors have found *Y. glauca* leaves commonly employed in the pueblos of Isleta, Laguna, and Acoma in placing the designs upon pottery.

At Isleta a short time ago the authors talked with a potter who recited the efficiency of her yucca leaf brush. Maria Chiwiwi of the same village stated that she learned pottery making from a member of the Laguna colony, and that this neighbor told her not to use a stick covered with wool as a paint brush but to make a brush from a piece of yucca leaf (125: 351). Brushes for this purpose are made from flat

pieces stripped from the leaf, cut to the proper length and bruised at one end to produce a fringe. Such brushes are of different sizes adapted to the coarse or fine lines which the artisan may wish to employ.

Yucca leaves were likewise used by the Zuñi to apply the pigment to their pottery, baskets, ceremonial masks, and altars (155: 82; 132: 51; 153: 330). The Hopi applied colors to their pottery with simple splints of *Y. angustissima* and *Y. glauca* leaf. The brushes were handled with marvelous proficiency and with the vessel on her lap the potter produced the lines with unerring accuracy (82: 273-74; 79: 146; 78: 40). Formerly, when the Navajo made pottery, it was decorated with a yucca brush (50: 289).

When *Sporobolus Wrightii* became hard to secure, the Pima began making their hair brushes of *Agave lechuguilla* and *Y. baccata*. These fibers make very satisfactory brushes but not so stiff as modern brushes made of bristles. The fibers were tied in a bundle a little below the middle, then folded outward from the center so that the upper end or handle was round and smooth while the lower end included all the free fiber ends. Twine was then wrapped in a coil downward from the upper end until the brush remained just long enough to give the fibers play in passing through the hair (136: 116-17; 94: 147). A somewhat similar brush made of yucca fiber was used by the Seri.<sup>1</sup> The Pima and Quahatika also used a piece of yucca leaf as a brush for applying the mesquite juice used to decorate their pottery (33: 43, 109).

The Coyotero Apache used the roots of yucca and a coarse species of grass for hair brushes. Like that of the Pima and Seri they were made by doubling a bunch in the middle and tying. As a brush it was rather coarse (120: 163). The hair brush of the Walapai was of *Y. baccata* or agave fiber and was made in the manner of those already described (97: 102, 109).

1. McGee, W. J., "The Seri Indians," *Ann. Rept., U. S. Bur. Amer. Ethnol.* 17, pt. 1, p. 227. 1898.

## MISCELLANEOUS USES

Kidder and Guersney, in northeastern Arizona, found Cliff Dweller and Basket Maker torches composed of long thin bunches of juniper bark bound with strips of yucca leaf which bore signs of having been fired (92: 108, 167). Haury (65: 106) excavated a bowstring of two-strand tightly twisted yucca cord but it should be mentioned here that there does not appear to have been extensive use of this material for such purposes in the Southwest.

In southwestern Colorado, Morris found a torch of juniper bark wrapped with strips of yucca (114: 180), and from Chihuahua comes a section of yucca stalk with rounded burnt end which may have been used as a fire-stick. A split section of yucca stalk, probably a fire board, uncovered here is rounded and has a hole drilled near the smaller end through which is knotted a piece of yucca cord (139: 80).

The Pecos River Cave Dwellers and Big Bend Cave Dwellers used the split stalk of yucca for a fireboard, and finds in the Big Bend Culture show that the pointed end of the leaf was used as a needle (138: 108; 88: 161).

The Hopi wove hoods for their fireplaces from the leaves of *Y. angustissima* (78: 38; 79: 144), and an emulsion of this plant was used in cases of insect and snake bite by the Coyotero Apache. Sore eyes were cured by placing a net made of yucca leaves over the head and encircling arms with bands of the same (120: 164). The Apache believed that Coyote taught them the art of fire making by rubbing together the dead flower stalks of yucca (13: 212). The tapering portion of the dry flower stalk of *Y. baccata* was used by the White Mountain Apache for a fire-drill, and the thicker portion of the stalk for the hearth. A cavity was ground into the hearth by means of a small stone while a piece of flint was used to saw the groove leading outward from the cavity. The cavity of the hearth was set over a stone and the drill twirled between the palms of the hands, until a glowing coal formed in the groove of the hearth, and from this coal the tinder for a fire was lighted

(80: 585-86; 147: 158). The authors have learned from informants at Acoma that the flower stalk of *Y. glauca* was frequently used as a spindle in making fire by friction, and this use, no doubt, extended to other pueblos as well.

Havasupai waterbottles were sometimes coated with piñon pitch and yucca paste (147: 127), and in tanning deerskin the deer brains were roasted and mixed in a ball of yucca fiber while the raw marrow of the spinal cord was mixed in another ball, both being used successively in tanning the hide. One of the balls was worked up in cold water to form a soapy liquid and after spraying the hair side, as well as the flesh side at the ends, with this the skin was rolled inwards from both ends and tied with leg portions of the hide (147: 142). Arrows were poisoned by dipping in a concoction made by mixing the juice of cooked yucca leaves with a powder made of big scorpions, red ants, centipedes, and jimson weed (147: 249).

Walapai pottery was baked in a fire of dead yucca roots and the sharp point of the leaf was sometimes used to pierce a baby's ears so that ornaments might be attached (97: 89, 104). For colds, rheumatism, wounds, etc., the patient before entering the sweathouse crushed yucca leaves into fibers, then in the sweathouse he produced vomiting to expel the poisons by inhaling large quantities of steam and chewing these leaf fibers (97: 119). A lance or thruster for hand to hand fighting was secured by the Northeastern and Western Yavapai from the hard flower stalk of a narrow leaved species of yucca (54: 288), and the Southeastern Yavapai sewed thin coiled baskets with an awl made from the point of a yucca or mescal leaf (53: 219). The Opata used yucca or palm leaves to cover their dwellings, and on the Sonora River, where the climate was warm, the walls also seem to have been made of yucca and canes (5: 58).

Among tribes, such as the Pueblos, Navajo, and Apache, which wore ceremonial headdresses, considerable use was made of thin strips cut from the flower stalk of yucca to build up the framework. Fragments of frames made from

this sort of material have been recovered from caves in the vicinity of El Paso, Texas (133: 3).

#### USES IN GAMES

A number of objects from Mancos Canyon, Colorado, show that yucca was used in the ceremonials or games played by the Cliff Dwellers. One of these is a dart to which a hawk feather is secured by wrapping with yucca fiber, while a second is a ball of coarse yucca stems (30: 427).

In one of the games played by the Zuñi, the object was to see who could most frequently throw a corn cob dart into a ball of yucca ribbons placed at a short distance from the players (30: 526).

The counting sticks used by the Navajo for the moccasin game were of yucca (30: 346), and in another game yucca leaves were placed in hot ashes to render them flexible and moist, after which these fibers were wound around bark or some other soft object. When of nearly the required size a small piece of an oak twig was fastened to the end of a buckskin string attached about the ball. The ball was thrown into the air, the heavier oak twig steadying it as it fell, and the player shot at the falling ball (30: 385-86; 50: 488). In still another game, the object was to toss a yucca-wrapped ring so that it fell over or touched either of two pegs set at ordinary pitching distance apart (30: 722). The impersonator of the god, *Hatdastsisi*, carried on his back a yucca leaf ring and suspended from this was a complete plant of *Y. baccata*. The ring was like that used in the game of *nanoz* and indicated that the god was a great gambler at this game (30: 459).

The Paiute, in a kind of game in which feathered darts were employed, used for target a hoop across which was stretched a net of yucca fiber (30: 498), while the Mohave are reported to have utilized bark rings wrapped with yucca fiber in the ring and pole game (30: 524). The rings used by the Tarahumara for the women's ring race were made of yucca fiber wrapped with some other material (30: 677).

The hoop and pole game of the Walapai (97: 169, 171) employed a ring of *Cowania* bark wound with yucca fiber. The hidden ball game (97: 169, 172) was played by four or five persons on either side. One person did all the guessing for his team as to which of four small mounds of dirt concealed a ball of yucca root. A similar sphere covered with gum or pitch was used in a kind of kicking ball game (97: 169), and a similar ball and counting sticks of yucca were used in the game of *nawfa* (30: 371). The White Mountain Apache made similar use of the flat leaves of yucca as counting sticks.

While not in the category of games, the use of yucca in the manufacture of dolls should be mentioned. The dolls of native manufacture which the authors have found in the various pueblos of New Mexico are usually of corn husks, but yucca was also generally employed for the purpose throughout this area. Walapai dolls (97: 169, 173) were made of yucca leaves, the ends being bent over to form the head. The ends of the leaves formed the body, with the arms manufactured of other plant material.

#### USE AS DETERGENT

The roots of the yuccas have a high saponin content and were used as soap by the Indians of the Southwest, indeed the authors find that this amole is still extensively used in all the New Mexico pueblos and among a number of the Arizona tribes. It has been a common thing in our visits to the various villages to find the roots stored outside the dwellings.

The Indians of Taos went on expeditions to secure the root of *Y. glauca*, and the San Felipe used the root of the same species for washing their hair and clothing. The roots were gathered, washed free from dirt, and crushed by pounding on a stone. The crushed roots might be rubbed on the hair or clothing or they were sometimes roasted, then allowed to stand in water and washing done in the soapy liquid after the roots had been removed. The authors have

observed women among the various pueblos preparing the concoction. The San Felipe also crushed the leaves of *Y. baccata* by pounding between stones, and used the macerated material in washing. The head itched more after washing with *Y. glauca* than with *Y. baccata*, but the former was considered a better aid in maintaining the natural color and softness of the hair.

At Jemez, the men and women were proud of their black hair and washed it in yucca root suds at least once a week and for ceremonials. Such a shampoo, aside from its ceremonial significance, was considered a good remedy for dandruff and falling hair (128: 32). The Tewa used the suds for washing hair and native fabrics and ceremonially the lather represented clouds (132: 50, 52). At Isleta, the hair was washed in these suds in connection with the ceremonies of the medicine societies and corn groups (125: 286). *Y. baccata* roots were freed from their bark by the Zuñi, pounded, and made into suds in cold water. These were used for washing the hair, fabrics, etc. (155: 83; 21: 72).

As a part of the marriage ceremony at Oraibi, the two mothers of the couple prepared two large bowls of suds from the root of *Y. angustissima*. The mothers knelt on the floor, and with the young couple in front of them, the head of the young man was washed by his future mother-in-law while that of the maiden was washed by the bridegroom's mother. Although the two mothers did the principal work, they might be assisted by relations each of whom poured a handful of suds over the head of each of the couple (160: 241). The body of a Hopi after death was not washed but after covering the corpse, the person in attendance immediately washed the hair of the deceased with yucca suds and tied it up with yucca fiber. It was considered dangerous to dream about the yucca root or head washing as this foretold death; also, the root of *Y. baccata* or *Y. angustissima* might be used in making suds for religious ceremonials (79: 145, 146; 78: 39, 40).

The Northeastern and Western Yavapai pounded the

root, stem and leaves of *Y. baccata* on a rock, then worked it in water to form a lather for washing the hair and body. It was less used by the Western than by the Northeastern Yavapai, and, although the plant grew in the mountains close at hand, a supply was always kept about the habitation (54: 279). A Northeastern Yavapai baby was washed daily with warm water and rubbed with chewed pieces of yucca stalk (54: 300). The Yavapai warrior who killed an enemy had to purify himself. For four days he bathed his body and mouth with yucca suds while the scalp which he had taken was likewise washed (54: 304). The first washing of a South-eastern Yavapai baby was in warm water, and the second day, a bath in yucca suds was given. After the birth of a child, the mother was washed with the suds; and a warrior, after being on a war expedition, was cleansed with this regardless of whether an enemy had been slain or not (53: 199, 214).

The Walapai used the suds to wash the hair, and every-day for a week after birth the mother gave her baby a bath with suds from young yucca (97: 110, 131). A girl at her first menstruation was given a bath and yucca root shampoo, while a warrior in ceremonial purification washed with yucca suds and induced vomiting by tickling the throat with a sprig of yucca leaf (97: 136, 138, 174, 176).

The Navajo liked to use yucca suds to wash their hair, and to cleanse hides before tanning, as well as employing them in ceremonial baths (50: 47, 225; 162: 13; 60: 9; 154: 257-58).

The authors, while among the Papago and Pima, were shown dried plants of *Y. baccata* which informants stated were extensively used for washing the hair. The whole plants were removed from the ground and after being taken home were hung up in the storehouses until used. When needed the entire plant was macerated on a stone and the pulverized tissue placed in water where it was allowed to remain until suds were obtained. Similar use of the plant is recorded by Russell (136: 72) and Castetter and Under-

hill (24: 51-2) in their studies of the Pima and Papago, respectively.

A Havasupai tale tells of the washing of scalps with yucca root, and after birth a mother and her baby were washed in yucca suds (147: 251, 300). In the puberty rite a girl was washed with yucca suds, and following the first menstruation after marriage, a husband and wife were bathed by their respective mothers (147: 326).

The roots of both *Y. baccata* and *Y. angustissima* were collected by the White Mountain Apache, taken home and, when needed, were pounded and placed in water to produce a lather. Baths were taken sometimes in the soapy decoction although it was more commonly used for shampooing the hair (129: 148-49).

The root was not used by the Maricopa (as is true generally for the Colorado River tribes) since they said it did not grow south of the territory occupied by the Yavapai (148: 100). But the root of *Y. decipiens*, as well as that of agave, was used by the Tarahumara for washing the hair and blankets (10: 82).

#### SOTOL

Sotol (*Dasyliirion* sp.) is considered in this paper since it constituted an important food for the aborigines in certain parts of the Southwest and, like yucca, was an important fiber plant. The plant was, at one time, even much more abundant over parts of Texas than at present since its numbers have been decreased by the practice of cattlemen chopping and feeding the crowns to cattle during dry winters. Two species are important in the state, *D. texanum* Scheele, which is to be found in southern and central Texas and *D. Wheeleri* Wats. in the southwestern part. Mounds, representing sites where aboriginal baking of the plant occurred, are distributed widely over southwestern Texas since it constituted an important food of the pre-historic Big Bend Cave Dweller, Hueco Cave Dweller, Pecos River Cave Dweller and what Setzler terms the Lipan Culture



(46: 39; 165: 61-3; 88: 165; 138: 62, 104, 110, 118; 47: 10; 87: 105; 77: 69; 56: 38).

The remains of sotol pits, which are essentially mounds of stone, around these sites indicate that its method of preparation was uniformly the same throughout the area where it grew. In preparation as food, large quantities of the crowns were gathered and placed near a site suitable for a large kiln. This kiln was a large hole three to four feet deep and several feet in diameter, and into this was placed a large pile of wood and rock in such a way that the rocks would become heated by the time the wood had been consumed by fire. The warm rocks were then arranged in the pit in such a way that the sotol could be placed on and around them. Next the pit was covered with brush and leaves, with a final covering of dirt to further insulate the mass. The whole was allowed to remain in this manner for several days during which time heat from the rocks penetrated the sotol and thoroughly cooked it. At the end of that time dirt and leaves were removed, and the crowns of sotol were spread out in the sun and allowed to dry. When dry the burned portion of the heads could be removed, after which the crowns were pounded in depressions in large rocks, known as mortars, until the mass resembled a white flour. This was finally mixed with water and made into small cakes and baked in the ashes and embers of a fire.

The Mescalero and Chiricahua Apache utilized sotol (*D. Wheeleri*) in much the same manner as mescal, but the crowns of the former were not considered so desirable for food since they were rather hard and woody, with only the younger, more tender portions being edible. They gathered the crowns when the flowers were beginning to emerge, after which these were pit baked in a manner similar to that described above. The baked crowns were removed from the pit, stripped of burned leaf bases and pounded on a rock, following which the pasty material was spread to dry on "mescal cradles." The dried product was usually saved for winter use, at which time it was eaten like a cake.

The utilization of sotol as food was limited to the Apache in southwestern Texas, southern New Mexico, and southern Arizona, as well as to other prehistoric peoples of southwestern Texas. The other Athapascans, Pueblos, Yumans, and Pimans lived for the most part outside the limits of the territory in which it was an important component of the vegetation.

The authors learned from their Papago informants that sotol was sometimes, though infrequently, used for food. The crowns might be pit baked, or another method of preparation was to remove the flower stalks and cook them as greens. The plants were present only in certain places in the Papago country, and as a result expeditions were made to these places.

Sotol leaves were used by the Pecos Cave Dweller, and the leaves were employed in the manufacture of sandals by the Big Bend Cave Dweller and Hueco Cave Dweller. Holden (77: 61) recovered cordage of sotol fiber from Murrah Cave, while Setzler (140: 107) secured sotol leaf sandals from a cave culture in southwestern Texas. In the ruins of Bee Cave Canyon leaves of sotol were numerous, and a hammock-like receptacle of plaited sotol leaves, from which the marginal spines had been stripped, was recovered (46: 39). Other pieces of sotol poles suggest that the dry flower stalks were used as hearths and fire-drills (46: 40; 88: 161). Material observed by the authors from caves in southwestern Texas indicates that sotol leaves from which the marginal spines had been removed were very extensively employed in the manufacture of mattings.

Mera (108: 30, 33, 39, 40, 45, 52, 53) has excavated sotol leaf matting of *D. Wheeleri* from the caves of southeastern New Mexico, and in several burial caves the body had been covered with such a matting.

The Tarahumara made twilled baskets from the leaves of *D. simplex* (10: 154). The weaving of hats was probably an art learned from the Mexicans, and in the manufacture of these they frequently used sotol leaves (10: 165).



*D. durangensis* furnished the Tarahumara with a good fiber. It, also, was employed extensively in the "ceremonial curing" of fields and animals, in which the animals and fields were "cured" every year to avoid sickness and to ward off lightning (10: 164, 279). The Mexicans of this region use sotol to manufacture the most common distilled liquor of the area, but the Tarahumara are not reported to have used the plant either as food or drink (10: 164).

Informants among the Papago stated that sotol (*D. Wheeleri*) leaves were widely used in the manufacture of large mats. Expeditions were made to the mountains and quantities of fresh leaves gathered. After being brought home the spines were removed by stripping the margins from either side of the leaf, after which the leaves were twilled into mats of the desired size. These mats were put to a variety of household uses and were used extensively as surfaces on which various vegetable products might be dried in the sun. The Pima organized expeditions to gather leaves of *Y. elata* and *D. Wheeleri* (136: 42), and, according to informants, manufactured mats in a manner similar to the Papago. Although the authors have observed these mats among the Papago, they seem to be absent among the modern Pima.

#### BEARGRASS

A third plant closely related to yucca and sotol is beargrass or sacahuiste (*Nolina* sp.). The plant produces a dense crown composed of many leaves which are narrow and longer than those of yucca. There is no evidence that the seed of the plant was ever used as food by the aborigines, but the leaves were extensively employed by Indians of the Southwest in the manufacture of coarse forms of basketry.

In the ruins of Bee Cave Canyon, Fletcher (46: 41) found that the long, slender leaves of *N. texanum* Wats. and *N. erumpens* (Torr.) Wats. had been used in making baskets and mattings and employed for thatching roofs. The leaves of *N. texanum* were found in Murrah Cave (77: 62),

which might be taken as evidence that they were used for basketry and matting by the former inhabitants of the area. The early inhabitants of southeastern New Mexico used mattings of *N. microcarpa* Wats. to cover their dead. Leaves were a tying material as well as a foundation element in coiled basketry. The authors after observing the number of specimens of basketry and matting from prehistoric sites in western Texas, in the manufacture of which *Nolina* was employed, are surprised that its occurrence is not reported more generally by the archaeologists working in the area.

Haury (65: 72, 74) found beargrass (*N. microcarpa*) to have been used in basketry excavated from the Canyon Creek Ruin and Cliff Dwellings of the Sierra Ancha, where it was also usually employed in the manufacture of mattings (65: 81). Many hanks and coils of beargrass were recovered, and the wattle framework of storage bins was bound together with beargrass, while the cross pieces which held the split boards of the roof in position were tied with the same material (65: 87).

It is probable that a certain amount of material identified as yucca includes some basketry made of beargrass.

*N. microcarpa* was employed extensively in fashioning the coarse plaited baskets used by Pueblo Indians for storage containers, receptacles for washing grain, etc. These baskets were made in sizes ranging from that of a small bowl to receptacles holding upwards of a bushel or more. The authors have found them in current use throughout the Pueblo area and have observed their manufacture at a number of places.

Women and children would make a trip to the foothills or lower portions of the mountains, where the plants grew in abundance, to collect the green leaves. These were tied in bundles, carried home and fabricated into baskets while still green and pliable. In the manufacture of the baskets the leaves were first plaited on the floor into a flat mat of the desired size. The mat was then fashioned into a shallow basket by tying the edges outward over a stick which was

bent in the form of a circle. In the case of small containers the stick was usually removed although in the very large ones it often remained to serve as a rim. Such baskets were very coarsely constructed, and never decorated since they were not an article of trade but made with the idea of serving as inexpensive containers.

Papago informants stated that *N. microcarpa* was an important basketry material. In early summer, men, women and children organized into an expedition which journeyed to the mountains for several days to collect the leaves. Although the making of baskets was a woman's task, it was formerly necessary for the men to go along as protection against marauding Apache. Consequently the men often helped in collecting the leaves. As many of the best leaves as needed were procured and carried home, where they were laid to dry in the sun for several days. Before fashioning into a coil the dry leaves usually were split between the teeth, aided by the fingers and fingernails. The coil might be sewed into a fairly tight basket with *Y. elata*, and recently the Papago have manufactured a more open basket in which the sewing leaves a major portion of the coil exposed.

Kissell (94: 137, 139, 183, 198) found *N. microcarpa* widely used by the Papago but makes no mention of it among the Pima. The authors were told by Pima informants that in the early days the long leaves of beargrass were used to fashion the coil for large wheat storage baskets. In the manufacture of these baskets the long leaves were worked into the coil and sewed with mesquite bark.

The hearth of the Yavapai firedrill was a split beargrass (*N. microcarpa*) flower-stalk (53: 204; 54: 269). It was placed concave side up and a notch cut in one edge to allow for accumulation of the dust. A little sand or fine gravel was used in the first drilling of the hole, and grass served as tinder to catch the pile of dust and spark from the drill.

The Northeastern Yavapai used the leaves of *N. micro-*

*carpa*, or juniper bark, for the outside thatching of their dwellings, although juniper bark was preferred (54: 271). Beargrass leaves were used in constructing bed mats (54: 272), also to wrap cakes of sahuaro fruit, juniper berries, or mesquite meal for transportation from place to place (54: 285).

The Havasupai used beargrass for the hearth of the firedrill while the White Mountain Apache used the stalk of *Y. baccata* (147: 143).

*N. durangensis* furnished the Tarahumara with a good fiber for twilled basketry (10: 5, 165). In more recent times, they have learned from the Mexicans the art of weaving hats. These hats are frequently woven of beargrass leaves and have served as an article of trade between the Tarahumara of the barrancas and their fellow tribesmen of the mountains (10: 155).

#### SUMMARY

The fleshy-fruited *Y. baccata* was utilized widely for food by practically all aborigines of the American Southwest. It was not gathered extensively by the Pima and Papago and was absent from the territory inhabited by the lower Colorado River tribes. It was present in the mountains and foothills of the eastern Mohave Desert of California, southern Nevada, southwestern Utah and southwestern Colorado. It occupied northern, central, and parts of southern Arizona, the greater part of New Mexico, and extended into southwestern Texas. Although archaeologists frequently have failed to record its importance as a food plant in sites which have been excavated, from evidence at hand one is led to conclude that it was an important food material of the earliest cultures of the Southwest. In southern New Mexico and southwestern Texas the baccate fruits of *Y. Torreyi* were eaten occasionally and among the tribes of southern California, northwestern Arizona, and southern Nevada those of *Y. schidigera* and *Y. brevifolia* were gathered also.

The flowers and green fruits of the dry-capsular species were cooked occasionally. Among the Papago, as well as the Apache of southern New Mexico, *Y. elata* was eaten. The Pueblos, as a rule, made some use of *Y. glauca* while the Hopi sometimes added the fruits of *Y. angustissima* to their diet.

Although *Yucca* was gathered widely for food, the leaf or fiber extracted from it was the most important product secured from the plant. The various cave cultures of western and southwestern Texas, the Hohokam, and early Basket Maker and Pueblo peoples relied heavily upon the fiber of the plant, and the little archaeological evidence at hand indicates that it was of great importance in prehistoric Mexico. Within the present period it has been used extensively by all the Indians of the Southwest, with the exception of the lower Colorado River tribes. Mention has been made in the text to the range of the various species. It is not necessary to summarize the importance and use of the fiber among each of the prehistoric cultural groups for the plant was important to all.

The split leaves or fiber were utilized extensively in the sandal industry of the Cave cultures, Hohokam, Basket Maker, and early Pueblo peoples. The fiber was employed universally by all cultures as a common tying material and was woven into nets and fabrics and formed the foundation for feather and fur cloth. The leaf was used widely in the manufacture of baskets and mattings. Because of its great accessibility yucca was put to use in those industries where the Indian employed fiber and the species used was the one nearest at hand. Its unimportance among the lower Colorado River tribes was due to its absence from their territory.

The third important use of yucca was as a detergent. Throughout the range of the various species it was utilized widely for washing the hair, fabrics, etc. The root or occasionally the whole plant was made to yield up its saponaceous ingredients by pounding in water.

In the opinion of the authors yucca ranked foremost

among the wild plants utilized by the inhabitants of the Southwest. It holds this place because of the great variety of uses to which it could be put and to the wide accessibility of the genus within the Southwest.

Sotol, like yucca, was an important fiber plant and was gathered for food in certain areas. The prehistoric people of southwestern Texas as well as the Apache of southern Arizona and New Mexico roasted the crowns of *D. Wheeleri* and *D. texanum* in a manner similar to that in which agave was prepared. Judging from the remains of pits where roasting occurred, it would appear that sotol was a very significant food among the Big Bend Cave Dwellers and the Lipan Culture. It should be noted that the utilization of sotol for food was limited because the range of the plant is confined to southwestern Texas, southern New Mexico, and southern Arizona.

Sotol leaves were manufactured into sandals by prehistoric inhabitants of southwestern Texas and southeastern New Mexico. These people, as well as Papago and Pima, plaited the leaves into mats, and the Tarahumara, in addition, used the leaves of *D. durangensis* in their basketry. Sotol was outranked strongly by yucca as a fiber plant, for yucca also occurred in the areas where sotol was present and could be fabricated with less difficulty.

Beargrass was utilized throughout the same area as yucca in the weaving of mats and baskets. Because of the greater length of its leaf the former was employed frequently as a foundation element for coiled basketry or was plaited into large baskets for washing and storing grain. It was not used so extensively as yucca nor was it ever fashioned into so fine a basket.

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