Archeoethnobotany of Cordova Cave, New Mexico

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Introduction

Cordova Cave is located in southwestern New Mexico in the drainage of the upper Gila River at an elevation of about 6840 ft. above sea level and about 1000 ft. above the San Francisco River. According to the excavators, Martin and his coworkers (1952), the cave was the site of human habitation from about 300 B.C. to about A.D. 1100. Because ceramic pot sherds were not abundant or highly diversified, a fine chronological division of human culture change at different levels in the cave fill could not be made.

The culture divisions capable of recognition are, from the lowest level of the cave fill to the surface, or present floor of the cave: Prepottery, about 300 B.C. to A.D. 1; Plain Ware Horizon, about A.D. 1 to A.D. 700; Late Horizon, about A.D. 700 to A.D. 1100. An ash layer shows that a severe and extensive fire occurred sometime between A.D. 1 and A.D. 500. This fire destroyed much of the vegetal material in existence at and below the surface at that time. After this fire, but not necessarily because of it, occupation of the cave was limited to small parties of hunters. Dampness of the sand at early Prepottery levels created favorable conditions for the decay of perishable materials.

Present Vegetation at the Cave Site

The valley floor and terraces of the San Francisco River are well watered and grasses are abundant. On the upper east-facing slope in which the cave is situated grasses are infrequent; *Pinus edulis* Engelm. (piñon) and *Juniperus Deppeana* Steud. (alligator juniper) are present. These shrubby trees persist to the higher reaches of the slope. *Opuntia* spp. of the flat-jointed and cylindrical groups and *Echinocereus* sp. are present. *Bouteloua hirsuta* Lag. (hairy grama) is present in isolated tufts up to the cave. Also present are *Agave* sp. and *Nolina* sp., particularly where the tree cover is sparse.

Several seep lines on the higher slopes provide niches for a few limited communities of herbaceaous dicotyledons and *Phragmites communis* Trin. (common reed). Above the grey sandstone face into which the cave opens, juniper and piñon continue to dominate the slope. Several hundred feet higher, at the crest, *Pinus ponderosa* Dougl. (western yellow pine), is the dominant plant cover.

Although a few crop plants could have been grown near the seeps, neither slope nor crest offers any extensive agricultural site. The nearest land that might have been used for subsistence scale farming lies below, in the valley of the San Fransisco. The presence of small ruins in the valley suggests the existence of a people nearer to the agricultural land and possibly contemporaries of the cave dwellers (John Rinaldo in conversation). The large number of projectile heads found in the cave by the excavators suggests that the occupants were preeminently hunters.

The species reported below were identified from fragmentary remains of plant materials that had been brought into the cave during its occupation. The excavators separated out the plant materials at the site, often with the aid of a ¼ inch mesh sieve. Frequent reference was made to herbarium collections of the Chicago Natural History Museum during identification. The nomenclature and arrangement of the list of identified plants are in accord with Kearney and Peebles, *Flora of Arizona*, 1951, referred to subsequently as: K. & P.

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Fig. 1. Cordova Cave, entrance.

Vegetal Materials

Pinaceae

1. *Pinus edulis* Englm., piñon. Numerous seeds and occasional cones were found at all levels. The use of piñon seeds for food is well known. Ripe seeds are gathered on the ground after the first frosts (Standley, 1912) in New Mexico or are taken from rodent caches. Nearly ripe cones are opened by roasting (K.&P., 1951). The "pine nuts", although abundant, could be expected to yield little information concerning changes in food utilization from one level to another because of their extensive transport by pack rats.

2. *Pinus ponderosa* Dougl., Western yellow pine. Large amounts of the bark and wood of this tree and a few cones were found distributed throughout the cave. Their principal use was probably as fuel. Use of the seeds (much smaller than those of the piñon) for food has not been reported, but Standley (1912) notes that Zuñis ate the inner bark of this tree.

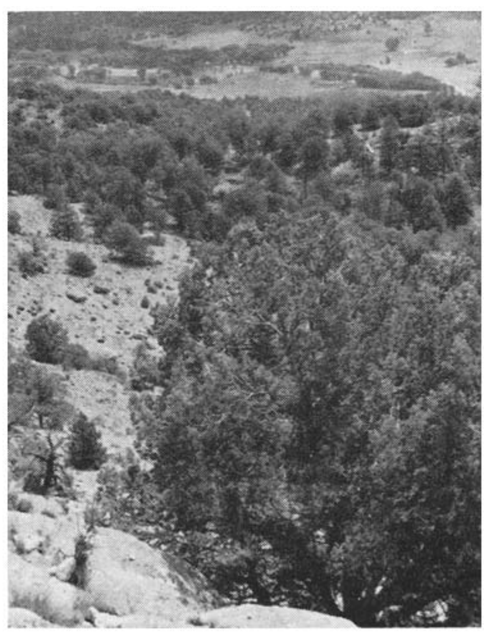

Fig. 2. Vegetation aspect, July. Looking from Cave toward San Francisco River.

Cupressaceae

3. *Juniperus Deppeana* Steud., alligator juniper. A small number of seeds and occasionally fruits, "juniper berries", were found at all levels.

4. *Juniperus monosperma* (Engelm.) Sarg., one-seed juniper. Seeds and occasional fruits were found at all levels and were particularly abundant in bear feces. Use of "berries" as food and seasoning has been common among indigenous peoples of the Southwest (Yanovsky, 1936).

5. *Juniperus osteosperma* (Torr.) Little (*J. utahensis* Engelm.), Utah juniper. Identification doubtful. A small number of seeds and occasional fruits were found at all levels of the cave. Use of the berries has been the same as noted for the fruits of other junipers.

6. *Juniperus* spp. Juniper, or inappropriately, cedar. Masses of bast, or inner bark from the fibrous-bark junipers (mainly *J. monosperma* ?) were found at all levels of the cave. This material has been widely used by Indians of the Southwest and other areas for bedding, basket lining, tinder, and for other purposes (Whiting, 1959).

Gramineae

7. *Poa Fendleriana* (Steud.) Vasey, mutton grass. Occasional spikes of this grass were found. Cutler (in Martin et al., 1952) suggests that plants of this species were gathered for the grains which presumably were eaten.

8. *Phragmites communis* Trin., common reed, carrizo. Sections of the culms have been widely used in the Southwest for cigarette casings and for arrow mainshafts (Martin et al., 1952). Rhizomes and grains have been used for food. Curiously, among the abundant grass remains at Bat Cave, thirteen species, no common reed was present (Smith, 1952).

9. *Koeleria cristata* (L.) Pers., June grass. A few spikelets of this perennial grass were found.

10. *Sporobolus* sp. or spp., Whiting (1950) reports that grains of *S. airoides* Torr., alkali sacaton, *S. flexuosus* (Thurb.) Rydb., dropseed, and *S. giganteus* Nash, giant dropseed have been gathered in quantity by the Hopi for food, particularly in times of famine. Whiting cites also the 1901 description by Dorsey and Voth of the use of *S. giganteus* in making the prayer stick of the Soyal ceremony.

11. *Bouteloua* sp., grama grass. A few spikes were found.

12. *Zea Mays* L. Maize, Indian corn, Complete and fragmented cobs, kernels, husks, and stalks were found at all levels. These remains are under study by Dr. Hugh C. Cutler. Although maize may have been obtained by trade, its presence and abundance is consistent with the hunting preoccupation of the Cordova Cave peoples, as is the absence of cultivated cucurbits and the virtual absence of beans. Of these three staple crops of the American Southwest, maize has been suggested as the most likely to be successful under the desultory agricultural practices of a hunting people (Franke and Watson, 1936).

Liliaceae

13. *Yucca elata* Engelm., soaptree yucca, palmilla. The fragments of from two to four fruits were found in the debris. Fruits of this species and of the other dry-fruited yuccas have been eaten green or stored, and cooked before eating, by Indians of the Southwest (Standley, 1912).

14. *Yucca baccata* Torr., banana yucca, datil, blue yucca. The fragments of from four to five fruits were found in the upper levels. Datil fruits have been used extensive-

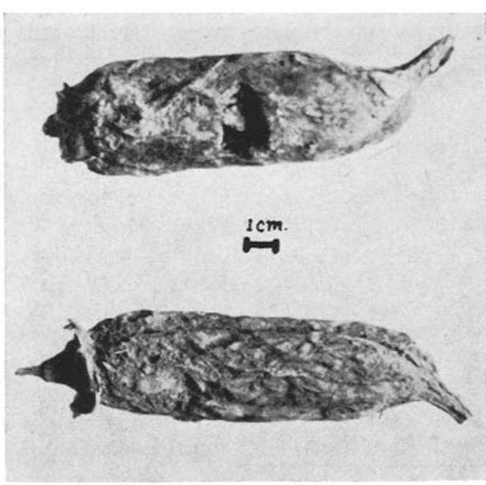

Fig. 3. *Yucca baccata* fruits; Tularosa Cave.

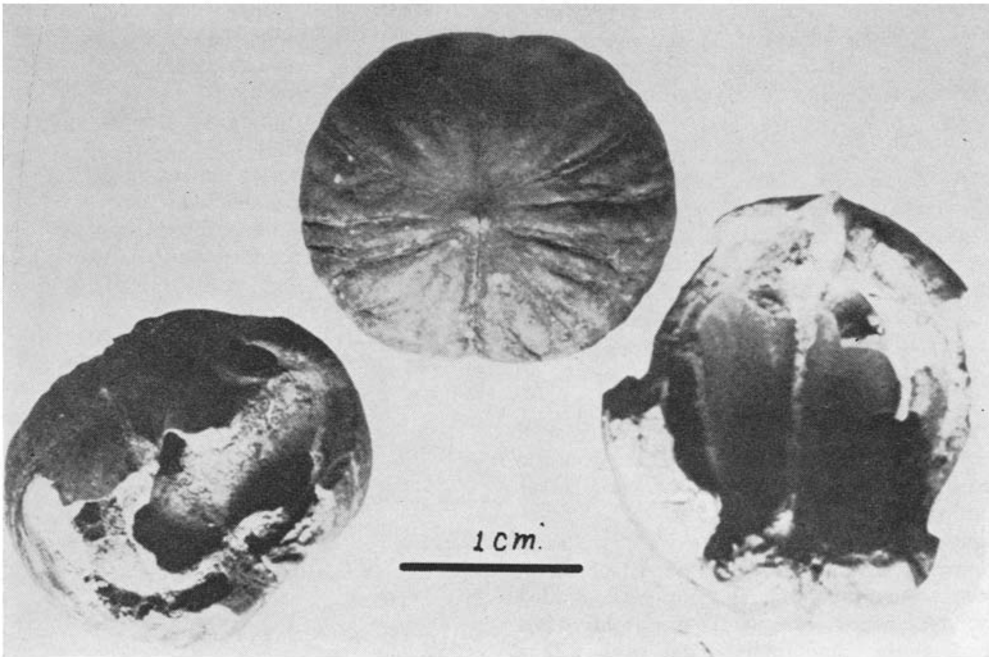

Fig. 4. *Juglans major*, nutshells; Cordova Cave.

ly by Southwest Indians for food. The fresh fruit which is available from April to July has been eaten raw or cooked or has been prepared for winter use by drying, grinding, and forming into cakes (Standley, 1912).

15. *Yucca* spp. Leaf fragments, fibrous compactions and pieces of twisted or knotted cords made from leaf fibers of yuccas were frequent at all levels of the cave. Martin and his coworkers (1952) have discussed the artifacts composed of these materials. Bell and Castetter (1941) have surveyed the utilization of yuccas and related plants in the Southwest. The identification of yucca fibers and fibers of the three taxa that follow in this list are based on gross study of the large fragments and microscopic study of macerated fibers that were compared with macerated materials from herbarium specimens. Equal parts of 10% chromic acid and 10% nitric acid were used according to the method of Jeffrey (Sass, 1940), to macerate the tissue. The fragmental state of much of this material made it inconvenient to apply the methods of Bell and King (1944).

16. *Nolina* sp. (probably *N. microcarpa* Wats.), sacahuiste, bear grass. Eight to ten leaf fragments were found. The use of beargrass leaves, mostly for basketry and matting, has been reviewed by Bell and Castetter (1941).

17. *Dasylirion Wheeleri* Wats., sotol. Ten leaf fragments were found. Sotol leaves have been employed as cordage, matting, and basketry material; the crowns, roasted, have been used for food and fermentation in the Southwest (Bell and Castetter, 1941).

Amaryllidaceae

18. *Agave* sp. (probably *A. parryi* Engelm.), century plant, mescal, lechugilla, amole. Leaf fragments, masses of fiber, and fibrous compactions were found at all levels of the cave. The utilization of mescal, especially the baked crowns which consist of the much shortened stem and some root tissue, for food and drink in extensive areas of the Southwest and Mexico is reviewed by Castetter, Bell, and Grove (1938). According to the distribution of mescal baking pits shown by these authors, the pits have not been found in the drainage of the San Francisco River. The use of *Agave* fiber or leaves in the manufacture of artifacts was not noted

by Cutler in his report on a preliminary survey of plant remains of Tularosa Cave (in Martin et al., 1952). No *Agave* remains were reported from Bat Cave (Smith, 1950).

Juglandaceae

19. *Juglans major* (Torr.) Heller (*J. rupestris* Engelm. var. *major* Torr.) walnut, nogal. Fragments and whole specimens totaling about 100 walnuts were found. The native walnut, although small and thick-shelled with little meat, has been gathered for food by many Southwestern peoples.

Fagaceae

20. *Quercus* sp. (or spp.), oak. Acorns have been used widely for food and in some areas of the Southwest have constituted a staple of the Indian diet. In southwestern New Mexico, however, there is no evidence to suggest that this food attained major importance at any period. A few acorns were found at almost every level of the cave fill. Much of the wood found in the cave is oak.

Chenopodiaceae

21. *Chenopodium* sp. (or spp.) goose-foot. Stem fragments, although not numerous, were found at almost every level in the cave. The leaves and shoots of goose-foot can be eaten as greens and the seeds have been prepared for food in Arizona (K. & P. 1961).

Rosaceae

22. *Cercocarpus* sp. (probably a variety of *C. montanus* Raf.), mountain-mahogany. Four achenes were found.

Loasaceae

23. *Mentzelia* sp., stick-leaf. A jar containing about three pounds of stick-leaf seed was found in square 3L1, level 4. Whiting (1950) notes the use of *M. multiflora* (Nutt.) A. Gray seeds, parched and ground, as a food of the Hopi reported by Hough in 1898 but was unable to verify this. Kearney and Peebles (1951) state that the seeds of *M. albicaulis* were used by Arizona Indians to make an edible parched meal, but they give no authority for this assertion. The finding of mentzelia seeds stored in quantity is regarded as verification of the accuracy of the reported food use in the Southwest.

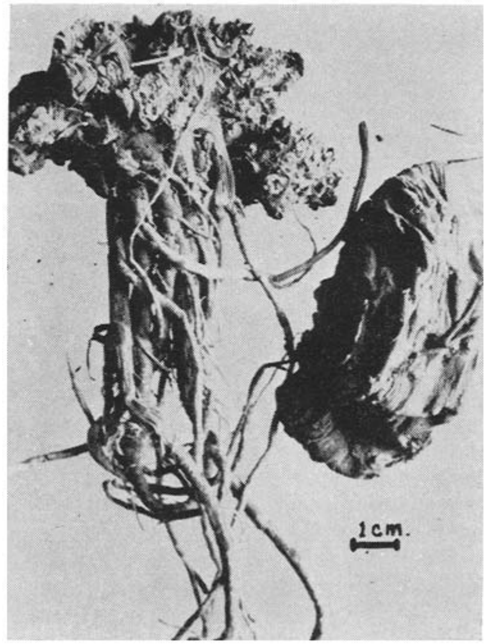

Fig. 5. *Echinocereus* sp. Cordova Cave. Fragment of succulent stem, right; crown and roots, left.

Cactaceae

24. *Echinocereus* sp. hedgehog cactus. Several fragments of shoots and root crowns were found. The young shoots of some cactuses (see the following entry) have been used for food or drink, the roots have been eaten and have been used medicinally. No specific reference to the hedgehog cactus as a food plant is known to the author.

25. *Opuntia* sp. flat-jointed prickly pear, nopal. Fragments of the joints were found. The succulent shoots, after removal of the spines by peeling, abrasion, or burning, are used widely in Mexico and the Southwest as food. Medicinal use of the flat-jointed nopals has been recorded by Martínez (1944, p. 429) for Mexico.

Martyniaceae

26. *Proboscidea parviflora* (Wooton) Woot. & Standl. (*Martynia parviflora* Wooton), unicorn plant, devil's claw. The fragments of from four to six fruits were found. The young fruits are edible, fresh or

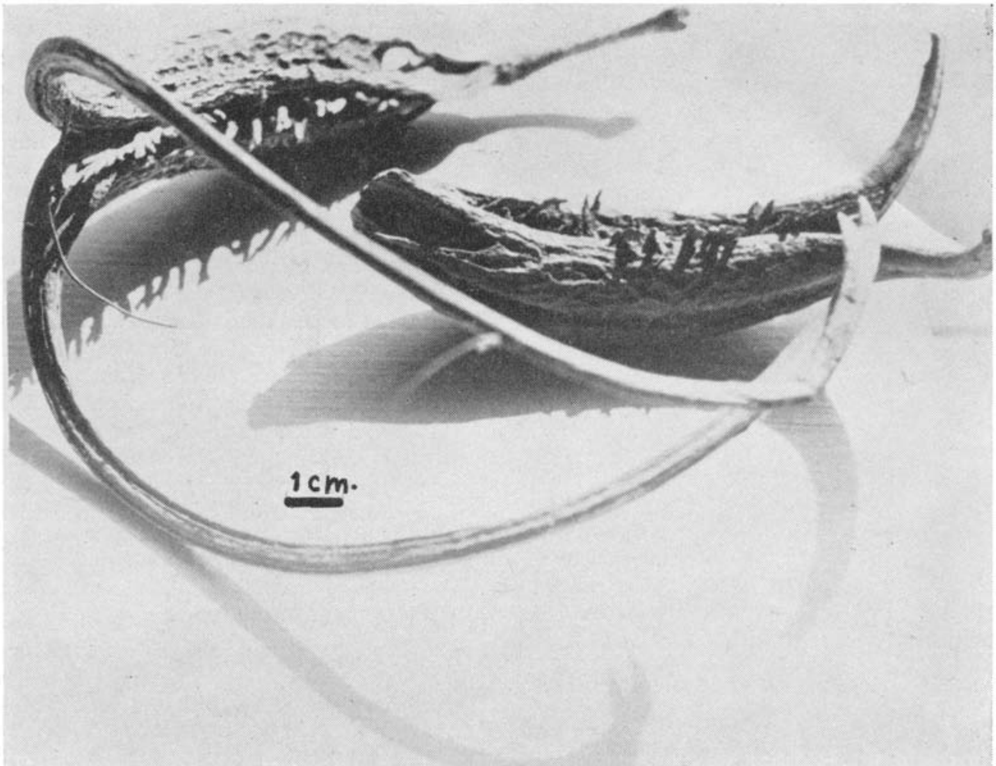

Fig. 6. *Proboscidea parviflora*, fruits; Cordova Cave and Tularosa Cave.

cooked. The mature pods are split and used to create the black designs in the basketry of the Pima and other Arizona Indians (K. & P., 1951). However, this material does not appear in the basketry of Tularosa and Cordova Caves.

Cucurbitaceae

27. *Cucurbita foetidissima* H.B.K., buffalo gourd, calabazilla. The fragments of fruit exocarps totaling 1373 square centimeters, fibrous pulp, and seeds were found. Thickened root fragments amounting to 587 cubic centimeters, tentatively assigned to this species were recovered. The fruits and seeds have been eaten by Southwest Indians (K.&P., 1951; Standley, 1912).

28. *Lagenaria siceraria* (Mol.) Standl., bottle gourd, lagenaria. Fragments of the gourd exocarps totaling 510 square centimeters were found distributed throughout the cave. The mature dried fruits are widely used as implements and containers; the young fruits and shoot tips are edible. This cucurbit is of world-wide distribution and is well established as a cultigen in the Southwest. Whitaker and Bird (1949), Towle (1952), Whitaker and Carter (1954), and Whitaker *et al.* (1957) have discussed lagenaria in pre-Columbian America.

Leguminasae

29. *Phaseolus vulgaris* L., common bean. One pod containing a single immature seed was found.

Compositae

30. *Helianthus* sp., sunflower. About 25 inflorescences were found. The abundant sunflower remains of Tularosa Cave have been discussed by Dr. Charles B. Heiser in Martin *et al.* (1952).

31. *Cirsium* sp., thistle. Leaves and inflorescences having the characteristic "wooly" quality and spines were present in all levels. Thistles have been used medicinally by the

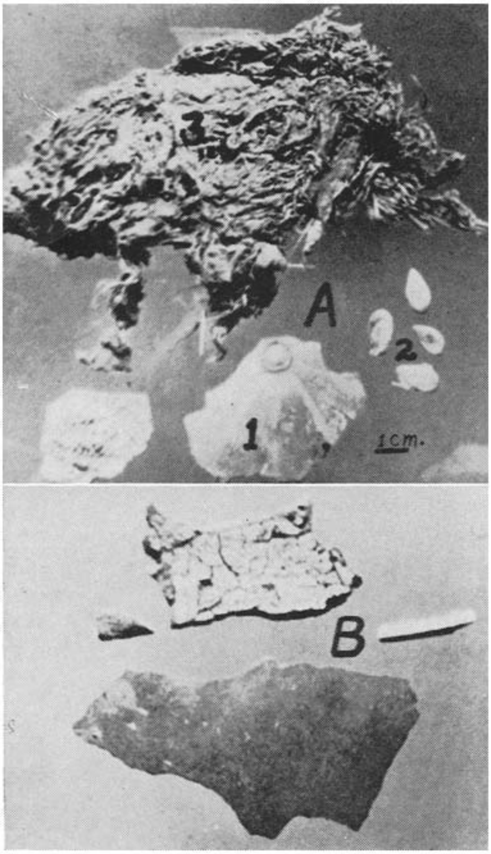

Fig. 7. Cucurbit remains, Cordova Cave. A. *Cucurbita foetidissima*: 1, exocarp fragment with abscission scar; 2, seeds; 3, fruit fiber. B. *Lagenaria siceraria*, exocarp fragments.

Hopi (Whiting, 1950; K. & P. 1951) and by the Navajo (K. & P., 1951).

Discussion

After identification, some of the classes of vegetal materials were measured quantitatively in an attempt to discover relationships to major culture horizons of the cave. Percentages of materials shown in Table 1 were calculated by determining the absolute quantity (QP) of a given class of plant material in a way appropriate to the plant parts represented. These quantities were then corrected to take into account the total volume of excavated material in each horizon (V).

As a formula:

$$\frac{QP}{V} \Big/ \frac{Q\Sigma P}{\Sigma V} \quad 100$$

where Q P = total quantity of a class of plant material in three culture horizons;
and ΣV = total volume of excavated material in three culture horizons.

Of the plant materials appearing in Table 1, *J. major, Z. Mays,* and fibrous compactions as a class are those that the author considers to have increased in frequency because of an increase in their use as food subsequent to the introduction of pottery about A.D. 1 and later. But no new food plant species, cultivated or wild, was introduced, despite the presence of pumpkins and beans in the area. Although both cultivated and wild food plant remains increased during late times, no explanation for what may have been a major dietary change is suggested by any of the cultural changes described for these times by Martin and his collaborators (1952).

An effort was made to detect possible in-

Fig. 8. *Cirsium* sp., fiber and epidermal hair mass; Cordova Cave.

TABLE 1
FREQUENCY OF SELECTED PLANT MATERIALS IN THE CULTURE HORIZONS OF CORDOVA CAVE

	Prepottery 300 B.C.–A.D. 1	Plain Ware A.D. 1–700	Late A.D. 700–1100
FOOD AND UTENSILS			
Cucurbita foetidissima: fruit exocarps	14%	60%	26%
Lagenaria siceraria: gourd exocarps	6%	41%	53%
Juglans major: nuts	16%	24%	60%
Zea Mays: cobs	30%	27%	53%
WOOD, non artifact, presumably fuel pine and oak	33%	40%	27%
FIBROUS COMPACTIONS			
Yucca	15%	42%	43%
Agave	5%	42%	53%
All other compactions	17%	32%	51%

fluence of selection on the plant materials treated quantitatively. Changes in size of the part of a plant that is used over a period of time might be one result of selection. The fruits of *C. foetidissima,* because they have a regular, spheroid form, offered a good opportunity for determination of size from fragmental remains. The fruits of *L. siceraria* are so variable in form that only a series of whole fruits of a particular form could reveal changes in size.

More than simply being measurable, *C. foetidissima* is the kind of plant that, when collected and accumulated in a cave for hundreds of years, merits some attention to its status as a possible domesticate. The buffalo gourd has never been reported as a cultigen, but it certainly has the properties of a potential cultigen, particularly in the Southwest. It grows admirably in disturbed lands and on trash heaps and produces useful fruits and seeds and edible roots. Because of its success as a weed and its trailing growth habit, it, like other cucurbits, fits well into maize agriculture. Although the unpleasant odor of the buffalo gourd may have had something to do with its not being domesticated, it was used. Other plants of strong odor have been domesticated and used in such ways that their olfactory properties are fully felt: the onions and garlics as spices and condiments; *Tagetes patula* in suffocating leis for honored guests in India; asafetida in medicine and the diet; and the many food products whose preparation includes anaerobic decomposition of proteins.

To determine whether *C. foetidissima* fruits have changed in size during the history of the cave, the data presented in Table 2 were evaluated.

Calculating the diameter of the roughly spherical fruits from the bottom row of data in Table 2 gives a range of about 2-2.5 cm., or much less than the diameter of *C. foetidissima* gourds, about 10 cm., according to Kearney and Peebles (1951). The differences among the measurements in the three culture horizons are not significant. Because many of the exocarp fragments measured were much larger than the calculated surface area of the prepottery buffalo gourds, poor preservation of the original ratio of scarred to unscarred gourd fragments must be assumed. This differential preservation might be the result of greater resistance to decay of the abscission-scarred fragments or of

TABLE 2
CUCURBITA FOETIDISSIMA EXOCARPS IN CORDOVA CAVE

	Prepottery	Plain Ware	Late
Total area of exocarp fragments	184 sq. cm.	904 sq. cm.	285 sq. cm.
Number of fragments bearing abscission scars	9	57	16 sq. cm.
Total exocarp area/number abscission scars	20 sq. cm.	16 sq. cm.	18 sq. cm.

food or other use that favored rapid destruction of unscarred fragments of the exocarp.

Although the quantitative method employed here does not show actual fruit size for *C. foetidissima*, it does reveal that there was no significant change in the size of this organ over a period of 1400 years, during which the gourds were gathered. Thus, while *C. foetidissima* is a plant that is useful, has been gathered over a long period, and thrives under cultivation, it never responded to, or was never subjected to, human selection. If selection were carried on, then there was no mechanism for the propagation of selected strains.

The roasting or boiling of seeds, and the use of the young *C. foetidissima* fruits for food (Cutler and Whitaker, 1961) would not involve the kind of fruit selection that might tend to produce viable seed more frequently from larger than from smaller fruits. However, the use of the less obnoxious fruit pulp of other cucurbits that were eventually domesticated would very likely have involved selection for size by food collectors. The storage of mature fruits, a primary pattern of use (Cutler and Whitaker, 1961), would offer many opportunities for stray seeds to be disseminated and find niches in middens where fertile conditions would permit their genetic potential to be fully expressed.

Most of the fibrous compactions found in Cordova Cave are leaf fibers that are doubled, twisted, or masticated into masses of from 2 to 10 centimeters long, flattened, and about one-third as broad as long. The compactions are usually devoid of epidermis and parenchyma and are partially or completely impregnated with foreign material that is indistinguishable from the dusty fill of the cave.

Of the 385 compactions recovered from the cave, 195 are derived from the leaf bases or crowns of agave, 78 are yucca leaf, 42 are from one or more kinds of wild fruits, 12 are unidentified phloem fiber, 10 are cactus fiber, six are buffalo gourd fruit pulp, and two are corn husk.

The increase in frequency of compactions, particularly where this coincides with the introduction of pottery in the Plain Ware Horizon, may be interpreted in part according to Cutler's suggestion that these artifacts (in Tularosa Cave) were used as pot cleaners or in the polishing of ceramic wares. But the continued increase of compactions extending into Late Horizon times is the result probably of an increase in food use of the gathered plant materials from which the compactions are derived.

Although few of the compactions bear definite dental impressions and can with assurance be called masticates, the nutritive juice of agave, baked or heated to transform complex polysaccharides to sugars and break down cellular integrity, is extracted so readily as to require little chewing. While the relevance to food resources of these fibrous materials in an area where there are no mescal baking pits might be questioned, it may be noted that in some regions baked mescal is traded over long distances. Informants in Aguacatenango, Chiapas, Mexico, state that in times of local maize shortage people from Comitan where agave is abundant come about 30 miles on foot to sell or trade baked mescal.

Summary

1. Thirty-one plant species from a prehistoric occupied cave in southwestern New Mexico are identified. Some possible uses of many of the plants are suggested.

2. *Cucurbita foetidissima*, the fruits of which were gathered and which has some of the traits of a potential domesticate, shows no effects of human selection over a period of 1400 years.

3. Several classes of vegetal materials measured quantitatively vary in frequency with changes in human culture but the relationship of these variations to culture change is not apparent.

4. An early but questioned report of the use of *Mentzelia* seed for food is supported by the presence of a quantity of the stored seed in the cave.

5. The significance of fibrous compactions, or masticates, present in this cave which is outside of the range of mescal baking pits is discussed.

Acknowledgment

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Literature Cited

Bell, W. H., and C. J. King. 1944. Methods for the identification of leaf fibers of Mescal (*Agave*), Yucca (*Yucca*), Beargrass (*Nolina*), and Sotol (*Dasylirion*). American Antiquity **10** (2): 150-160.

———, and E. F. Castetter. 1941. Ethnobiological studies in the American Southwest, VII. The utilization of Yucca, Sotol, and Beargrass by the Aborigines in the American Southwest. U. of New Mexico Bull. Biol. Ser. **5** (5): 1-74.

Castetter, E. F., W. H. Bell, and A. R. Grove. 1938. Ethnobiological studies in the American Southwest, VI. The early utilization and distribution of *Agave* in the American Southwest. U. of New Mexico Bull. Biol. Ser. **5** (4): 1-92.

Cutler, H. C., and T. W. Whitaker. 1961. History and distribution of the cultivated cucurbits in the Americas. American Antiquity **26** (4): 469-485.

Franke, P. R., and D. Watson, in D. D. Brand. 1936. Symposium on Prehistoric Agriculture. U. of New Mexico Bull. Anth. Ser. **1** (5): 35-41.

Kearney, T. H., R. H. Peebles, and collaborators. Arizona Flora. University of California Press, Berkeley and Los Angeles, 1951.

Martin, P. S., J. B. Rinaldo, E. Bluhm, H. C. Cutler, and R. Grange, Jr. 1952. Mogollon Cultural Continuity and Change. Fieldiana: Anthropology, Vol. 40.

Martínez, M. Las Plantas Medicinales de México, Ed. 3, Ediciones Botas, Mexico, D. F., 1944.

Sass, J. E. Elements of Botanical Microtechnique. New York, 1940.

Smith, C. E., Jr. 1950. Prehistoric plant remains from Bat Cave. Bot. Museum Leaflets, Harvard Univ. **14** (7): 157-180.

Standley, P. C. 1912. Some useful native plants of New Mexico. Ann. Rept. Smithson. Inst. 1911. 447-462.

Towle, M. A. 1952. The pre-Columbian occurrence of *Lagenaria* seeds in coastal Peru. Bot. Museum Leaflets, Harvard Univ. **15**: 171-184.

Whitaker, T. W., and G. F. Carter. 1954. Oceanic drifts of gourds: Experimental observations. Amer. Jour. Bot. **21**: (9): 697-700.

———, H. C. Cutler and R. S. MacNeish. 1957. Cucurbit materials from three caves near Ocampo, Tamaulipas. American Antiquity **22**: 352-358.

——— and J. B. Bird. 1949. Identification and significance of the cucurbit materials from Huaca Prieta, Peru. American Museum Novitates, 1426.

Whiting, A. F. 1950. Ethnobotany of the Hopi, Museum of Northern Arizona. Bull. 15, Northern Arizona Society of Science and Art. Flagstaff.

Yanovsky, E. 1936. Food Plants of the North American Indians. U. S. D. A. Misc. Pub. No. 237.