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THE CULTIVATED BEANS OF THE PREHISTORIC SOUTHWEST*

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Beans, corn, and squash were the basic cultivated plants of pre-Columbian North America. There is no monograph on prehistoric beans, and the history of their distribution and a description of their variations have not been published. Although prehistoric collections are few as compared with those of corn, a study of available material can contribute significantly to the history of agriculture in North America.

Apart from horticultural, agricultural, and other practices which create or modify ecological conditions so that domesticated plants and weeds might survive, man exercises conscious and unconscious varietal selection. Patterns of selection are set by culture-based criteria, and attitudes towards plants and selections are made within the limits of plants available and primary factors such as geography and climate.

The roles of plant geography, ecology, and of human culture in shaping the species composition and distribution of beans are taken up in the first part of this paper. The factors which determine the kinds of plant materials available for this sort of study are also discussed. Descriptions of the materials and their distributions in the Southwest are subsequently given, with discussions of the part they play in the history of cultivation and variation in beans.

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Taxonomy and Distribution of Cultivated Beans

For purposes of this study beans are defined as the seeds of cultivated plants belonging to the genus *Phaseolus*. Bentham (1841) placed this genus with other trifoliolate genera in the papilionaceous tribe, PHASEOLINAE, sub-tribe EUPHASEOLEAE, but separated it from other genera of the sub-tribe by the coiled keel characteristic of *Phaseolus* flowers.

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below the threshhold of detection by human taste is sufficient to influence plant growth by altering water relations under drought. Many of the sites selected as acceptable could have been salty enough to intensify the effect of arid conditions.

Irrigation.—Emory (1859), in his survey of the Mexican-U. S. boundary, noted that little agriculture could be engaged in without water supplied in addition to the seasonal precipitation. To meet the water requirements the Pima and Papago (Castetter and Bell, 1942) have employed irrigation systems, drawing water from the Gila River as did the earlier Hohokam peoples. Halseth (1936), by aerial survey, found about 125 miles of ancient irrigation canals in the Salt River Valley and other canals about half that extent in the Gila Valley. Some of the canals are more than ten miles long, and all ruins associated with them were Hohokam in culture. The very high temperatures and high evaporation rates characteristic of southern Arizona may be supposed to have encouraged the cultivation of teparies rather than other beans despite irrigation and flood-water farming.

Extensive irrigation by canals has not been shown to be characteristic of farming among the Basketmaker and Pueblo peoples to the north, and the author is unaware of any irrigation in use in prehistoric Mogollon cultures. Some irrigation is practiced by the Hopi of Moencopi according to Whiting (1950, p. 10), who implies that this was learned from the Mormons. The terraced gardens observed by the author at the Hopi village of Hotevilla were irrigated by hand, and Whiting indicates that this is the general practice among the Hopi. According to him, neither corn nor bush-type beans planted in the same or separate fields in sandy washes and alluvial soils by the Hopi and the Navajo are irrigated except by occasional flood water.

Effect of Daylength.—Carter (1945) has stated that the majority of native Southwest beans are bush types, and the observations of Whiting (1950) and others that field-grown beans are planted apart from corn would substantiate this. Allard and Zaumeyer (1944) have studied the photoperiodic responses of many strains of cultivated species of *Phaseolus* and found that the bush types of *P. vulgaris* are mostly day-neutral in their flowering and vegetative responses. Daylengths used in their study were comparable in range to those of the latitudes of the Southwest. The semi-determinate or semi-pole types studied by them exhibited more positive reactions to photoperiod than the bush types. The twining habit of the semi-pole varieties was emphasized by long days and accompanied by a delay in flowering, while shorter-day treatment was correlated with earliness and the determinate habit. Thus varieties which were determinate at lower latitudes might well have taken on vining characters when introduced to the Southwest. It is apparently precisely this factor which prevents the semi-pole California Pink and Pinto varieties from entering the northern part of the western range where the delay in flowering would mean injury because of early frosts.

While many of the pole types were shown by Allard and Zaumeyer (1944) to be short-day, they proved to be mostly day-neutral for flowering. This type

remained twining at all daylengths so that the varieties would be expected to be twining even under conditions of short days when the semi-pole would be determinate. The lima beans tested were all day-neutral while runner beans were long-day. Allard and Zaumeyer did not include tepary beans in their work.

Planting dates to take advantage of the limited precipitation and of flood waters, or to avoid frost periods, might have been adjusted without difficulties arising from new photoperiodic relations. The diffusion of some bean varieties within the Southwest may have been impeded by photoperiodic reactions, but there is strong evidence from experimental and field studies that this environmental factor does not restrict bean distribution within this area.

Vegetal Remains of the Prehistoric Southwest.—Much of the Southwest region is arid, and many of the ancient peoples lived in caves, shelters, or houses which have remained relatively dry. For this reason perishable materials have been better preserved than in more humid areas such as in the Mississippi Valley and other parts of the eastern United States. Even in less-protected Southwestern ruins fires often occurred at or soon after the time of abandonment, frequently charring and preserving vegetal materials.

Collections of prehistoric vegetal materials have been studied and reported upon by various authors. Some of these studies have only provided descriptions of the materials found at particular sites; others have related their descriptions to other collections and other aspects of Southwestern culture. Among the latter, Carter's (1945) studies have been most comprehensive for remains of cultivated plants. He theorized that the division between Hohokam and Anasazi corn and a change in corn types is a result of Mexican and later Eastern (United States) influences. Some question exists as to the extent of the Eastern influences in the corn of the prehistoric Southwest. The steady reduction of the percentage of maize cobs with high row-numbers reported by Cutler (Martin *et al.*, 1952) for the more recent periods (especially 200–400 A. D.) of Tularosa Cave appears to be a pattern for the entire Southwest. Nickerson has recently (1954) provided evidence on the basis of anatomical characters to show the similarity of maize from widely distributed Southwestern sites.

Beans recovered from archaeological sites have received the attention of botanists and students of human culture. Earlier studies were directed toward demonstrating their place of origin by their presence in undisputed pre-Columbian ruins. Jones (1952) has adequately discussed the historical phase of prehistoric beans. He has shown that a mixed collection of charred seeds, later described as both *Phaseolus vulgaris* and *P. acutifolius*, found in Canyon de los Muertos, Arizona, was used by Ludwig Wittmack in 1888 to demonstrate conclusively the American origin of the garden or common bean, *P. vulgaris*. More recently beans dating from prehistoric times have been described from sites in the Southwestern United States in relation to migrations and diffusion of culture traits and other aspects of culture history. Most of this discussion has been of a highly general nature, and little attempt to classify bean types on a subspecific level has been made.

It is hypothesized that the distribution of beans in the prehistoric Southwest will show a relationship to the cultural subdivisions which have been recognized by archaeological studies. The distribution patterns can be expected to reveal something of the antiquity and history of beans as cultivated plants in this region.

Materials and Methods

Sources and Collection of Materials

The data presented in this paper were collected from materials studied at or obtained on loan from museums and universities where they had been deposited by archaeologists and ethnologists active in the field of Southwestern prehistory. A trip[1] to the Southwest during the summer of 1953 enabled the author to study materials in museums of that region; the institutions visited are given in Table VII. In the course of this field work, observations were made of Hopi and Navajo cultivated lands. Further observations during field work[2] in rural Mexico in 1953 and 1954 contributed to the author's understanding of comparative native American farming and food habits.

Modern archaeological excavations are carried out with careful regard for the position of artifacts recovered and their relation to dates of occupation and culture change. Vegetal materials obtained from excavations are to a greater or lesser degree artifacts and can sometimes be dated reliably with respect to their associations with other material for which dates have been established. Cutler (Martin *et al.*, 1952) has pointed out the value of large samples of plant materials, such as corn cobs, in describing a specific class of vegetal remains occurring in a particular time level of a prehistoric site. One advantage of a large sample is that it minimizes the influence of extraneous material which may have been brought in from other levels by rodents or by human disturbance such as burials in the fill. Beans, unlike corn, seldom have a waste or by-product which can accumulate in the debris of a cave or dwelling over a period of years. Threshing of dry beans, as has been described in historic times among Indians in the Southwest (Whiting, 1950; Castetter and Bell, 1942), is carried out in flat cleared areas well removed from habitation. The bean seeds arrive at the habitation ready for the pot or storage with nothing to be discarded except, perhaps, the culls. The practice of threshing beans in the field from the dry picked pods or from piles of the harvested whole plants is widespread in Indian America. It is reported from coastal Peru (Gillin, 1945) as well as from the southwestern United States, and for representative climatic regions of Mexico (Brand and Nunez, 1951; Foster, 1946; Kelly and Palerm, 1950), where it was observed by the author in 1954. A clue as to why pods are occasionally encountered in some abundance in prehistoric occupied sites is pro-

[1] Supported in part by a Wychwood Fellowship in the Department of Botany, University of Chicago.
[2] Supported in part by a Chicago Natural History Museum Fellowship in the Department of Botany, University of Chicago.

varieties. However, as far as I am aware, no one has studied the dull testas of *P. acutifolius* seeds which is a diagnostic character of that species.

Shaw and Norton, according to Kooiman (1931), distinguished two classes of color in bean-seed coats, a red-and-purple, and a yellow-black. The pigments of the second were only slightly soluble in alcohol and alkali.

Use of the character of color quality introduces the problem of dealing with color change over time. Hedrick (1931) recognized this problem and chose to describe seed-coat color as it appeared in the first year subsequent to harvest. It is common to find dark brown specimens in old collections labeled "yellow beans," or to find familiar varieties of quite a different (dark) color than the fresh seed of the same variety. Skalinska (cited by Kooiman, 1931) showed that yellow and yellowish pigments oxidize to brown *in vitro*.

It is possible to divide color change into two physiological periods, that of ripening and during dry dormancy. Very young seeds are green and may remain so or may be tinged with green through maturity, as in French horticultural and certain greenish-white tepary beans. Loss of the chlorophyll may be accompanied by whiteness or lack of color which may persist or be quickly replaced by light tints of what would probably be the color at maturity. Coloring is first noticeable in the eye ring and then appears in the other parts of the testa, but darkening earlier with proximity to the placenta. Where there is patterning, it occurs as a sort of "developing out" process, reminding one of the development of a latent image on photographic paper. Streaks, spots, or other forms of variegation appear as islands of coloration on a light ground which itself may become colored subsequently. The color change which occurs during this period is largely quantitative, as indicated previously, but may proceed to a point where it appears to be qualitative. In the tropical black *P. vulgaris* the young rose-colored testa changes by the time of maturity to a purple so deep as to give the effect of black.

Subsequent to ripening, the rate of color change in the dry bean is slower but may be accelerated under certain conditions. The darkening of the light pink ground color of the seed coats of "Mexican pinto" (Type C13) beans has been observed to occur at a differential rate when the seeds were exposed to strong sunlight for several months. The sides of the seeds exposed to sunlight were much darker than the sides not so exposed. Samples of seeds which had been stored at room temperature for fifty to sixty-five years failed to show any color change when maintained at a temperature of 60° C. for thirty days, suggesting that limits of normal change had been reached at some time during this period.

It is sometimes difficult to distinguish what the color of the seed coat might be were it not for opacity. Thus, among black beans it is difficult to determine the nature of the blackness. The Hopi "Blue Dye" beans (Type C29), for example, are very dark blue while other "blacks" may be dark purples. In this study the use of color in the classification of seed types has been made with a realization of the changes in color which have undoubtedly occurred; nevertheless, all designations are based upon color quality at the time of examination. The larger color

West (1947) reports an interesting practice of certain Tarascan Indians which may be related to this problem. A variety of *P. coccineus*, grown only by the more conservative people and tended mainly by the women in their house gardens, is used in special dishes, among which is a *pinole* made with a special "black maize." The corn is said to be toasted, but the preparation of the beans prior to grinding is not indicated. This practice was not found among non-Indian (Ladinoized) residents of the area.

Whiting (1950) reported that the Hopi parch white and mottled teparies before cooking. This treatment of the white tepary (or in its absence, "other white beans") is noted in connection with the breaking of a ritual fast by priests.

Although the material from Kiet Siel, which, according to tree-rings dates back to as early as 1106 A. D. and as late as 1221 A. D. (McGregor, 1934), contains the oldest sample of parched beans yet seen, parching may be supposed to have been practiced earlier and may well have formed the basis of dry-bean use for protein in pre-pottery times.

Parching of dry mature beans for use in such foods as *pinole* may have once been important and widespread, but now parching has been all but superseded by boiling. Ritual food preparations, such as those referred to above, may be the most likely conditions under which an ancient manner of food use might be retained although reinterpreted.

DISTRIBUTION OF BEAN TYPES

Tepary Beans.—The greater importance of tepary bean cultivation in the most arid region of the Southwest, that of the Pima and Papago (Hohokam), has been shown among the contemporary Indians by Freeman (1912), and Castetter and Bell (1942). Fewer tepary varieties than the forty described by Freeman were encountered in the collections available for this study. However, collections from the Pima and Papago and the Colorado River tribes (Table VII and figs 3–13) substantiate the extensive use of teparies by these tribes in recent historic times.

Efforts by the author to obtain teparies in 1953 and 1954 on the Pima and Papago Reservation at Sells and Ajo, Arizona, and from trading posts on the Cocopa Reservation were unsuccessful. Local residents said that droughts of recent years and availability of the popular pink beans (Type C26) may explain the general decline of old bean varieties among the Indians.

As the agronomic, botanic, and ethnologic writings on the tepary invariably refer to the drought and heat resistance of this species, some of the problems relating to the history of its domestication should be discussed.

Freeman (1912) first reported the superiority of yield of teparies over common bean varieties under dry-land and irrigated conditions in Arizona. Good yields under dry-land conditions have been obtained as far north as Colorado, where the Redfield tepary out-yielded the high-producing Pinto common bean (Brandon, 1943). The paucity of prehistoric tepary bean remains outside of the southern

TABLE VI. OCCURRENCE OF TYPES

Type	Prehistoric					Contemporary					
	Mogollon	San Juan Anasazi Mesa Verde	Northern Arizona Anasazi	Verde Valley Hohokam-Anasazi	Northern Periphery	Rio Grande Pueblos	Hopi	Zuni	Navajo	Arizona Piman	Colorado River Yuman
*C1	X	X	X	X		X	X				
C2	XX		X				XX				
C3	XX			X	X		XX	X			
C5	XX								X		X
C6	XX										
C7	XX								X		
C8	X						X		X		
C9	X	X	X	X	X		X	X			X
C10		X	X	X	X						
C11			X	X	X	X					
C11a				X		XX				X	
C12				X		XX				X	
C13			X	X		X	X	X			
C14			X	X		X	X				
C14a	X			X	X	X					
C15	X						X	X			X
C16				X		X	X	X		X	X
C17	X		X		X						
C18						XX					
C19				X		XX			X		
C19a				X		X		X			
C20				X		X					
C21							X				X
C22						X	X			X	
C23						X	X				
C24							X				
C25						X	X				
C26							X				X
C27							X			X	
C28							X				
C29							X				
C30							X				
*L1				X			X				X
L2							X				
L3							X				
L4							X				
L5							X				
L6							X				
*T1				X							
T2						X					
T3						X	X			X	X
T4				X			X	X		X	X
T5				X			X			X	X
T6				X			X				
T7							X				
T8											
*R1							X				
R2							X				

* C refers to common bean *(Phaseolus vulgaris)* types; L, to lima bean *(Phaseolus lunatus)* types; T, to tepary bean *(Phaseolus acutifolius)* types; R, to runner bean *(Phaseolus coccineus)* types.

probably be necessary for the effect of any such mutations to be expressed phenotypically. A more likely source of variability in tepary beans is hybridization with some other related species. This process is certainly suggested by Freytag's demonstration (unpublished thesis) of the effect of introgressive hybridization in common beans.

Unfortunately, very little genetic or even breeding work has been done on teparies, and no interspecific crosses have been reported. Teparies in the Southwest, and probably common and lima beans as well under arid conditions, are almost entirely self-fertilizing owing to very early pollination in the unopened flower bud. A thorough study of cultivated and non-cultivated *P. acutifolius* and *P. acutifolius* var. *latifolius* and suspected hybridizing species is necessary to indicate what the source or sources of variability in this species might be. Also of importance would be the determination of the geography and ecology of hybridization in this species.

Southwestern and Other Bean Assemblages Compared.—The grouping of bean types presented in Table II suggested that large geographic areas have characteristic bean assemblages. At present, it is not possible to give more significance to the distributional patterns other than to indicate that they exist. Whether the cultural or natural agencies shaping the distribution are selective or non-selective is likewise obscure; however, some of the selective factors which might be worthy of further investigation are discussed below. Data are drawn from Southwestern materials examined by the author, from the reports of the Russian investigators (Ditmer *et al.*, 1937), and from Hedrick's study (1931) of the United States commercial beans.

It will be noted that never does the percentage of variegated-seeded forms exceed that of the corresponding self-colored forms. The highest percentage of variegated forms, 50 per cent in the United States, reaches that figure largely because of the great diversity and number of variegated forms among the bush snap beans. Many of these are introductions from Europe, and the needs of the canning industry and available year-round markets have stimulated the use of many varieties with differing horticultural characteristics. Diversity in seed characteristics here is incidental. Among the bush snap beans described by Hedrick (about 127 named varieties), 55 per cent have variegated seed coats. In all other varieties there are considerably fewer variegated forms than there are self-colored ones. The percentage of strictly prehistoric types of the Southwest most closely approximates Peruvian distribution, while the totals for the Southwest, including prehistoric, contemporary, or both periods combined, are most like the Mexican distribution and very little like the 1:1 ratio for the United States. The high percentage of self-colored beans, which occurs only in contemporary Southwestern Indian cultures, and the fact that few of these are found as field beans in other more humid parts of the United States, indicate an influx during historic times of self-colored beans. The trend in the Southwest thus has been toward absolute and percentage reductions in the numbers of variegated bean types and a corresponding increase

in self-colored types which are dry shell beans, except for the Hopi "Black" string bean (Type C30). The importance of the Pinto or *Garrapata* bean (Type C13), a variegated dry shell bean, is also recent.

Freytag (unpublished thesis) states that Latin American beans used in the dry-shell stage over a wide area are likely to be self-colored and not of an unusual shape, while variegated or odd-shaped dry-shell types are of restricted distribution. These selective factors are apparently not operative in snap beans as such beans are consumed before seed maturity. This seems to be true in the United States, as variegated dry beans, with the exception of the pinto varieties which are used for Mexican or Texas style dishes, are of quite restricted distribution.

Interpretations of Bean Distribution:—

Three fairly distinct regions can be outlined in the prehistoric Southwest for the cultivation of beans. So far as is possible, the source of beans, the dates of their introduction, cultural affinities, and movements within the Southwest will be indicated.

It was hypothesized that the distribution of cultivated beans in the prehistoric Southwest would show a diversity resulting from differing climatic and ecological conditions and from differences in culture history. The influence of the environment and some ethnobotanical factors such as food preparation have already been discussed. A division of the Southwest following three main cultural groupings was adopted for the organization of bean distributions into regions. These regions can be compared with those of other plant materials and culture traits.

1. Mogollon:—

Although beans are known only from a few sites in a limited area of the Mogollon, it is evident that the cultivation of the common bean in this area preceded the introduction of pottery. The number of pre-pottery beans from Tularosa Cave is small but the prepottery context is clear, and it may be stated that by 300 B. C. common beans, along with maize and pepo squash, were being cultivated by Mogollon Peoples. The number of communities or settlements cultivating beans at this time cannot be estimated, but it is probable that it was not large, as none of the Mimbres River sites nor Cordova Cave, which is even closer to Tularosa Cave, show any evidence of important bean cultivation. The open sites of Higgins Flat and Hinkle Park, which appear to be immediately subsequent to and in the same cultural tradition as the Tularosa Cave, indicate that bean culture continued with common types similar to those of Tularosa Cave and may indicate a greater extent of bean growing. Since tepary beans do not occur in the Mogollon before 1100 A. D. (Higgins Flat), they may be regarded as introductions from the Hohokam; there seems to be no prior association of *P. acutifolius* in the Mogollon with *Cucurbita pepo* of which abundant remains were found in Tularosa Cave.

2. Hohokam:—

As noted previously, vegetal materials are absent in most early Hohokam sites. While this lack may be due to poor conditions of preservation, beans first appear in the Sacaton phase, or about 1,000 A. D. at Snaketown. The charred tepary and common beans identified by Volney Jones are said by Castetter and Bell (1942, p. 32) to constitute these remains, and may be the earliest record of tepary beans in the whole Southwest as well as in the Hohokam. Not enough evidence is available at present to warrant conclusions as to approximate dates for the introduction of cultivated beans to the Hohokam, nor is it possible to say whether beans were utilized in pre-pottery times in this region. Since the distinguishing feature in Hohokam beans seems to be that they are tepary varieties, which may represent a response to climatic rather than cultural factors, a long history of selection for varietal preference need not be hypothesized. The climatic conditions of southern and southwestern Arizona would quickly encourage the cultivation of tepary beans after their introduction. If domestication of the tepary occurred in the region of the Hohokam, it is not now possible to estimate when the cultivated varieties emerged as different enough from the indigenous forms to be differentiated from them. The Hohokam ruins which have provided the best bean material are later than 1,000 A. D., and usually they show the influence of the Anasazi in several aspects of culture. Montezuma's Castle (1300 A. D., Collection Nos. 201–205a), located in the Verde Valley, central Arizona, is listed by Carter (1945, p. 24) as a Pueblo III, Little Colorado River site, among those sites demonstrating the advance of *Curcurbita moschata* from the Mesa Verde region to the south and west into the area of the Hohokam. In this site only have been found uncharred, definitely identifiable bean remains representing the three species known to occur in the prehistoric Southwest. A mixture of bean assemblages of the Hohokam and Anasazi are evident in the teparies, and limas from the Hohokam and the characteristic striped violet common bean (Type C11) of the Anasazi. Other sites of the Verde Valley evidence the influence of the Anasazi bean types rather than those of Mogollon.

The lima bean appears to be characteristic of the Hohokam. Mackie (1943) has the theory that lima beans entered the Southwest by way of western Mexico and the Colorado River tribes into the Hohokam area. He discounts the likelihood of the eastern Mexico-Sierra Madre Oriental corridor as unsuitable because of excessively humid conditions. Mackie also finds that the Hopi lima beans and the beans of eastern United States Indian groups are identical and suggests that the eastern limas are an extension across the Mississippi Valley of the Hopi varieties. Carter considers that the absence of native archaeological lima beans east of the Hopi mesas until Pine Bluffs, Arkansas, necessitates an eastern Mexico-Texas corridor to the east. I have found, in undated excavated material from Sunny Glen Cave, Texas (Anonymous, 1932), and in sites from Tamaulipas, Mexico, (specimens and personal correspondence from McNeish, in 1955), extensive remains of common bean pods and a few seeds. The lima bean pods found among

the vegetal remains from Tamaulipas strengthen the eastern Mexico corridor hypothesis.

Lima beans are known from relatively few prehistoric Southwestern sites; these are discussed by Steen and Jones (1941) and mapped by Carter (1945).[4] The sites from which these beans are known are in the Verde Valley which shows an admixture of Hohokam with other cultures. However, since the lima beans are found neither in the Mogollon nor northern Anasazi sites, their relationship to the Hohokam seems clear.

3. Anasazi:—

In the scatter diagrams the bean remains of the Mesa Verde pueblos are separated from those of the northern Arizona Anasazi to emphasize varietal diversity. In this study only two types are recognized as present among the Mesa Verde pueblos, and the larger number of types found in the ruins of northern Arizona. The frequency of occurrence of the striped, violet common bean, type C11, in both the northern Arizona and Mesa Verde Anasazi, and its rarity elsewhere unifies these two regions with regard to bean distribution.

Collections of beans from Zion National Monument in southeastern Utah examined at the Museum of Anthropology, University of Michigan, provide evidence which helps to clarify the relationship of Northern Periphery beans to those of the Anasazi. Although the stratigraphy has been disturbed, habitation of the site probably extended from Basketmaker II times until about 1150 A. D. (correspondence from A. H. Schroeder to Volney H. Jones). Among these well-preserved beans are to be found: types C11, C15, C12, C19a, and possibly C1—collection numbers 232–236 respectively.

Jones' description (Brew, 1946) of charred beans (limas, common beans, and others whose dimensions fell within those for Southwestern teparies) from the Alkali Ridge site in southeastern Utah may indicate early agricultural influence from the south. Since the beans of Mesa Verde in southwestern Colorado—an occupied area showing many cultural affinities with Alkali Ridge (Brew, 1946)—are all common beans, none of which even in the charred condition could be mistaken for lima beans or teparies, Northern Periphery and Anasazi beans do not correspond completely. The presence of the small red, flecked bean, type C12 in the Zion material (the small charred seeds found by Jones in the Alkali Ridge collection may be of this type), links the Verde Valley (collection no. 162a) with southeastern Nevada Virgin River sites (collection nos. 206, 206a), said by Reed (1954) to be Pueblo II outliers of Anasazi culture, and with southeastern Utah.

The Verde Valley and Anasazi, then, appear to have had beans in common with those of the Northern Periphery. Although Northern Periphery materials discussed in this paper are probably earlier than the Anasazi beans, which are mostly

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[4] The charred seeds cited by Carter as those of lima beans from the Hodges site in south-central Arizona are actually *Canavalia ensiformis*, as evidenced by the broad hilums which are about half the length of the entire seed.

from Pueblo III, there is little to indicate a direct movement of agricultural complexes to the Anasazi from the south by way of Nevada and Utah. However, it does seem evident that the characteristic bean—C11—of the Anasazi did derive from the Northern Periphery or, at least, although rare in the Anasazi, was common to both regions in pre-pottery times.

In Basketmaker III times (Wormington, 1955) and later culture periods, many traits point to a close relationship between the Northern Periphery and the San Juan Anasazi. Among such evidence is the Central Mexican type of corn found in prehistoric sites of southeastern Utah (Wormington, *op. cit.*). This type of corn was described from the vegetal remains of Alkali Ridge by Anderson (1944) and, with other artifacts, strongly suggest Mexican influence. However, neither Nickerson (Wormington, 1955) nor Carter (1945) believed the corn to have come directly through the Arizona Pueblo, Mogollon, or Hohokam areas, but both authors consider a plains route as a likely alternative. The high row-number corn of many early Southwestern sites, however, may indicate an early widespread distribution of the Central Mexican corn. Evidence provided by bean remains supports early southern rather than eastern agricultural influence.

The Existence of Bean Areas.—Two theories may be advanced for the existence of bean areas and their coincidence with culture areas in the Southwest.

One theory would involve an early introduction of beans to the Mogollon and a later introduction to the Anasazi of varieties distinct from those found in the Mogollon and unlike those found in the Hohokam. Thus the late introduction to the Anasazi would not have come by way of either of these two regions and therefore hardly could have come from Mexico directly except by way of eastern Mexico and Texas. There are no dated remains to support this. An indirect route from the Mexican-Central American center by way of the Caribbean, the Gulf Coast, and eastern United States cannot yet be properly evaluated, but in the opinion of the author this remains an unlikely route for reasons of cultural affinities and plant geography.

A more likely theory would assume the early entrance and widespread distribution of beans throughout the Southwest but their adoption and culture by a relatively small number of communities. This might explain both their presence and their rarity in Basketmaker sites. The early beans thus could have been both widespread and varietally more uniform than indicated by the later materials. These later materials, as yet the only ones available to us, would have come from a time postdating an intensification of bean culture, a time more likely to have left bean remains simply because more people were growing them. During the period between the introduction or introductions of beans to the Southwest and the beginning of their more general cultivation, differentiation of types on the basis of local or regional cultural preferences and regional climatic and edaphic conditions would have occurred.

CONTEMPORARY BEANS

Early Spanish and later Anglo-American contacts brought new plants to the Indian farmers, some of which became important and sometimes basic crops. During the historic period contact among Pueblo peoples has been of more than a casual or even trading nature, and introductions of Peruvian beans by way of California and United States commercial varieties have occurred.

1. Hopi Beans:—

The assemblage of Hopi bean types (Table VI and fig. 9) appears to be most closely related to that of the Verde Valley among the prehistoric groups. Beans of the Verde Valley are the most diverse of the prehistoric groups and seem to be composed of types which had come from the northern Anasazi, the Hohokam, and the Reserve, New Mexico, Mogollon area. The mixture of types and species found in the Verde Valley is not to be found in any one of the three great culture groupings discussed in this paper.

In addition to the "old" beans which appear to have come down to the Hopi from Verde Valley peoples, newer varieties which do not appear in the archaeological record have been adopted by the Hopi. These new varieties have had several sources. The Pinto beans (Type C13) as known in the United States are only a few variants of the *Garrapata* or tick bean group, which is highly diverse and well distributed in northern Mexico (Collections of Oficina de Estudios Especiales, Secretaria de Agricultura y Ganaderia, Chapingo, Mexico). The occurrence in the Verde Valley (Collection number 164) of the only prehistoric collection of Pinto beans indicates a distribution limited to a single variety of the *Garrapata* group as well as a rather restricted range of cultivation. The highly important and widespread Pinto bean varieties now in use among most Southwest Indians probably represent historic introduction of *Garrapata* varieties from Mexico as well as a possible expansion of cultivation of the Verde Valley type. The arrival of these beans among the Hopi and other Indians may have been early, with the Spanish missionaries, or with later Mexican contacts.

Two other types which have become important in the contemporary Southwest but which are absent in prehistoric collections are the Pink and Bayo types (Types C28 and C17, respectively) both of which are found among the Hopi. Hendry (1918) states that the Pink bean is Chilean in origin, and that a translation of its northern Mexican name is "White man's bean." The date of introduction of the Pink bean is not known, and whether it arrived overland by way of Mexico, or sailing vessel by way of California, is equally obscure. The Bayo types which are found among the Zuni and the Hopi are said by Hendry to have come to California prior to 1850 in sailing vessels from Chile and to have become well established in the Southwest. These also have become widespread in western Mexico.

2. Zuni Beans:—

It is probable that the collections of Zuni beans studied are less complete than those of the Hopi, and the same may be said for other contemporary Southwestern