A number of researchers have attempted to follow a trail of linguistic clues back to the origins of the Uto-Aztecan language family, unusual both for its large north-south geographical range spanning the boundary between tropical and temperate environments and for the large variety of subsistence adaptations and social structures represented among its contemporary speakers. But while some linguistic detectives are convinced the Arizona-Sonora borderlands at the juncture of the southwestern United States and northwestern Mexico were the homeland of foragers who were the first speakers of the ancestral Uto-Aztecan “proto-language” (Campbell 1977; Fowler 1983; Hale and Harris 1979; Lamb 1958; Miller 1983b; Romney 1957; Suárez 1979), others argue that this region was a frontier of northward expansion by the original Uto-Aztecan speakers, who may have been the first farmers in the highlands of Mexico (Bellwood 1997, 1999; Hill 1996, 2001, 2003).

For archaeologists, these linguistic models of culture history are intriguing, but they raise a perennial question in their own field of study: How can a pre-literate culture, its members speaking a common language, be recognized in the archaeological record? The assumption that sets of material culture traits represent “cultures” and the postulation of migrations to explain the appearance of new sets of traits in
the archaeological record were givens for generations of archaeologists emphasizing cultural-historical classification (Willey and Sabloff 1982). These conventions have come under criticism as overly simplistic in the correlation of ethnicity with material remains and as underestimating the role of internal cultural changes (Thompson 1958; Adams, Van Gerven, and Levy 1978; but see Anthony 1990). The result of these reappraisals is a growing recognition among archaeologists that while some material traits will cluster in relation to ethnicity, it is not certain which traits might do so in a particular case (Sutton 1991).

In this chapter we evaluate linguistic models of early Uto-Aztecan history in the light of archaeological data, focusing on evidence from the critical region of the Arizona-Sonora borderlands. We interpret temporal-spatial patterns in the archaeological record in terms of material culture “complexes” representing, simultaneously, cultural traditions and communication networks (Mabry 1998). In this perspective a set of artifact styles and feature types overlapping in time and space to form a complex could have spread through (1) migration, involving an actual movement of people; (2) diffusion, involving slow transmission across cultural-linguistic boundaries or rapid dispersal within a cultural-linguistic continuum; or (3) a combination of migration and diffusion processes. On the basis of ethnographic and historical studies, we assume that certain aspects of material culture, particularly “passive styles” and “technological styles,” are useful cultural markers because they unconsciously represent cultural identity. Here, we focus on these aspects of style expressed by projectile points, direct radiocarbon dates on cultigen remains, and other archaeological data to infer (1) the diffusion of maize to indigenous cultural groups either before or after the arrival of Proto-Uto-Aztecan peoples in the Arizona-Sonora borderlands; (2) a series of subsequent diffusions, migrations, or both from the south that introduced other Mesoamerican cultigens and material culture traits; (3) the extent of the Proto-Uto-Aztecan continuum prior to its breakup into northern and southern groups; and (4) the timing of that divergence. (Editor’s note: Interested readers are also referred to LeBlanc [Chapter 7] for a different approach to this topic.)

**LINGUISTIC MODELS**

Uto-Aztecan is one of the largest and most widely distributed language families in the Americas, extending from the Shoshoneans in southern Idaho south to the Pipil in Nicaragua. Based on more than 100 sets of cognates that exhibit sound correspondence and similarities in meaning, the numerous linguistic members of the Uto-Aztecan family have been demonstrated to comprise a genetic unit, meaning that in the remote past there existed a single linguistic community in which a common ancestral language, Proto-Uto-Aztecan (PUA), was spoken. Suggestions for the center of origin for Uto-Aztecan languages—the PUA homeland—vary widely, although most scholars support a northern origin in western North America, ranging anywhere from the Columbia Plateau (Hopkins 1965), northern California (Nichols 1981), the Great Basin (Goss 1977), or the northern Rockies (Taylor 1961).
south to the foothills of the Mogollon Highlands and the Sierra Madre (Fowler 1983; Romney 1957), the deserts of the Arizona-Sonora borderlands (Lamb 1958), or southern California (Miller 1995). Catherine Fowler (1983) identified twenty-seven cognates for plants and animals that were presumably part of the folk biological knowledge of PUA and that she suggested placed them in the mid-elevation, mixed woodland-grassland zone of the northern Sierra Madre foothills in northern Mexico and the Basin and Range Province of southern Arizona and southwestern New Mexico. Jane Hill (2003) argues for a PUA homeland somewhere at the northwestern edge of Mesoamerica, in an upland region where the set of flora and fauna reconstructed by Fowler (1983) can be found, as in the present-day Mexican states of Jalisco, Nayarit, Durango, Zacatecas, and Aguascalientes.

Linguistic geography and degree of internal differentiation suggest that Uto-Aztecan is younger than Hokan, Penutian, or Algic in western North America but nevertheless indicative of considerable antiquity. Glottochronological analyses have arrived at estimates ranging between 8,000 and 3,000 years to account for the degree of internal differentiation in the Uto-Aztecan stock. Romney (1957) estimated the time depth of the PUA community at about 3,000 years, although the data on which his estimate was based remain unpublished. Later studies yielded estimates of 4,000 years (Hale 1958) and 4,700 years (Swadesh 1960). Fowler (1983) uses a figure of 5,000 years as a minimum age for the Proto-Uto-Aztecan dialect chain. The figure of 6000 B.C. that appeared in a widely cited publication by Miller (1983b) is almost certainly a misprint (i.e., it should probably be B.P.), as the author elsewhere referred to 5,000 (Miller 1984) and 4,000 (Miller 1995) years of time depth. Most linguists today accept 5,000 to 6,000 years as a minimum age for the proto-language, thus establishing a baseline between approximately 4000–3000 B.C.

Hale (1958) and Voegelin and colleagues (1962) suggested that the Proto-Uto-Aztecan stock subsequently split into northern and southern substocks, the northern developing into the Shoshonean and Sonoran branches and the southern into the Nahuatlan branch. Today, many place the Sonoran languages in the southern group (Campbell and Longacker 1978; Fowler 1983; Heath 1977; Hill 1996; Manaster Ramer 1992), with the Tepiman languages representing the northernmost subgroup (Shaul and Hill 1993).

Bascom’s (1965) reconstruction of Proto-Tepiman includes a cognate for saguaro cactus, which is not found in other Uto-Aztecan languages. This suggests to Fowler (1983) that Tepehuan speakers spread southward from a Proto-Tepiman homeland in the Sonoran Desert; she attributes the locations of the Tarahumara and Cahitan groups that interrupt the distribution of Piman languages to subsequent movements of these groups toward the west Mexican coast. This contrasts with her earlier suggestion that the southern languages began to diverge from PUA in the Sonoran foothills of the Sierra Madre, perhaps in the Rio Sonora and Rio Yaqui basins (Fowler 1972). Shaul and Hill (1993) argue that Proto-Tepiman was in contact with Yuman languages and thus forward a northern center of development for this subgroup of the southern Uto-Aztecan languages.
We have previously followed the borderlands homeland model in arguing that the introduction of maize into northwestern Mexico and the southwestern United States could be attributed either to (1) the movement of agricultural Proto-Southern-Uto-Aztecan (PSUA) out of a presumed homeland in the coastal plain, the serrana of the Sierra Madre Occidental surrounding the region where Sonora, Chihuahua, Durango, and Sinaloa merge, or both (Carpenter, Mabry, and Sanchez 2001; Carpenter, Sanchez, and Villalpando 2002, 2005), or to (2) diffusion across a previously established continuum of Proto-Uto-Aztecan speakers spanning these regions (Mabry 2005a; see also Mabry and Doolittle, Chapter 4, this volume). As part of the first model, we have also suggested that the timing of the initial bifurcation of Uto-Aztecan into northern and southern branches (circa 6000 B.P.) could be explained by the abandonment of the Sonoran Desert region as a result of changing climatic conditions during the Middle Holocene interval of higher temperatures (the Altithermal period). Likewise, the subsequent diversification of PSUA beginning at approximately 4000–3000 B.P. could be attributed to the re-population of the desert areas (which remained a largely empty niche) by agricultural peoples following a return to more amenable conditions with the onset of the Late Holocene. In the second model, PUA groups first arrived in the thinly populated borderlands at the beginning of the Late Holocene, before the arrival of maize, and all this linguistic diversification occurred subsequently.

Recently, Hill (2001) has challenged some of the conventional linguistic models of Uto-Aztecan prehistory (which she herself had long upheld)—both the one that envisioned PUA speakers to be foragers who later adopted agriculture and the one that held that their homeland was in the Arizona-Sonora borderlands. Based on linguistic data, with some references to radiocarbon dates on cultigens from archaeological sites, Hill elaborated on Bellwood’s (1997, 1999) model that agriculture was introduced to the U.S. Southwest by a migration of Uto-Aztecan speakers from central Mexico. Specifically, Hill’s (2001) major propositions are that (1) maize was introduced to the Southwest by a single northward migration of Proto-Uto-Aztecan agriculturalists who originated in central Mexico, (2) the PUA community included the domesticators of maize, (3) the initial expansion of Proto-Uto-Aztecan into the Southwest occurred between about 4,000 and 3,000 years ago, (4) the PUA expansion into the Southwest occurred in a leapfrog pattern from oasis to oasis, (5) the PUA community practiced irrigation, (6) the PUA community began to break up between the arrival of maize and beans, and (7) the historically non-agricultural Uto-Aztecan peoples in the extreme north abandoned agriculture during prehistoric time. This new model is important because of its fresh perspective and breadth of interpretation, and it has forced both linguists and archaeologists to rethink their positions on early Uto-Aztecan prehistory. In the rest of this chapter, we explore whether the linguistic and archaeological data converge to provide a coherent picture of early Uto-Aztecan speakers in the Arizona-Sonora borderlands, including their role in the arrival of agriculture in this region.
POSSIBLE ARCHAEOLOGICAL EVIDENCE OF THE ARRIVAL OF EARLY UTO-AZTECANS IN THE SOUTHWEST

Projectile Points

To identify the material traces of a population movement from a specific homeland during the pre-pottery period of prehistory, we first turn to projectile points, "the only artifacts that are routinely discovered at Archaic sites that have the potential to inform us about the movement of information, ideas, and perhaps even people over the landscape that is now the Southwest" (Huckell 1996:3). But like pots, points do not necessarily equal peoples. The types of variations in projectile points that are most likely related to cultural identities need to be identified on the basis of ethnoarchaeological, historical, and technological studies.

An ethnoarchaeological study in southwestern Africa has shown that variations in the shapes of projectile point blades may consciously express social differences within the same ethnic group and so are examples of "active style" (Weissner 1983). This conscious expression of difference is often related to the need to mark boundaries between groups that are in constant contact, even among those that are culturally and linguistically related. Among nineteenth-century Numic-speaking bands in the Great Basin, variations in arrow shaft decorations, rather than arrowhead shapes, were expressions of different group identities, and shaft decoration varied the most between closely interacting groups (Sinopoli 1991). Decorated Basketmaker dart foreshafts and mainshafts found in caves in the Southwest (Cosgrove 1947) and the Great Basin (Harrington 1933) display great variability in decorative elements and may be similar expressions of group identities among a population using the same hafting technique. Clearly, active style variations in projectile point blades, foreshafts, and mainshafts may be useful signs of differences between cultural subgroups and possibly between unrelated cultures, but they are not necessarily markers of cultural differences.

In contrast, the less visible, more conservative, and largely unconscious variations in projectile designs are examples of "passive style" and reflect shared enculturative backgrounds even more strongly (Weissner 1983). What, then, are the aspects of passive style represented in the designs of Archaic and Early Agricultural projectiles of the southwestern United States and Mexico? Hafting designs, the techniques used to attach points to shafts, may or may not be related to cultural identities. Rather, they represent "technological traditions" that may have crossed cultural boundaries (Musil 1988). The temporal-spatial distribution of a particular hafting design represents a time and an area of shared technology that was a product of information flow among groups in frequent contact because they were exploiting the same environment (Holmer 1986). However, the geographical limits and temporal continuities of such technological traditions allow some conclusions about whether they are indigenous or introduced.

The best examples of passive style in projectile points are the less visible variations within each hafting design tradition: the variations in the shapes and dimensions of projectile point stems, bases, notches, and necks. These were largely
obscured from direct view by sinew bindings and may have been unconscious reflections of cultural identity because they were culturally specific, alternative solutions to the same technological problems. Here, several dart point types representing different hafting technological traditions and their passive style variations are discussed in terms of their possible associations with the earliest farming cultures between the borderlands and central Mexico.

**Point Types Representing Distinct Hafting Designs**

**Contracting stem points.** The contracting stem dart point represents a unique hafting design that may have originated in Mexico. Based on the residues found on a large proportion of contracting stem points in the Southwest and the Great Basin, it has been suggested that these points were glued into the socketed or split ends of foreshafts with adhesives such as asphaltum and pine pitch and that this is a hafting tradition that originated south of the other hafting traditions in North America, probably in Mesoamerica (Holmer 1986). Known by various names, contracting stem points appeared between about 5000 and 4000 B.P. in the lower Rio Grande and Pecos valleys (Almagre and Langtry types) (Marmaduke 1978), the Southwest (Gypsum Cave, Agustín, and Pelona types) (Berry and Berry 1986), and the southern Great Basin (Elko Contracting Stem and Gatecliff Contracting Stem) (Holmer 1986; Thomas 1981). Similar points (including examples with adhesive residues) appeared along the southern California coast and the Channel Islands (Harrington 1933:117–118; Koerper and Drover 1983:10; Orr 1968) as early as 4500 B.P. (Justice 2002:194). However, the contracting stem point variants in southern coastal California may have developed independently from earlier leaf-shaped points (Justice 2002:194).

Similarly shaped points appeared in the central highlands of Mexico, within the Coxcatlán phase in the Tehuacán Valley (MacNeish, Nelken-Terner, and Johnson 1967), associated with maize radiocarbon dated to about 4700 B.P. (circa 3500 B.C. calibrated) (Long et al. 1989). This is among the earliest maize yet identified in the central highlands, although maize dating to about 5400 B.P. (circa 4200 B.C. calibrated) has been found in the southern highland region of Oaxaca (Piperno and Flannery 2001). Similar contracting stem point types have also been reported from non-agricultural sites in Coahuila and Tamaulipas in northeastern Mexico, estimated to date between roughly 6000 and 3500 B.P. (circa 4900–1800 B.C. calibrated) (MacNeish 1958; Taylor 1966).

At only two sites north of Mexico has this point type been found in association with possible maize remains. At the Keystone Dam site near El Paso, contracting stem points were found in a stratum bracketed by charcoal dates between 4100 and 3300 B.P. (circa 2600–1600 B.C. calibrated) and containing small, circular pit structures, storage pits, roasting pits, fire-cracked rock hearths, grinding tools, and probable maize pollen (O’Laughlin 1980). In Bat Cave, contracting stem points occur together with expanding stem Bat Cave points and side-notched Chiricahua points.
in the deepest stratum (Dick 1965), which has provided a maize radiocarbon date of 3740 ± 70 B.P. (circa 2150 B.C. calibrated) (Wills 1988). When this date was published, it was suggested that it may be unreliable because of possible contamination with a preservative, but that was an attempt to explain a data outlier that seemed implausible at the time. Today, this date closely matches the earliest direct dates on maize in several parts of the Southwest (see references in Mabry 2005b).

Expanding stem points. Representing a different, probably indigenous southwestern hafting design are expanding stem points, of which the best known are the San Jose variants. These have narrow, usually serrated blades and either a straight stem with a concave base (sometimes with shoulders) or an expanding stem with concave sides and base. Both forms were included in the original definition of the San Jose complex (Bryan and Toulouse 1943), but Irwin-Williams (1973) called the first San Jose and the second Armijo and believed the latter developed from the former. Obsidian hydration dates support this interpretation (Moore 1994). A variant of the Pinto point resembles the first variant, which has sometimes been referred to as San Jose–Pinto (Bayham et al. 1986; Berry and Berry 1986; Huckell 1996). The Bat Cave point (Dick 1965:fig. 23c–h) appears to be an unserrated, straight-based version of the second variant (Justice 2002).

These variants, glossed here as expanding stem points, are found only in the Southwest, in both possible and definite associations with maize. In northwestern New Mexico, San Jose points were found in association with maize pollen at two sites in Chaco Canyon; hearths containing maize pollen yielded four charcoal dates between 3985 and 3560 B.P. (circa 2500–1900 B.C. calibrated) (Simmons 1982, 1986). In this same region, charcoal dates of 3480 ± 95 and 3390 ± 120 B.P. (circa 1800 B.C. and 1700 B.C. calibrated) were obtained from a stratum containing San Jose points and maize pollen in En Medio Shelter (Irwin-Williams and Tompkins 1968). Also in this region, at Atlatl Cave, San Jose–Pinto Basin points were found in the same levels as maize remains (cob fragments?), with an associated charcoal date of 4240 ± 70 B.P. (circa 2900 B.C. calibrated) (Berry and Berry 1986). In southern Arizona, unserrated points with narrow blades, including two tip fragments and a complete example with an expanding stem with a straight base and broad, shallow side notches, were associated with maize dates of 3690 ± 40 and 3650 ± 40 B.P. (circa 2100 B.C. calibrated) at the Clearwater site (Mabry 2006b). Points similar to the complete example from the Clearwater site have been variously called San Jose (Huckell 1977), Bat Cave (Dick 1965), Armijo (Irwin-Williams 1973), Concho (Plog 1981), and Armijo-Concho (Parry, Smiley, and Burgett 1994).

Radiocarbon dates are also known from contexts with expanding stem points but no maize. These include dates between about 4300 and 4000 B.P. (circa 3300 B.C. and 2500 B.C. calibrated) from the Buried Dune site in southern Arizona (Bayham et al. 1986) and a date of 3520 ± 60 B.P. (circa 1800 B.C. calibrated) from the Laguna Salada site in the Little Colorado River Valley in northeastern Arizona (Martin and Rinaldo 1960). At sites with these point types, pit structures and storage pits
are known at sites both with maize (Clearwater) (Mabry 2006b) and without maize (Collier Dunes) (Irwin-Williams 1973, 1979).

The oldest radiocarbon dates associated with expanding stem points (but not maize) are from northwestern New Mexico and indicate that the time span of this point type on the Colorado Plateau extends back into the Middle Holocene, prior to the arrival of maize. Charcoal dates of 6770 ± 240 and 6060 ± 180 B.P. (circa 5600 B.C. and 5000 B.C. calibrated) are reported from San Jose strata at Armijo Tank Shelter in Arroyo Cuervo (Berry and Berry 1986), and charcoal dates of 5680 ± 180 and 5660 ± 270 B.P. (circa 4500 B.C. calibrated) are reported from San Jose sites in the San Juan Basin (Del Bene and Ford 1982). A charcoal date of 6880 ± 200 B.P. (circa 5700 B.C.) from Grants Arroyo Site 1 is from a hearth in a dune deposit containing both San Jose and leaf-shaped, parallel-flaked Yuma points (Agogino and Hester 1958); either both point types were made by the same cultural group (Agogino and Hester 1958), or this date is related to an earlier occupation associated with the leaf-shaped points (possibly resharpened Bajada points; Justice 2002).

Expanding stem points may have an even deeper lineage in the Southwest. While a number of archaeologists have treated the San Jose point as a southwestern variant of the Pinto point of the Great Basin, both Irwin-Williams (1973, 1979) and Justice (2002) have argued that the San Jose type evolved independently from the Bajada point of the Middle Holocene in the Southwest. The Bajada type is reported to date between about 6800 and 5200 B.P. (circa 5600–4000 B.C. calibrated) in northwestern New Mexico (Irwin-Williams 1979) and between about 7800 and 6400 B.P. (circa 6600–5300 B.C. calibrated) in south-central New Mexico (MacNeish 1993). However, its distribution is largely confined to the Colorado Plateau, at elevations above 6,000 feet (Mabry 1998). In northeastern Arizona, San Jose points (including an unserrated variant) were found together with Bajada points at the Hastqin site (Huckell 1977) and at AZ D:11:3063 on Black Mesa (Parry and Smiley 1990); radiocarbon dates on charcoal from hearths at both sites cluster near 8000 B.P. (circa 7000 B.C. calibrated).

The temporal priority of expanding stem points in sequences of point types associated with early maize (except possibly the temporally overlapping Chiricahua point, discussed later) is demonstrated in some cave and floodplain sequences. San Jose points occur by themselves in the earliest occupational strata at En Medio Shelter (Irwin-Williams and Tompkins 1968) and Harbison Cave in northern Arizona (Jennings 1971) and then are followed stratigraphically by Armijo, Basketmaker, and San Pedro notched point types in those cave sequences. Bat Cave points co-occur with contracting stem points (Augustin, Pelona, and other varieties) and triangular and leaf-shaped bifaces in the earliest occupation level at Bat Cave (the top of the Buff Sand) and then appear with these types and also with Chiricahua and Datil points in the next-higher level (Level VI) (Dick 1965). Between about 3700 and 2000 B.P. (circa 2100–50 B.C.) in the floodplain of the middle Santa Cruz Valley in southern Arizona, there was possibly a local evolution from the expanding stem Armijo/Bat Cave–like point, to the straight-stemmed Empire points, then to the
side- to corner-notched San Pedro point, the side-notched Western Basketmaker point, and the corner-notched Cienega point series, with some temporal overlaps between these types and variants (Jane Sliva, personal communication 2006).

Straight-stem points. The Empire point, with a straight stem and long, narrow triangular blade, dates to the early San Pedro phase, and its known distribution includes south-central Arizona and northwestern Sonora (Stevens and Sliva 2002). At the Las Capas site in the middle Santa Cruz Valley of southern Arizona, Empire points were found together with San Pedro points in a stratum containing maize radiocarbon dated to 3050–2950 B.P. (circa 1250–1150 B.C. calibrated) (Hesse and Foster 2005; Sliva 2005). At a nearby site in the same valley, a similar point type, but with a shorter and more convex-based stem and resembling the Datil point, has been found in association with San Pedro points and maize radiocarbon dated to 3080–2970 B.P. (circa 1300–1200 B.C. calibrated) (Wöcherl 2005). Jane Sliva (personal communication 2006) has suggested that these stemmed Empire point variants led to a shallow side-notched variant and then to the notched San Pedro, Western Basketmaker, and Cienega point types.

Side-notched points. The Chiricahua point was originally identified as “intrusive” in the type-site assemblages of the Chiricahua stage in southeastern Arizona, bracketed between 9,000 and 4,500 years old by geoclimatic correlations (Sayles and Antevs 1941). Since then, this point type has been found at sites radiocarbon dated between about 4800 and 3900 B.P. (circa 3600–2400 B.C. calibrated) and no earlier in this region (Bayham et al. 1986; Huckell 1996). Its currently known distribution, while concentrated in southeastern Arizona, extends to every part of the Southwest except the northern and western Colorado Plateau and the lower Colorado Valley (Huckell 1996) and into northern Sonora and Chihuahua (Irwin-Williams 1967). Huckell (1996) and others have noted similarities among the Chiricahua point, the Northern Side-notched point, and other side-notched types of the Colorado Plateau and eastern Great Basin dating to the Middle Holocene and the initial part of the Late Holocene.

The presence of maize cobs in strata that yielded Chiricahua points (along with other Middle Archaic types) and radiocarbon dates on charcoal of about 5900 and 5600 B.P. (circa 4800–4400 B.C. calibrated) in Bat Cave in west-central New Mexico (Dick 1954, 1965) and the presence of maize pollen in a stratum that contained a single Chiricahua point at the Cienega Creek site in southeastern Arizona (Martin and Schoenwetter 1960) have been cited by many (e.g., Haury 1962; Dick 1965; Hunter-Anderson 1986; Sayles 1983) as evidence of the arrival of agriculture in the Mogollon Highlands during the Chiricahua stage. However, the identification of maize pollen in the deepest cultural layer at Cienega Creek is equivocal (Berry 1982), and re-dating of several charcoal samples with the CO₂ method bracket this deposit between about 3000 and 2400 B.P. (circa 1200–400 B.C. calibrated) (Wills 1988:137–141). On the other hand, the earliest maize from Bat Cave, thought by
Wills (1988) to date no earlier than 3100 B.P. (circa 1300 B.C. calibrated), may be as old as 3740 B.P. (circa 2150 B.C. calibrated) if the oldest direct date is not rejected. Several maize radiocarbon dates averaging about 3700 B.P. (circa 2100 B.C. calibrated) have been obtained from contexts containing Chiricahua points in McEuen Cave in the Gila Mountains of southeastern Arizona (Huckell, Huckell, and Shackley 1999; Steven Shackley, personal communication 2003).

Later notched point types definitely associated with early agricultural sites in the Arizona-Sonora borderlands include the San Pedro, Western Basketmaker, and Cienega points. Rather than developing from the earlier Chiricahua point, with its apparent affinities to earlier notched types to the north, these later notched types appear to have evolved locally in the southern Arizona–northern Sonora region from a series of stemmed point types (Jane Sliva, personal communication 2006). The San Pedro point—with a triangular blade, straight to convex base, and shallow side or corner notches—dates to the San Pedro and Cienega phases (3000–2000 B.P.) (circa 1200 B.C.–A.D. 50 calibrated) and has been found in southern and western Arizona, western New Mexico, and northern Sonora (Lorentzen 1998). The Western, or San Juan, Basketmaker II point—with a triangular blade, straight to convex base, and deep side or corner notches—dates to about 2800–1600 B.P. (circa 1000 B.C.–A.D. 400 calibrated) and has been found on the southern and central Colorado Plateau in northeastern Arizona, southeastern Utah, and northwestern New Mexico (Justice 2002); it has also been found recently at sites in the Tucson Basin in Late San Pedro– and Early Cienega–phase contexts (Mabry 2006b). The Cienega point series—with triangular blades (sometimes serrated, slightly concave, or both), expanding to straight stems, convex stem bases, and deep, wide corner notches—dates to about 2600–1800 B.P. (circa 800 B.C.–A.D. 200 calibrated) and is found in southeastern Arizona, southwestern New Mexico, and northern Sonora; a small early variation is probably an arrowhead, representing the introduction of the bow and arrow to the Southwest (Sliva 1999).

**Cortaro biface.** At the Clearwater (Mabry 2006b) and Buried Dune (Bayham et al. 1986) sites in southeastern Arizona, Armijo/Bat Cave points co-occur with the triangular, concave-based biface type formerly referred to as the Cortaro point, which is now thought to be a multifunctional tool type (Jane Sliva, personal communication 2003). The distribution of Cortaro bifaces includes northernmost Sinaloa and Sonora, southeastern Arizona, and southwestern New Mexico (Carpenter, Sanchez, and Villalpando 2005; Roth and Huckell 1992). In southeastern Arizona they are associated with Armijo/Bat Cave points at the Clearwater site in the Tucson Basin (with maize dates of 3690 and 3650 B.P., or circa 2100 B.C. calibrated; Mabry 2006a) and possibly in McEuen Cave in the middle Gila Valley (with several maize dates averaging about 3700 B.P., or circa 2100 B.C. calibrated; Steve Shackley, personal communication 2003). Cortaro bifaces also co-occur with later San Pedro and Cienega points in the borderlands (Sliva 2005). Two possibilities are apparent: (1) Cortaro bifaces represent a long, Late Holocene technological
tradition among both hunting-and-gathering groups and early farming groups in the Arizona-Sonora borderlands and northwestern Mexico; or (2) they are associated with the initial arrival of maize-bearing Uto-Aztecan–speaking peoples in the borderlands (Carpenter, Sanchez, and Villalpando 2002, 2005).

Atlatls

Like projectile point hafting designs, the general designs of atlatls represent Archaic technological traditions that probably spread across linguistic and cultural boundaries. However, Ferg and Peachey (1998:188) have noted that the known distribution of “male-type” atlatls, with cylindrical shafts and raised spurs, in the southern Baja Peninsula and mainland Mexico corresponds in part to the geographic distribution of the “Hokaltecan” languages, while the distribution of “mixed-type” atlatls, with troughed flat boards and flush or only slightly raised spurs, corresponds well with the distribution of the Uto-Aztecan languages. Within a set of fifty-six mixed-type whole or partial atlatls found at twenty-nine sites in the U.S. Southwest and northwestern Mexico, flush spurs are the primary type found in the Southwest, while slightly projecting spurs predominate in northwestern Mexico, with an area of overlap in the border area of southern New Mexico, northern Chihuahua, and westernmost Texas (Ferg and Peachey 1998:191, fig. 8).

Fiber Artifacts

The appearance of new manufacturing techniques for cordage, basketry, sandals, and other woven items in a region may represent migration, diffusion events, or both. The appearances of bundle-foundation coiled basketry, twill plaiting, final S-twist cordage, and four-warp wickerwork sandals between 3000 and 2500 B.P. (circa 1200–700 B.C. calibrated) in the Jornada Basin of south-central New Mexico are synchronous with the appearance of tropical cultigens in the region (Hyland, Adovasio, and Taylor 1998; Hyland and Adovasio 2000). These new techniques and forms of northern Mexican origin were added to older ones and did not replace them. The retention and addition of technological styles may represent one or more migration and hybridization events, characterized by a merging of immigrant farmers and indigenous hunter-gatherers (Hyland, Adovasio, and Taylor 1998; Hyland and Adovasio 2000).

Relevant to future studies of possible clues about cultural identities in the Southern Southwest during the transition to agriculture are the presence of both two-rod-and-bundle foundations and one-rod foundations among the coiled basketry in the cremations at the Cienega Creek site (Haury 1957), now dated to about 2400–1900 B.P. (circa 1200–400 B.C. calibrated) (Wills 1988:137-141). Likewise, the differences in initial direction of cordage spin and in sandal warp and foot-tie treatments among specimens from levels containing early cultigen remains in Fresnal Shelter in the Tularosa Basin of south-central New Mexico (predominately Z-spin
cordage and sandal warps that are knotted off) and in Bat Cave, Tularosa Cave, and Cordova Cave in west-central New Mexico (all mostly S-spin cordage and sandal warps that become ties) may indicate ethnic differences (McBrinn 2002, 2005).

**Water Control Technologies**

A common heritage among northern and southern Uto-Aztecan languages has also been identified in the way of speaking about the manipulation of water for agriculture, including cognates and semantic parallels for the words “canal,” “dam,” and “to irrigate.” This implies that irrigation was practiced in the Southwest prior to the breakup of the Proto-Uto-Aztecan speech community between 3,000 and 2,500 years ago (Hill 2001).

This scenario is supported by recent discoveries of irrigation canals dating between 1500–500 B.C. at Early Agricultural–period sites in the Tucson Basin (Ezzo and Deaver 1998; Mabry 1999, 2006a, 2006b; Mabry, Holmlund, and Nials 2002) and canals dating as early as 1200 B.C. at Basketmaker II sites on the southern Colorado Plateau (Damp et al. 2000). These earliest known canals in the Southwest, which diverted perennial river flows, are older and more complex than the earliest known canals in Mesoamerica—ditches for runoff diversion and drainage built in Guerrero, Oaxaca, Veracruz, the Basin of Mexico, Guatemala, and Belize during the Early Formative period between 1200–800 B.C. (Doolittle 1990; Neely 2005). Therefore, it seems likely that early southwestern farmers developed irrigation independently, after the arrival of maize and squash from Mexico.

**Cultigens**

Like technologies and styles, cultigens can also be introduced to new regions by diffusion and migration processes. Current evidence of the timing of cultigen arrivals and dispersals also suggests there was more than one migration or diffusion event that introduced tropical cultigens to the Southwest (Doolittle and Mabry 2006; Mabry 2005b). The currently available direct dates (see references in Mabry 2005b) suggest that both maize and squash arrived in the southern Basin and Range Province between 4000 and 3700 B.P. (circa 2500–2100 B.C. calibrated). Maize spread rapidly northward, reaching the Mogollon Highlands and the southern Colorado Plateau by 3800–3750 B.P. (circa 2200 B.C. calibrated). Maize did not spread east of the middle Rio Grande Valley until 2900 B.P. (circa 1100 B.C. calibrated), and dispersal farther northward and eastward on the Colorado Plateau did not occur until between 2500 and 2000 B.P. (circa 750–50 B.C. calibrated). Pepo squash reached the Mogollon Highlands and the southern Colorado Plateau between 3000–2900 B.P. (circa 1200–1100 B.C. calibrated). Bottle gourd and common bean arrived in the southern Basin and Range Province between 3000 and 2500 B.P. (circa 1200–750 B.C. calibrated). These currently available data indicate that maize and pepo squash
were the first tropical cultigens to arrive (possibly together, as a crop complex) and that they spread rapidly to all parts of the Southwest, while common bean and bottle gourd arrived about a millennium later and spread gradually northward.

DISCUSSION

Marmaduke (1978:248) attributes the distribution of the contracting stem point type and its glued hafting design as representing the transmission of a cultural idea (i.e., diffusion of a technological tradition), but Berry and Berry (1986) argue that it indicates population movements from Mesoamerica northward. Holmer (1994) suggests that this point type was part of the Proto-Nomic (Proto-Northern-Uto-Aztecan) material culture assemblage, which appeared in the archaeological record of the southwestern Great Basin by 5000 B.P. (circa 3800 B.C. calibrated). He interprets radiocarbon dates associated with this point type as indicating its spread north and east, reaching southern Utah by 4400 B.P. (circa 3000 B.C. calibrated) and western Colorado by 3800 B.P. (circa 2200 B.C. calibrated), a pattern he attributes to the expansion of the Numic peoples.

The range of this hafting technological tradition in northwestern Mexico and western North America does generally coincide with the distribution of Uto-Aztecan languages, and it is possible that this hafting technology diffused northward along with maize cultivation (Carpenter, Sanchez, and Villalpando 2005). However, the appearance of this hafting design in northeastern Mexico as early as 6000 B.P. (circa 4900 B.C. calibrated) indicates that either this technological tradition was transmitted across ethnic/linguistic boundaries or there was an initial migration of Proto-Uto-Aztecan into this region that left no historical linguistic traces. It seems likely that the broad spread of this hafting design in Mexico and western North America between about 6000–4000 B.P. (circa 4900–2500 B.C. calibrated) primarily represents diffusion of a new technology across cultural and linguistic boundaries and among both foraging and farming groups (akin to the later diffusion of bow-and-arrow technology, for example) rather than primarily a migration or series of population movements of a specific cultural group at such an enormous scale.

However, within this hafting tradition, minor variations in stems (for example, among Gypsum, Agustin, Pelona, Elko Contracting Stem, and Gatecliff Contracting Stem types) may represent passive stylistic variation between different cultural groups. For example, some Great Basin groups may have adapted this new point type to an indigenous split-end foreshaft design, resulting in a hybrid technology. In the central Great Basin, the Gatecliff Contracting Stem and Gatecliff Split Stem types (which resemble the bifurcate-stemmed Pinto Shouldered type), perhaps representing socketed and split-end foreshaft designs, respectively, co-occur in strata bracketed by charcoal radiocarbon dates between about 5000 and 3300 B.P. (circa 3800–1500 B.C. calibrated) (Thomas 1981). The Gypsum series B and Langtry varieties, with slightly indented bases, which appeared in the southeastern Great Basin by 3600 B.P. (circa 1900 B.C. calibrated) (Fowler, Madsen, and Hattori 1973) and
in the lower Rio Grande Valley by 4500 B.P. (circa 3300 B.C. calibrated) (Turner and Hester 1985), may also be modifications to better seat the points in a split-end foreshaft (Justice 2002).

Perhaps the most important implication of the wide diffusion of this new hafting technology is that it demonstrates that after a long break in contact in the desert lowlands of the U.S.-Mexico borderlands during the Altithermal of the Middle Holocene, populations came into contact with each other over a continuous area extending from central Mexico to the central Great Basin and from the southern California coast to the Colorado Plateau. Similarly, the broad distribution of mixed-type atlatls across the southwestern U.S. and northern Mexico (Ferg and Peachey 1998) indicates contacts during the early portion of the Late Holocene. Significant to the arguments here is that this return to the Desert Borderlands and establishment of contacts prior to 4000 B.P. (circa 2500 B.C. calibrated) preceded the spread of tropical cultigens northward and that the spread of the glued hafting design through those contacts therefore reflects a combination of migration and diffusion processes.

In contrast to the new hafting design of the contracting stem point, expanding stem points and side-notched points represent older hafting designs initially used during the Middle Holocene by indigenous hunting-and-gathering groups on the Colorado Plateau and in the Great Basin. Through migration or diffusion or both processes, these hafting designs spread southward into the desert lowlands at the beginning of the Late Holocene. The simplest explanation is that hunting-and-gathering populations from the Colorado Plateau (and possibly the eastern Great Basin) expanded southward as environmental conditions improved in the lowlands, and there some of them adopted maize agriculture after contacts with Proto-Uto-Aztecan farmers in northern Mexico. Then, through regular contacts among groups using these hafting designs, maize rapidly diffused northward to the Mogollon Highlands and the Colorado Plateau.

The sequence of dart point styles found at early agricultural sites in southern Arizona suggests continuity between early southwestern cultivators using expanding stem (and possibly side-notched points) and subsequent early farming groups using other notched point types. The Late Holocene appearance of the Cortaro biface, whose distribution is limited to the borderlands region, may represent local development of a new general-purpose tool by the first farmers of this region.

Most of the known atlatl specimens in northwestern Mexico and the southwestern United States are not well dated, but the few that have been radiocarbon dated (Ferg and Peachey 1998; Moreno 2000) or dated by their association with temporally diagnostic artifacts were manufactured during the Late Holocene, after the arrival of maize. Therefore, the northern and southern distributions of two slightly different variations in spur designs on mixed-type atlatls may represent passive stylistic variation reflecting ethnic differences between subgroups of Uto-Aztecs (northern and southern?) that developed after the arrival of Mesoamerican agriculture.
Linguistic data suggest the chronology of tropical cultigen arrivals in the Southwest. Many of the surviving Native American languages of the Southwest and Mexico belong to the Uto-Aztecan family of languages, and shared word roots and similarities in grammatical and semantic structures allow linguists to trace these related languages back to a common ancestral language of several thousand years ago. Fowler (1994) and Hill (2001) have shown that maize was cultivated during the time of the Proto-Uto-Aztecan speech community because there is a shared vocabulary for the cultivation and processing of maize between northern Uto-Aztecan languages, such as Hopi (and probably Numic), and the southern languages in this family (such as Nahuatl, the language of the Aztecs). Words for “squash” also show similarities that indicate that this cultigen spread before the breakup of the dialect continuum, while differences in words for “bean” show that it diffused among Uto-Aztecan speech communities after the breakup. The timing of this breakup is therefore bracketed by the initial dates of squash and bean in the Southwest (Hill 2001), currently 3700 and 2500 B.P. (circa 2100 and 750 B.C. calibrated), respectively.

The timing of the appearances of tropical cultigens in the southwestern archaeological record can be reconciled with Hill’s (2001) linguistic model by several alternate scenarios: (1) a northward expansion of people who spoke the PUA language brought maize and squash to the Southwest, and then other tropical cultigens spread after the breakup of this PUA speech community; (2) an expansion of PUA speakers (from either north or south) occurred prior to the spread of agriculture as the climate improved at the beginning of the Late Holocene, and then these cultigens diffused in two or more waves across a continuum of linguistically and culturally related hunting-and-gathering groups; or (3) both diffusion and migration processes were at work on the early agricultural frontier in the Southwest, and early agriculturalists in this region included speakers of both the PUA language and indigenous languages (Hokan and possibly Penutian).

The rapid dispersal of maize and pepo squash to the Mogollon Highlands and the southern Colorado Plateau may have been a result of either the existence of such an established linguistic-cultural continuum or of northward migrations of farmers from the desert lowlands. The latter scenario best fits the relatively sudden appearance on the central Colorado Plateau of the Western (or White Dog–phase) Basketmaker II archaeological complex (1000 B.C. – A.D. 500) with maize and pepo squash and provides an explanation for similarities in the material cultures of the Western Basketmaker II and San Pedro complexes (1200–800 B.C.) of the southwestern U.S./northwestern Mexico borderlands.

In comparing the assemblage of perishable materials in San Pedro–phase levels of Ventana Cave in southern Arizona with similar materials in Western Basketmaker II cave occupations in the Four Corners area, R. G. Matson (1991, 1999) has argued that these two complexes also have in common some sandal types and coiled basketry with two-rod-and-bundle foundation and uninterlocked stitch. Mabry (2006b) noted that some elements of the San Pedro complex overlap with the Western Basketmaker II complex: Western Basketmaker points, San Pedro points, bone
dice, bulbous stone pipes. These shared elements of both nonperishable and perishable materials appear to support models proposing that the sudden appearance of the Western Basketmaker II complex on the Colorado Plateau represents a migration of San Pedro–phase farmers between 850 and 500 B.C. (Berry and Berry 1986; Matson 1991, 1999). This scenario would also account for the spread of the PUA language community to the Northern Southwest before 500 B.C., as reconstructed with linguistic data by Hill (2001, 2003).

The long delays in maize dispersal north of the Colorado and San Juan rivers, on the other hand, may have been a result of these rivers becoming the boundaries between PUA farmers and indigenous hunter-gatherer groups who later adopted agriculture (cf. Geib 1996). In contrast to maize and squash, both common bean and bottle gourd spread more slowly from south to north, probably because of their preferences for warm temperatures and long growing seasons and because they had to cross emerging cultural boundaries after the breakup of the PUA speech community.

If Proto-Uto-Aztecs brought agriculture with them, or if agriculture spread among them after their arrival in western North America, why did it not persist into historic times among the speakers of northern Uto-Aztecan languages? Romney (1957) was the first to suggest that the historically non-agricultural Uto-Aztecan peoples in the extreme north had abandoned agriculture, referring to archaeological evidence of agriculture in the area of the Great Basin occupied by Shoshoneans, historical evidence of irrigation of wild plants by the Owens Valley Paiute, and the documented practice of broadcast sowing of wild plant seeds by several groups in the basin. Could these features be interpreted as remnants of a past agricultural tradition among Shoshonean people? Hill (2001) reiterated this possibility to explain the presence of agriculture-related word cognates in some northern Uto-Aztecan languages.

The irrigation canals recently found at early farming sites in the Southwest, the prehistoric maize cobs and possible canal found in dunes near Lovelock, Nevada (Jensen 1976), and the historical practice of irrigating maize fields in southwestern Nevada (Steward 1938) all suggest that the historical irrigation of wild plants by the Owens Valley Paiute and broadcast sowing of wild plant seeds by other Ute and Shoshonean groups in the western Great Basin represent remnants of an ancient horticultural complex in a region ultimately too marginal for tropical cultigens. Then again, Great Basin agricultural strategies may also be explained by diffusion from adjacent agricultural traditions to the east. The high degree of correspondence between the distribution of Uto-Aztecan language and agriculture, together with the ethnographic cultivation practices documented by Steward and others and the linguistic evidence cited by Hill (2001), suggest that agriculture may have been abandoned after the PUA expansion into the Great Basin. However, this does not inform on whether agriculture arrived in the Great Basin by diffusion or migration.

The dating of possible archaeological evidence of the arrival of Proto-Uto-Aztecs in regions beyond the Southwest may help bracket their earlier arrival in
the Southwest. The arrival of Uto-Aztecan, Takic-speaking peoples on the southern California coast (the so-called Shoshonean wedge that split the previous continuum of Hokan [Yuman]-speaking peoples) is generally associated with regional settlement and subsistence changes that occurred between about 3500 and 3000 B.P. (circa 1800–1200 B.C. calibrated) (Erlandson 1997; Mason, Koerper, and Langenwalter 1997; Moratto 1984) and the appearance of cremations about this time (King 1981). However, it has also been variously proposed that the Uto-Aztecan arrival on the southern California coast is marked by the appearances of flexed inhumations by 6400 B.P. (circa 5400 B.C. calibrated) (Drover and Spain 1972), of Olivella grooved rectangular beads at about 5000 B.P. (circa 3800 B.C. calibrated) (Howard and Raab 1993; King 1990; Vellanoweth 1995), of contracting stem dart points about 4500 B.P. (circa 3300 B.C. calibrated) (Harrington 1933), and of clockwise-coiled basketry about 3800 B.P. (circa 2200 B.C. calibrated) (Bleitz 1991).

In the southwestern Great Basin, the arrival of Proto-Uto-Aztecan has been attributed to the appearance of contracting stem dart points about 5000 B.P. (circa 3800 B.C. calibrated) (Holmer 1994), while the apparent continuity in material culture and subsistence strategy in the central Great Basin since about 5000–4500 B.P. (circa 3800–3300 B.C. calibrated) until historic time has been cited as evidence of the long presence of Uto-Aztecan (Aikens and Witherspoon 1986).

Although arrivals of Proto-Uto-Aztecan on the southern California coast between 3500 and 3000 B.P. (circa 1800–1200 B.C. calibrated) would fit with a circa 4000 B.P. (circa 2500 B.C. calibrated) arrival of PUA agriculturalists in the Arizona-Sonora borderlands region, a date of 5000 B.P. (circa 3800 B.C. calibrated) or earlier for reaching either the Great Basin or the Pacific Coast would imply an arrival in the Southwest prior to the arrival of Mesoamerican cultigens. Acceptance of such a scenario would strengthen the case for a pre-agricultural northward expansion of PUA speakers or would require revisiting the models of PUA origins in the Great Basin or farther north rather than to the south.

Regarding Fowler’s (1983) newer position that the locations of Tarahumara and Cahitan groups that interrupt the distribution of Piman languages are a result of subsequent movements of these groups toward the west Mexican coast, we believe both linguistic and ethnographic data demonstrate they have been in place for at least 2,000 years, if not more. The Cahitan-speaking groups of the coastal plain have traditionally been considered late arrivals, descending from the Sierra Madre Occidental and displacing presumably Tepiman-speaking peoples (Beals 1932:145; Braniff 1992:217; Sauer 1934:82; Wilcox 1986). However, as discussed by Miller (1983a:333), this interpretation seems to have been based solely on geographical appearances. In considering the linguistic data, Miller and others (1983a, 1983b; D. Shaul, personal communication 1993) have suggested that the Cahitans may have been established on the coastal plain near the beginning of the Christian era. In turn, the Tepimans may likely represent a late (circa twelfth-century) intrusion, perhaps from the north (Hill 1996; Fowler 1980; Miller 1983a:333, 1983b; Shaul and Hill 1993).
Long-term in situ development for the lowland Cahitans is also supported by the ethnographic data. Sixteenth-century population estimates indicate an extremely high density, with figures ranging from 70,000 souls and 5.2 persons per square kilometer for the Tahue to 60,000 Opata with a projected density of 1.5 persons per square kilometer (Sauer 1935:5). Extensive temporal agriculture was carried out along the floodplains of the major drainages, reportedly producing up to three harvests per year for a wide range of cultigens that included maize, beans, squash, cotton, peppers, eggplant, and guavas (Sauer and Brand 1932:52). Some groups also reflect well-developed maritime exploitation of both littoral and deep-water resources (Pérez de Ribas 1944; Sheridan 1981). In contrast, the Lower Pimans are often described in contact-period documents as occupying largely marginal lands, practicing little or no agriculture, and with little exploitation of coastal resources (Tom Sheridan, personal communication 1993).

SUMMARY
We argue that current archaeological evidence does not reconcile neatly with Hill’s (2001) linguistic model of a Proto-Uto-Aztecan migration from central Mexico that brought Mesoamerican agriculture to the Southwest. Some archaeological data point to the possibility of a pre-agricultural expansion of PUA speakers into the Southwest, creating a linguistic-cultural continuum across which maize and pepo squash later spread. However, a variety of archaeological evidence suggests that the Arizona-Sonora borderlands were reoccupied from both the south and the north at the end of the Middle Holocene and that maize and other early tropical cultigens arrived and spread across the Southwest through a combination of diffusion and migration processes. The implication is that some early farmers in the Southwest spoke indigenous languages while others spoke Proto-Uto-Aztecan. As with maize and squash agriculture, irrigation spread across the Southwest before the breakup of the PUA community, and the historical practice of irrigating wild plants by some Paiute groups in the western Great Basin may reflect a remnant of that early irrigated-farming complex. However, irrigation technology (and most likely ceramics) probably represents independent innovations by early southwestern farmers.

NOTE
1. Bellwood (1997, 1999) and Hill (2001) referred to the “rake-like” structure of the Uto-Aztecan language family as an indication of the rapid divergences that would occur with migration and rapid agricultural colonization. However, such a structure could also develop with increasing sedentism and loss of contact between groups and with other processes of ethnogenesis. Miller (1984:20–21) suggested that because the ancestral PUA community was composed of hunter-gatherers in contact with a small number of other groups, a “wave principle” operated, a situation in which there is “a dialect continuum which dissolves into distinct languages and in which newly budded languages reflect the earlier dialect relationships.”
With the shift to agriculture and the resulting greater population density and increased sedentism, the geographic area of mutual influence was reduced, but the network included more people. This may have functioned to minimize the wave principle and to maximize a "family tree principle" (which Miller preferred) or a rake principle (favored by Bellwood and Hill), in which multiple splits occur in quick succession within a parent language. While the linguistic evidence for multiple splits in rapid succession within Uto-Aztecan presented by Bellwood and Hill represent a rake-like principle, it is possible that the process of language change shifted to this principle after the diffusion of agriculture and increasing sedentism.

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