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dated by radiocarbon dating alone. This is because of the nature of radiocarbon dating as a statistical approach and the lack of adequate samples of datable carbon from many (if not most) features, components, and sites.

Finally, this author would like to make some recommendations to archaeologists who rely on radiocarbon assays. One suspects that like the author, prior to the Hinojosa site experience, most archaeologists have never taken the time to understand how radiocarbon dating really works. Previously, this author used radiocarbon dates rather carelessly; if a date "looked right," it was used uncritically, if not it was ignored or explained away. In order for radiocarbon dating to live up to the "optimistic plaudits" mentioned, the tool of radiocarbon dating must be used for what it is rather than for what we archaeologists would like it to be. Toward this end the following suggestions are offered:

(1) Archaeologists should take time to carefully investigate the radiocarbon laboratories to which he or she sends samples. The pretreatment methods, equipment calibration standards, and counting times used by a given laboratory can seriously effect how the date will come out. If samples are to be split and sent to two laboratories, it behooves the archaeologist to make sure that both laboratories use essentially identical methods, or else the results are liable to be inconsistent.

(2) Archaeologists should work more closely with radiocarbon scientists at all stages of the process, from the field circumstances to the final interpretations. Each feature, component, or site is unique and should be treated as such.

(3) Radiocarbon laboratories should provide as standard information the processing details for each sample. Some laboratories make a standard practice of this, many others do not. Most information could be summarized in three to five pages. The pretreatment variation, the sample count times, and any problems in processing for each sample should be reported to the archaeologist.

(4) It is very obvious that a detailed comparative study needs to be made of the radiocarbon laboratories that provide data to archaeologists. This study would reveal which procedures are and are not producing reliable results and would provide a means to evaluate and compare data received from various radiocarbon laboratories.

PERDIZ ARROW POINT SPECIAL STUDIES

A comparatively large sample of **Perdiz** arrow points (100) and fragments of other arrow points (64; most of which are probably **Perdiz** fragments) was recovered from 41 JW 8. These were found in virtually all excavation units in most excavation levels except for the lowest nonproductive levels. The large arrow point sample was used for three special studies in addition to the wear pattern examination discussed in Section VI. These studies are an evaluation of a projectile point neck width dating formula hypothesis, a look at plow-damaged arrow point distribution, and a study of arrow point breakage patterns.

NECK WIDTH HYPOTHESIS

Bill Fawcett (1978) has suggested that a mathematical relationship exists between the neck width of central and southern Texas Late Archaic and Late Prehistoric projectile points and time. Simply stated, Fawcett contends that projectile point neck width gradually decreased through time. Furthermore, he argues that the average neck width for a group of projectile points from a single component can be used to derive an estimate of the occupation date. Fawcett derived a "mean neck-width formula" from measurements of projectile points from south, central, and coastal Texas sites that had discrete occupation levels dated by radiocarbon assays. Fawcett (1978:137) then used the **Perdiz** point data from 41 JW 8 presented in Hester (1977) as a test of his mathematical model. Based on his measurement from photographs of 27 **Perdiz** points from the 1975 testing and surface collection, Fawcett determined the mean neck width of the 27 illustrated points was 7.5 mm and estimated that the Hinojosa site dated to A.D. 1327. This date is very close to the mean date of the two radiocarbon assays from 1975 (although one of the dates had a plus or minus of 1230!). Fawcett (1978:137) concluded that "a single application of the formula demonstrates the accuracy of this formula dating methodology."

A number of weaknesses in Fawcett's methodology are readily apparent. First, he makes the unstated assumption that south, central, and coastal Texas prehistories were so similar that projectile point size (or at least projectile point neck width) was uniform at any point in time and changed diachronically at a uniform rate. Second, his data was mostly derived from measurements of photographs of select projectile points; hence he assumes that the photographed points were representative of the entire sample from a given occupation level and that measurements from photographic representations are accurate. Fawcett also assumes each radiocarbon assay is accurate, although he uses various linear regression correction factors to adjust shell and snail assays. Finally, while Fawcett cites the site references, radiocarbon assays, and mean neck widths, no data is provided on sample size or even the type of projectile point being measured.

The validity of all of Fawcett's assumptions can be seriously challenged. The absence of the sample size and type data makes it impossible to evaluate the formula. These problems aside, the idea presented by Fawcett is an interesting one. If an accurate neck-width formula could be constructed then many site components could be dated that lack carbon preservation. In an effort to provide better neck-width data and to test Fawcett's basic premise, the **Perdiz** points from the 1981 season were accurately measured. All measurements were made of the actual specimens using calipers.

The sample of **Perdiz** points from the 1981 season at 41 JW 8 was much larger and better controlled than the 1975 sample. A total of 77 **Perdiz** points with measurable stem (neck) widths was recovered. The mean stem width of this total was 58.7 mm. The neck-width formula devised by Fawcett is:

$$Y = .832\,(X) - .0099,$$

where X is the neck width in millimeters, and Y is the estimated age in hundreds of years B.P. (before the radiocarbon present, A.D. 1950). Using this formula, an estimated age of 487 B.P. (A.D. 1463) is derived by plugging in the site mean (.832 x 5.87 - .0099 = 4.87 x 100 = 487; 1950 - 487 = 1463). This date is within the range of the radiocarbon assays but is about 100 years later than the A.D. 1350-1400 period in which this author believes the site was occupied.

The neck-width model was further tested by looking at the distribution of neck widths within the excavated sample from 41 JW 8. The following assumptions were made: (1) it was assumed that the site deposits result from repeat visits to the site by related groups over several generations, and (2) it was assumed that the **Perdiz** points in the lower excavation levels were deposited before those in the upper levels. Given these assumptions and Fawcett's hypothesis one would expect that the **Perdiz** points from the lower levels would have a larger mean neck width than those from the upper levels.

The sample of **Perdiz** points from the Wagon Trail Area was used to evaluate the neck-width hypothesis because this area was felt to be less disturbed than most other excavation areas and had associated radiocarbon assays. The WTA **Perdiz** points were divided into two groups. Those from Levels 1 and 2 were placed in the upper group while those from Levels 3 and 4 were placed in the lower group. Unfortunately, **Perdiz** points were more numerous in the upper levels. Nonetheless, the resulting means tentatively appear to support Fawcett's hypothesis. The lower group had a mean neck width of 6.51 mm (N=9) while the upper group had a mean neck width of 5.48 mm (N=22). Plugging these means into the neck-width formula one arrives at estimated dates of A.D. 1409 for the lower group and A.D. 1495 for the upper group.

It is interesting that the 41 JW 8 **Perdiz** point neck-width dates appear to be within the range of most of the radiocarbon assays. The 85-year spread between the lower sample and the upper sample does not seem to be an unreasonable estimate of the length of the prehistoric occupation. However, certain caveats seem to be warranted. First, the neck-width means were based on comparatively small sample sizes; the addition or subtraction of one or two unusually large or small neck widths would significantly alter the mean. Second, and perhaps most important, Fawcett's neck-width formula was not derived from a large well-controlled sample.

It is suggested that in spite of the many weaknesses in Fawcett's neck-width hypothesis, the basic premise may have merit. Projectile points do generally decrease in size through time during the Late Archaic and Late Prehistoric periods in central and southern Texas. However, it remains to be demonstrated whether the decrease in projectile point size can be mathematically linked to neck width through time. This author does not believe that the original formula was accurately constructed. A more reliable formula could be constructed by the accurate measurement (beyond the photographic measurement of complete illustrated specimens) of projectile points from a series of comparatively well-dated single component sites such as 41 JW 8 or from isolated components. Crucial to the accuracy of the formula is the sample size of each projectile point type and the accuracy of the radiocarbon dating of the components represented by the projectile point types.

PLOW DAMAGE STUDY

The Hinojosa site is located on the edge of an agricultural field that has been plowed for many years. Many of the artifacts recovered from the site bear scars, breaks, and iron deposits (plow damage visible on the artifacts in Fig. 6) that attest to frequent plowing. During the artifact analysis, it became apparent that a majority of the lithic artifacts from the surface and first level had been struck at least once with the plow. It was also observed that the artifacts from the lower levels had not been disturbed by plowing. In an effort to document the extent of the plow zone a study was made of 157 **Perdiz** arrow points (A1) and arrow point fragments (A4).

Arrow points were chosen for the study because of the large number of specimens and their relatively wide vertical and horizontal distribution. It was observed that iron deposits left by plowing are most commonly found on the ridge scars of bifacial artifacts. Hence, the more numerous lithic items such as flakes might not show damage as often as bifacially chipped artifacts. The arrow points are the most numerous bifacial artifact group at 41 JW 8. The 157 specimens represent all the A1 and A4 artifacts that were placed in bags with full provenience information. Other A1 and A4 specimens were only labeled by lot number and were not included simply to save the author the time from having to look up the provenience. The 157 specimens are considered an adequate sample.

Each arrow point or fragment was examined under 10X-20X magnification for the presence of iron deposits (plow marks). As mentioned, plow damage is evidenced by breaking, scarring, and iron deposits. Virtually all lithic artifacts that appear plow damaged have surface traces of iron. These plow marks appear as isolated dark surface deposits or a linear series of deposits that usually occur on flake ridge tops or near the artifact edge. Under magnification, the edges of the plow marks appear maroon to red to orange in color. Some care had to be exercised as a small percentage of the examined artifacts had iron inclusions within the chert and red-stained areas that could be confused with plow marks. Somewhat more common were silver to gray metal traces. These represent contact with the galvanized 1/4-inch screen hardware cloth during the excavation recovery process.

About 35% of the 157 specimens have noticeable plow marks. Assuming that the sample is representative of all the artifacts, over one-third of all the artifacts recovered from the site have been displaced by plowing. On a vertical basis the 157 specimens have a highly significant distribution. Of the four arrow points recovered from the surface, three had plow marks. Although this is a small sample of surface material, almost every surface-collected artifact of any type examined by the author had obvious plow marks. Level 1 specimens have plow marks on 38 out of 74 (51%). Level 2 specimens have plow marks on 14 out of 45 (31%). None of the 22 specimens from Level 3 or the 12 specimens from Levels 4-6 have plow marks. This correlates very well with the profile illustrations and observations that the plow zone was approximately 20 cm thick.

Discussions with relatives of the landowner and with the tenant farmer revealed that the site was never deep plowed to their knowledge. The Hinojosa family told the author that the family had acquired the property in the early 1900s by hiring workers from Mexico to hand grub several hundred acres in the site vicinity. The Hinojosa property was deeded to the family in exchange for the land clearing. Thus, the site was spared the severely destructive deep root plowing often used in more recent times to clear land in southern Texas (Dusek 1982). In fact, the plow marks observed on the 41 JW 8 specimens could be more accurately called "disk" marks as most probably represent the shallow disking that precedes planting. A disk plow has several closely spaced rows of metal (iron) disks that literally cut up compacted soil and agricultural waste and allow the soil to absorb more moisture. Each row of disks turns in the opposite direction of the adjacent row. Thus, an artifact would probably be displaced only a few centimeters by disking.

ARROW POINT BREAKAGE PATTERNS

A breakage study was made of all specimens identified as **Perdiz** points (A1, N=100) and all unidentifiable arrow point fragments (A4, N=87). As mentioned, the majority of the A4 fragments are thought to be broken **Perdiz** points. This statement is supported by the fact that **Perdiz** points account for about 92% of the identifiable arrow points.

The purpose of the study was to look at how **Perdiz** points had been broken and to attempt to correlate the breakage patterns with functional interpretations. The study was prompted by recent observations on a small sample of **Perdiz** points recovered at 41 LK 67 (Brown **et al.** 1982:42-43). Brown noticed that most of the **Perdiz** points found at 41 LK 67 had transverse snaps of the proximal section (stem) and/or the distal tip. He suggested that arrow points striking a hard substance (stone, wood, or bone) would tend to shatter, while an arrow point striking a soft substance such as animal tissue or soil would break once embedded due to stress caused by the weight of the shaft. Brown argued that an arrow point embedded in soft material would be susceptible to transverse snapping of the blade and the stem.

As Brown notes, the two extant examples of hafted **Perdiz** points found in dry central Texas caves, were both snapped at the top of the foreshaft. The remaining stem fragments measured 7 and 10 mm long. The missing stem sections of the 41 LK 67 **Perdiz** points appear to have been less than 7 mm, leading Brown to suggest that "a somewhat different breakage pattern must be implied, probably involving breakage of the stems inside the haft due to lateral stress on impact" (**ibid.**:43). Brown unsuccessfully attempted to look for similar breakage patterns in the archaeological literature and noted the problem of bias against illustrating broken specimens.

All of the A1 and A4 specimens from 41 JW 8 were divided into categories based on the location and angle of the breaks. Most of the breaks were transverse snap breaks. The original categories were based on schematic drawings of **Perdiz** points showing the various break locations. Some categories with minimal numbers were combined with closely related break categories. Figure 14 shows examples of most of the common break categories recognized at 41 JW 8. Tables 15 and 16 show a breakdown of the examined specimens. The tables are organized by the location(s) of the missing

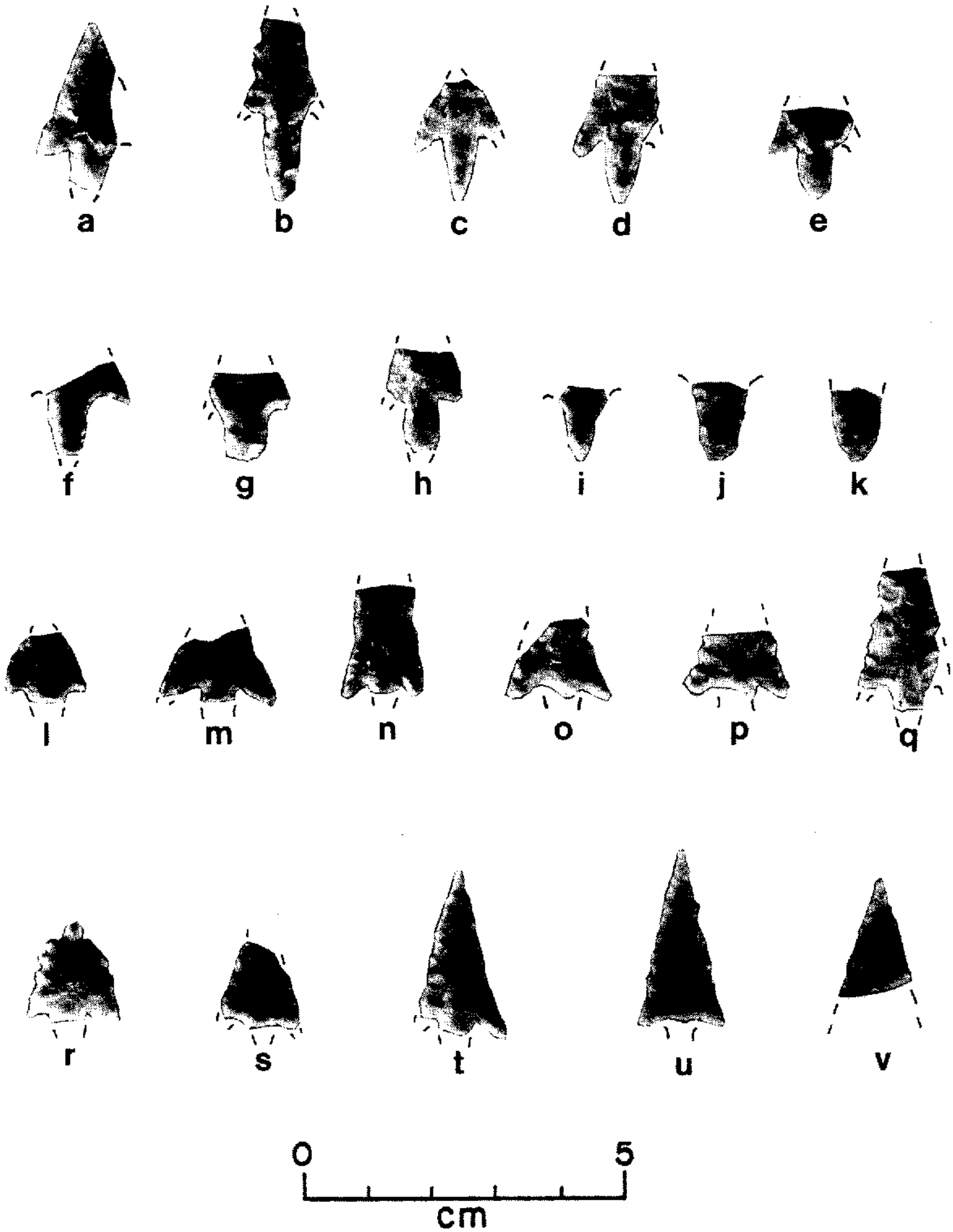

Figure 14. **Arrow Point Fragments.** a-h, **Perdiz** (A1); i-v, miscellaneous (A4). Lot numbers: a, 440; b, 254; c, 514; d, 434; e, 328; f, 57; g, 126; h, 191; i, 179; j, 259; k, 487; l, 437; m, 384; n, 513; o, 523; p, 342; q, 342; r, 328; s, 321; t, 313; u, 433; v, 433.

TABLE 15. (A1) ARROW POINT BREAKAGE

Missing:	DT	1B	2B	LS	US	EB	Count
	X						7
	X	X					17
	X		X				3
	X				X		2
	X	X		X			2
	X			X			2
	X		X	X			2
		X					12
			X				3
						X	18
				X			3
		X		X			1
			X	X			1
Total	35	32	9	11	2	18	73

TABLE 16. (A4) ARROW POINT BREAKAGE

Missing:	DT	1B	2B	LS	US	EB	LH	LT	Count
	X				X				6
	X	X			X				16
	X		X		X				4
	X						X		10
							medial subtotal:		36
								X	16
							X		8
					X				5
		X			X				3
			X		X				3
							distal subtotal:		35
						X			7
				X		X			3
							proximal subtotal:		10
Total	36	19	7	3	37	10	18	15	81

Note: DT= distal tip (less than one-third blade)
1B= one barb
2B= two barbs
LS= lower stem (less than one-third stem)
US= upper stem (more than one-half stem)
EB= entire blade (above stem)
LH= lower half (lower blade section and stem)
LT= lower two-thirds (all but distal tip)

portions of each fragment. The breakage categories and patterns for each group (A1 and A4) are discussed next.

Table 15 contains data on only 73 of the 100 A1 specimens. This total includes neither the 24 specimens that are completely intact (four of which were never finished) nor the three thermally fractured specimens. Of the 73 broken specimens, 35 (48%) are missing the distal tip. All but four of these 35 have transverse snap fractures. The four atypical specimens have acutely angled snap fractures. Of the 73 broken specimens, 41 (56%) are missing one or both barbs. Most of the barb fractures are snap fractures. Of the 73 broken specimens, 13 have stem fractures. Of these, 11 (15% of broken A1 specimens) are missing only the lower few millimeters. Of the 73 fragmented A1 specimens, 18 (25%) are complete stem fragments. Two of these have triangular or wedge-shaped remnants of the blade. The remaining 16 have transverse snap fractures at the top of the stem.

Table 16 contains data on 81 of the 87 A4 specimens. This total does not include three definitely unfinished fragments, two thermally fractured fragments, or one indeterminate fragment. Of the 81 fragments, 35 can be classified as distal sections, 36 as medial sections, and 10 as proximal fragments. Of the 81, 36 (44%) are missing the distal tip, 37 (46%) are missing most of the stem, and 26 (32%) are missing one or both barbs. It should be noted that 7 of the 10 proximal fragments are narrow pointed fragments that this author feels are more likely to be stem sections than distal tips. Conversely, the 16 distal fragments that are missing the lower two-thirds are pointed and appear most likely to be distal sections rather than stem fragments. As with the A1 specimens, except for a small number of acute snap fractures, all specimens have transverse snap fractures.

The fact that almost all of the A1 and A4 fragments have transverse snap fractures is interesting. Two technological factors, thinness and heat treatment, may contribute to the breakage pattern. The complete A1 specimens averaged less than 3 mm in thickness. This author has found thin flakes to be much more susceptible to snap fracture than thicker flakes or other thick artifacts. The heat treatment noted on many **Perdiz** points also increases the brittleness of chert. Given that the **Perdiz** arrow point is an extremely fragile projectile tip, breakage can be expected to have resulted from almost any stress. The susceptibility to breakage may have been compensated by the fact that **Perdiz** points are simply made from relatively small flakes and are thus cheap and easy to manufacture (in terms of raw material and effort).

A study of combined breakage data (Tables 15 and 16) reveals that many of the smaller arrow point fragments were not recovered. For example, 71 fragments were missing the distal tip, yet only 16 (23 counting the pointed "proximal" fragments) tips were recovered. At least 83 barb fragments are missing; none were recovered. The absence of these tiny fragments is no doubt due to the use of 1/4-inch mesh screening. The stem fragments are better represented; 39 fragments are missing most or all of the stem, and 28 stems were recovered.

More of the stem fragments consisted of the entire stem rather than only the lower section of the stem which suggests that the 41 JW 8 specimens were hafted similarly as the known examples (Jelks 1962; Olds 1965). Some fragments are missing only the lower portion of the stem (14 specimens). These are comparable to the 41 LK 67 specimens and may as Brown suggests be due to lateral stress on impact.

If Brown is correct, the transverse snap fractures noted on a large majority of the 41 JW 8 arrow point fragments are largely related to impact stress. The recovery of numerous distal and medial sections at the site suggests that the projectile impact either occurred at the site or that the target animals were brought back to the camp. The latter is evidenced by the relatively large quantity of medium to large mammal bones recovered from the site.

SOILS CHEMISTRY

Soils chemistry is a nonartifactual form of analysis which can provide important supplementary data for the interpretation of an archaeological locality. While some initial attempts have been made to analyze chemical aspects of archaeological site sediments in southern and south-central Texas (Black and McGraw 1985), very little comparative data is currently available for the region. Black and McGraw (1985) discuss this problem and make some comparisons between the soils chemistry results from the Panther Springs Creek site (41 BX 228) and the few other south-central Texas sites for which there is data. Over most of south Texas almost no previous studies have been done.

The soils chemistry work reported herein is thus somewhat of a pioneering study in the region. A major purpose of this study is simply to demonstrate that soils chemistry is effected by the hunters and gatherers who occupied 41 JW 8 and many other similar localities in southern Texas. If the changes in soil chemistry can be linked to cultural occupations and features, then this type of analysis has a definite potential application in future research in the region.

At 41 JW 8 we are dealing with a known prehistoric locality and recognizable cultural features. The soils chemistry samples were collected from known rather than unknown contexts, thus the excavations guided the soils chemistry testing. If it can be demonstrated that the prehistoric occupations are marked by changes in soil chemistry and that particular features are associated with soil chemistry anomalies within the occupation zone, we can suggest that future studies attempt to use soils chemistry testing to guide excavations.

SOILS CHEMISTRY BACKGROUND

Shackley (1975) has discussed the application of soils chemistry to archaeological problems at some length. Among the possible changes in soils chemistry due to human occupation are changes in soil ph, organic matter content, and phosphate content to name but a few. Of these, phosphate distribution has proven to be the most effective indication of human activity and was chosen as the major soils chemistry method used in this study.