Black, S.L.
1986 *The Clemente and Herminia Hinojosa Site, 41 JW 8; A Toyah Horizon Campsite in Southern Texas.* Center For Archaeological Research. The University of Texas at San Antonio, Special Report 18.

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.

It has long been known that the distribution of phosphate is influenced and often concentrated by man's activities. Animal and plant tissue, teeth, bones, and excrement all contain phosphorus in the form of orthophosphate (Lewis 1978). In calcareous soil conditions, such as those present at 41 JW 8, calcium phosphate compounds are formed when orthophosphates are added to the soil. These compounds are insoluble and tie down the phosphate and prevent lateral or vertical migration under most conditions. Thus, an area where man has deposited organic materials and wastes can be expected to have more phosphate than an unoccupied area. This fact has been used for many years to help determine the nature of man's land use in many different parts of the world. Black and McGraw (1985) summarize and provide references for the use of phosphate analysis to document man's activities.

METHODS

With the exception of the soils chemistry results obtained during the pollen pretesting, all of the soils chemistry analysis*was conducted by the author. The methods that are briefly outlined are obtained from Dr. Donald R. Lewis in a two-part archaeometry course (ANT 6973) offered at the graduate level by the UTSA Anthropology Department. Dr. Lewis supervised the author's work and provided invaluable advice. Most of the details of the methods outlined are derived from detailed papers prepared by Dr. Lewis. The work was conducted in the Archaeometry Laboratory at the UTSA.

Phosphate Spot Testing

Phosphate spot testing is a relatively quick, inexpensive method of determining if phosphate is present and if so, in what relative quantity. The method has been widely used in archaeological applications and is discussed in detail by various authors (Woods 1975; Eidt 1977, 1984; Lewis 1978).

In brief, spot testing involves the placement of a small quantity of soil (100-200 mg) on a circular paper filter, adding drops of two chemical solutions at carefully measured time intervals and watching the resulting reaction. Samples without phosphate will not stain the filter, while samples with large quantities of phosphate will turn the central portion of the filter very dark blue. Two minutes after the last solution is added, the final evaluation of the spot test ranking is made. All of the 41 JW 8 samples were stabilized at the two minute mark by dipping the stained filter into a solution of sodium citrate. The stabilized filters retained the approximate color intensity at the time of stabilization for several months. Two years later, the colors are faded, however, the filters can still be compared for relative values.

The spot test ranking is based on four parameters: the length of time before blue appears, the approximate closure of the blue ring around the sample, the length of the color rays extending out from the sample, and the intensity of the color (Woods 1975). The author attempted to use this rating system, but found that all of the samples collected within the occupation area at 41 JW 8 had considerable quantities of phosphate, turned blue instantaneously, and had complete ring closures. The length of the color rays were discovered to be partially a function of the quantity of soil used. Thus, the intensity of the color was the only factor that could be used to distinguish most of the samples. It was found that the stabilization allowed the visual comparison of all the samples. The spot test ranking given, as follows, was based on a side-by-side visual comparison. A ranking of one indicates very little phosphate whereas a six indicates a very high quantity of phosphate.

During the spot testing it was observed that the quantity of soil had some effect on the size of the area of the filter that was covered by blue. A simple experiment was conducted using four soil samples (from the same provenience) that varied between 10 and 40 mg. Each sample was processed and the resulting filters compared. While all four had equally intense coloration, the size of the resulting stain increased with quantity. This experiment suggests that while 10-20 mg of soil is an adequate sample, size consistency is important for accurate comparisons.

Total Phosphate Determination

A more accurate determination of the quantity of phosphate present in soil can be made using more sophisticated chemical procedures. As noted by Lewis (1978), phosphate can be divided into three fractions or types, labile, bound, and mineral. The process of fractionation yields the total phosphate determination and the percentage of each constituent fraction. This method is time consuming, and it requires considerable equipment. However, the percentage of the phosphate fractions allows a more thorough understanding of the nature of the activities which resulted in the phosphate distribution.

Alternatively, the total phosphate can be determined by using spectrophotometric techniques. Basically this involves extracting phosphate from a soil sample, adding a colormetric reagent to form a blue color, and measuring the intensity of the blue color using a spectrophotometer. The quantity of phosphate is determined by comparing the spectrophotometer readings of the soil samples with the readings obtained on a series of samples of known phosphate content. The basic method was developed to determine the phosphate content of natural water (Murphy and Riley 1962). This method has been modified by Lewis to fit the nature of the samples (soil instead of water) and adapted for the equipment available at the CAR Archaeometry Laboratory. A detailed outline of the method is on file at the CAR.

Results

Table 17 provides the phosphate data for all of the processed samples. Phosphate spot tests were conducted on 42 samples. The total phosphate amounts were determined for 22 of the 42 spot tested samples. The data show a great deal of consistency as well as patterning that can tentatively be linked to the prehistoric occupation.

It is significant that the highest spot test rankings and total phosphate quantities occur within the most intensive occupation zone, the WTA, as defined by excavation and from the cultural features. The two off-site columns, the Noise Pit South (NPS) and the Wheat Field Noise Pit (WFNP), had

TABLE 17. PHOSPHATE TESTING RESULTS

Lot Number	Provenience	Spot Test Ranking	Total Phosphate ppm
	F.5 A.I. (0,0)	6	2342/2392
	F.5 A.I. (0,-10)	6	
	F.5 A.I. (0,-20)	4	
	F.5 A.I. (0,-50)	5	
	F.5 A.I. (0,10)	6	1144
	F.5 A.I. (0,150)	4	499
	F.5 A.I. (0,200)	4	573
	F.5 A.I. (-10,0)	6	
	F.5 A.I. (-50,0)	4	
	F.5 A.I. (-100,0)	4	798
	F.5 A.I. (-150,0)	3	
	F.5 A.I. (10,0)	6	
	F.5 A.I. (20,0)	6	
361	WTA Col. 1, L.1	5	893
362	WTA Col. 1, L.2	5	895
403	WTA Col. 1, L.3	4	717
451	WTA Col. 1, L.4	3	298
363	WTA Col. 2, L.1	5	1348
378	WTA Col. 2, L.2	5	764
402	WTA Col. 2, L.3	4	
452	WTA Col. 2, L.4	2	179
489	WFNP Z.1	1	
491	WFNP Z.2	1	20
493	WFNP Z.3	1	
500	NPS Z.1	1	
490	NPS Z.2	1	55
502	NPS Z.3U	1	
507	NPS Z.3L	1	
501	N80 E102 Z.1	3	
498	N80 E102 Z.2U	3	
504	N80 E102 Z.2L	2	
508	N123 E106 Z.1	5	
495	N123 E106 Z.2	3	282
505	N123 E106 Z.3	2	
405	F.6A	5	1397
406	F.6B	4	868
400	F.6C	6	1493
401	F.6D	4	796/808
404	F.6E	6/6	1529/1597
407	F.6F	5	649
496	F.8	5	762
242	N96 E82 L.2 rock cluster	3	

Note: ppm = parts per million; A.I. = Axial Interval; WTA = Wagon Trail Area; WFNP = Wheat Field Noise Pit; NPS = Noise Pit South; U = Upper; L = Lower; L. = Level the lowest phosphate quantities. In fact, the samples from these areas had almost no phosphate. It is particularly interesting to note that the samples from the middle of a fertilized wheat field registered the lowest total phosphate determination of the 22 samples.

Within the samples collected from the occupation area, several patterns are apparent. The four columns (WTA Columns 1 and 2, N80 E102, and N123 E106) all show a decrease in phosphate with depth. This is consistent with the fact that the prehistoric occupation was concentrated within the upper three levels (equivalent to Zones 1 and 2). The WTA columns indicate higher phosphate quantities than the other two columns. This is consistent with the fact that much greater quantities of cultural material were recovered in the WTA. Within the WTA, the highest phosphate quantities are associated with Features 5 and 6, the two definite cooking features (hearths).

A comparison of the phosphate spot tests ranks with the total phosphate determinations (Table 18) shows that while the average of each rank is progressively higher in total phosphate the ranges of the upper three categories partially overlap. This suggests that spot test differences of only one rank cannot be considered significant unless backed by total phosphate determinations. The fact that the rank averages are consistent suggests that spot testing is a valid method of determining overall relative quantities.

Two different total phosphate determinations were made on three samples as shown in Table 17. In each case the two determinations are in close agreement. However, it should be noted that the paired determinations were made from different concentrations of the same soil extract. Thus, no attempt was made to take subsamples of a soil sample and run a complete extraction and determination of each. In all likelihood, given the variation in phosphate content of the samples from different areas within Feature 6, subsampling would result in greater variation.

AXIAL INTERVAL SAMPLING

Axial interval sampling, as outlined in Section III, was an experimental method of obtaining soil samples for phosphate testing in and around key features. Feature 5, a cluster of burned rock and charcoal (see Section VIII) was selected as a trial case for axial interval sampling. In brief, this involved superimposing a two-dimensional grid centered over Feature 5 and colleting small soil samples (75 cc) at intervals within and around the feature. The grid was oriented on cardinal directions. The samples were identified by cartesian coordinates that reflect the distance in centimeters from the midpoint (0,0). The north-south grid line was designated the X-axis and the east-west grid line the Y-axis. The first coordinate was a positive number north of the midpoint, and the second coordinate was a positive number east of the midpoint. Thus, sample (0,200) was collected 2 m due east of the midpoint, while sample (-150,0) was collected a meter and a half due south of the feature midpoint.

Figure 15 illustrates the axial interval sampling conducted at Feature 5. Phosphate spot tests were done on all of the axial interval samples. Figure 15 shows that the quantity of phosphate is much higher within and immediately

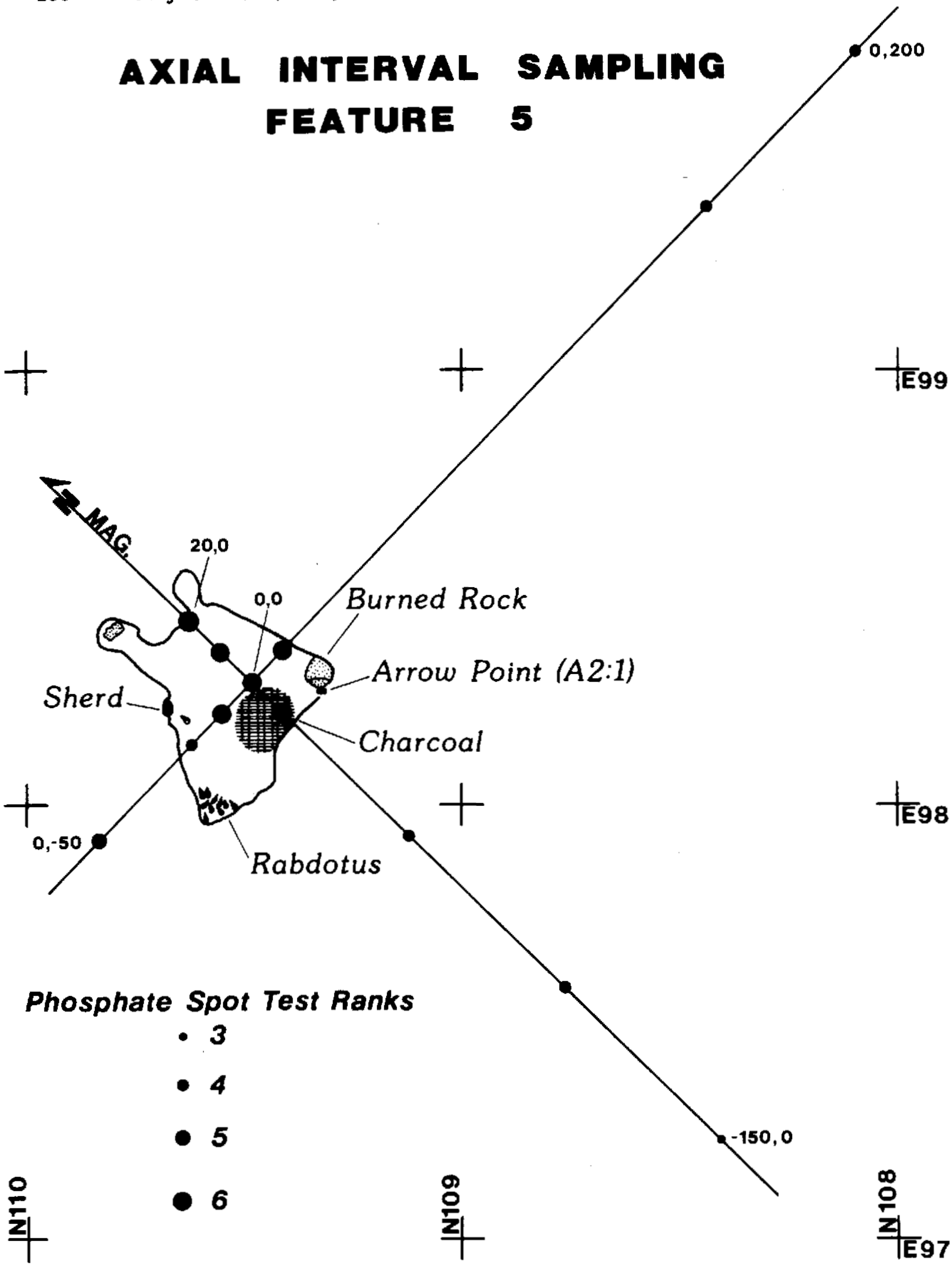

Figure 15. **Axial Interval Sampling, Feature 5.**

TABLE 18. A COMPARISON OF SPOT TEST RANKS TO TOTAL PHOSPHATE

	Total Phosphate			
Spot Test Rank	High	Low	Average	Sample Count
6	2392	1144	1750	6
5	1397	649	958	7
4	868	499	722	7
3	298	282	290	2
2	179	179	179	1
1	55	20	38	2

adjacent to the central feature area than in the surrounding area. The highest total phosphate reading from the site was from a sample collected in the center of Feature 5.

ADDITIONAL SOILS CHEMISTRY

Fourteen soil samples were submitted to the Soil Testing Laboratory at Texas A&M University by Richard Holloway, the project pollen analyst. The purpose of this test was to determine the likelihood of pollen preservation as discussed in Section VII (Pollen Analysis). A secondary benefit is that the tests provide additional soils chemistry data from 41 JW 8. Table 19 presents the results of these tests. The Soil Testing Laboratory provides a standardized report that rates the amount of key chemical constituents based on agricultural usages. Most of the results are reported in parts per million (ppm). Each test category is briefly discussed next.

The soil pH of the 14 samples ranged from 7.7 to 8.1, a fairly consistent range of mildly alkaline readings. The soil phosphorus readings were of limited value because the maximum detection level was 150 ppm, and most of the samples measured over this. As expected, the samples from the Noise Pit South averaged significantly lower in phosphorus than the samples from the site area. One unusual anomaly was reported. The WTA Col. 1, L.2 sample (Lot 362) was found to have only 11 ppm of phosphorus. This figure does not agree with the other samples from the WTA and with the total phosphate determinations made by the author. It is assumed that the Soil Testing Laboratory result is in error.

Nitrogen levels ranged from 3 to 18 ppm and showed no particular patterning. Potassium levels ranged from 372 to 560 ppm. Magnesium levels ranged from 305 to 756 ppm. Both potassium and magnesium had higher average amounts from the WTA samples as opposed to the Noise Pit South. The calcium readings were all over the maximum detection level, 4000 ppm, indicating very calcareous soils. The percentage of organic matter ranged from 1.00% to 6.40%. The WTA samples had a higher average organic matter content than the Noise Pit South

TABLE 19. SOILS TESTING LABORATORY RESULTS

			ppm						
Lot Number	Provenience	pH	Phos-phorus	Nitro-gen	Potas-sium	Magne-sium	Cal-cium	Organic Matter
361	WTA Col.1 L.1	7.8	>150	3	560	395	>4000	1.86%
362	WTA Col.1 L.2	7.9	11	3	532	405	>4000	1.93%
403	WTA Col.1 L.3	7.9	>150	16	468	440	>4000	1.65%
451	WTA Col.1 L.4	7.9	133	11	408	455	>4000	1.72%
500	NPS Z.1	7.8	48	3	428	360	>4000	2.32%
490	NPS Z.2	7.8	36	3	380	305	>4000	1.00%
502	NPS Z.3U	7.7	35	3	372	365	>4000	1.37%
405	F.6 (A)	7.8	>150	3	512	420	>4000	2.48%
404	F.6 (E)	7.9	>150	16	756	500	>4000	6.40%
407	F.6 (F)	8.1	>150	3	492	440	>4000	2.16%
307	F.5 (S. 1/2 U)	7.8	>150	5	468	435	>4000	3.28%
309	F.5 (S. 1/2 L)	7.9	>150	18	508	480	>4000	3.28%
497	F.8 upper	8.0	>150	3	396	410	>4000	1.44%
488	F.8 lower	8.0	>150	3	460	475	>4000	3.64%

samples. Within the WTA, the feature samples had noticeably higher organic matter readings than the nonfeature samples. It should be noted that the organic matter readings reflect only the available carbon, hence, most of the additional carbon provided by charred botanical materials was not measured (R. Holloway, personal communication).

In summary, the soil testing results from Texas A&M confirm trends noted in the phosphate testing conducted by the author. The fact that phosphorus, potassium, magnesium, and organic matter readings all average higher from the intensively occupied site area (the WTA) than the off-site area (the NPS) suggests that the prehistoric occupation at the Hinojosa site significantly altered the overall soil chemistry.

CONCLUSIONS

The phosphate testing of soil samples from 41 JW 8, although limited in scope, provides a basis and some supporting data for the hypotheses which follow. The hypotheses are the tentative conclusions or interpretations of the 41 JW 8 data.

1. Intensively occupied Late Prehistoric hunter and gatherer sites in southern Texas have much higher phosphate concentration than adjacent nonsite areas.

2. Certain types of cultural features such as cooking hearths result in very localized phosphate anomolies (extremely high concentrations).

3. Spot tests are adequate for defining occupation zones but must be combined with total phosphate determinations to accurately define anomolies within intensively occupied site areas.

4. Intensive prehistoric occupation areas may also show increased quantities of other aspects of soils chemistry such as magnesium, potassium, and organic matter.

Future researchers in the region will have the opportunity to test the above hypotheses and to expand the application of phosphate testing in southern Texas. One potential approach would be the use of spot tests on soil samples collected from shovel tests. The use of a systematic method of shovel test location, such as transect or grid sampling, should allow accurate determination of the intensively occupied site areas.

The total phosphate determination method could be used within an intensively occupied zone to define anomalies caused by cultural features. Phosphate tests from samples associated with other types of cultural features (in addition to hearths) may also demonstrate anomalies. A fractionation study of various cultural features might provide more specific functional evidence.

It should be noted that the Hinojosa site is comparatively recent in contrast to many sites in southern Texas. It remains to be seen whether the high phosphate readings found in intensive occupation zones and some cultural features at the Late Prehistoric site of 41 JW 8 are also found at Archaic sites in the region.

WATER SEPARATION

Fifty-eight soil samples were collected at the Hinojosa site for the purpose of recovering cultural materials missed by the use of 1/4-inch mesh screening. These soil samples consist of feature matrix samples, on-site control column samples, and off-site control column samples. The samples ranged in volume from two liters to more than six liters. A two-liter sample from 29 of the soil samples was processed using water separation techniques. The major goal of the water separation program was to recover microfauna and charred botanical remains.

The experience gained in previous attempts at flotation (Black and McGraw 1985) guided the 41 JW 8 water separation program. McGraw constructed a flotation device at the CAR laboratory nicknamed the "Izum of Texas." This device is a modified version of the Davis and Wesolowsky (1975) original Macedonian "Izum" with certain improvements suggested by the Bodner and Rowlett (1980) flotation system. Detailed plans of the device are on file at the CAR.

The water separation device is built around two 55-gallon drums positioned such that the first drum is higher than the second. The first barrel has a metal rebar rack about 10 inches below the top on which a wooden sluice box