Report to: Dr. Cynthia Irwin Williams   Date: April, 1965

From: J. Schoenwetter

Title: Preliminary Palynological Investigations on the Archaic Horizon

INTRODUCTION

In March and April of 1965, pollen analysis was undertaken on a suite of sixteen stratigraphic sediment samples from the Armijo Shelter for Eastern New Mexico University. The samples were associated with BMII, BMIII, Santa Ana-Atrisco, and San Jose cultural materials, and the lowermost two samples were of culturally sterile sediment. Only seven of the samples yielded sufficient pollen for analysis using the standard extraction and counting techniques of this laboratory.

It was apparent that the other saples contained pollen, but in such reduced frequency that the proportion of organic and inorganic debris on the slides was extremely high. Therefore, the nine samples were processed by a different technique: one designed to more fully eliminate detritus and concentrate the pollen. Four more counts were obtained. If yet another technique of extraction was used on the remaining five samples even these might yield pollen counts, but there was no time to attempt such a process.

It is known that different extraction techniques sometimes produce different results on the same pollen sample, so when two extraction methods are used on the same series, it may be argued that comparison of pollen counts from samples processed in different ways is suspect. In the present instance there is no direct data to allow evaluation, but there is a fair amount of consistency in results between sample 15 and sample 16, which were processed in different ways, and samples 5 and 6, which were processed in different ways. In my opinion there is little reason to presume that the results of samples 1, 2, 3, 4, 5, 10 and 15 are not comparable to those of samples 6, 7, 9 and 16.

RESULTS AND CONCLUSIONS

Samples 8, 11, 12, 13 and 14 failed to yield sufficient pollen for analysis, and sample 9 yielded only a 100-grain count. The other ten samples gave the 200-grain base count which this laboratory uses as its standard. The pollen diagram is drawn up in the normal fashion of this laboratory and it reflects the use of an adjusted pollen sum (Schoenwetter and Eddy, 1964, pp. 69-72).

The stratigraphic pollen series seems to be divisible into a number of discrete zones. The uppermost sample is the only available representative of the first zone. This zone is characterized by a significant increase in arboreal pollen and a significant increase in Ambrosieae pollen relative to the samples immediately below. The second zone is recognized in the samples collected 16 and 22 inches below surface. Not only are these distinctive by reference to the sample collected at 10 inches below surface, but they also contain less *Artemisia* pollen than those immediately below and none of the hygric pollen types (*Typha*, *Salix* and *Cyperaceae*). These samples are also distinctive in containing *Ephedra* pollen of a different type than the other samples.

The samples collected at 28 inches, 34 inches, 40 inches, 46 inches and 58 inches below surface may be considered collectively as members of a third zone characterized by the presence of pollen of plants adapted to hygric conditions. This zone may be subdivided into a later subzone (IIIa) characterized by significantly higher frequencies of *Artemisia* pollen, and an earlier one (IIIb) characterized by significantly higher frequencies of grass pollen.

The sample from 64 inches below surface constitutes Zone IV. It is characterized by significantly higher Ambrosieae frequencies than zones above or below it. This sample contained one grain of *Zea* pollen. *Zea* pollen is differentiated from pollen of *Tripsicum* or *Euchalaena* (teosinte) by surface sculpturing visible by phase contrast microscopy and by its range of size which, while overlapping with the others, is somewhat larger. Since no phase contrast equipment was available for use in determining that this grain was *Zea*, size was relied on. The grain, in its crushed fossil state, has a measurable diameter of 67.5 microns and probably measures over 85 microns in an expanded condition. The pore is masked by the folds of the crushed grain. Under oil immersion (900X) the surface of the grain is finely microreticulate.

The sample from 94 inches (Zone V) is distinctive in its significantly higher frequency of juniper pollen, and its significantly lower frequency of Chenopodiaceae pollen. It contains significantly less Ambrosieae pollen than the sample from Zone IV, and no pollen of hygric plants or cultigens.

The sample from 100 inches differs sufficiently in its Juniperus frequency to be designated as a separate zone (VI). In other respects it is like Zone V.

The interpretation of environmental conditions from the statistics of a palynological spectrum proceeds in two fashions. The empirical approach, utilized primarily in pollen investigations in the American Southwest, compares the results from surface samples collected under known conditions of vegetation with subsurface samples and applies the principle of uniformity in interpretation of the latter. A second approach considers the ecological factors pertaining to the pollen taxa recognized in the subsurface samples in light of their modern floral equivalents.

No surface samples have been collected or analyzed from the area in which this site occurs, nor from the general vegetation patterns of this region. Any attempt to utilize the empirical approach to interpretation, then, must be based upon samples collected to the north and west in New Mexico or to the south and west in Arizona. In the area of the site the vegetation pattern would be characterized as a shrub and grassland community dominated by saltbush, with favorable site locations supporting savanna and woodlands of juniper or juniper and pinyon. The surface samples which have been collected to the north are from a region which supports more sagebrush than saltbush. The northern area has species of grasses which tend to be more cold tolerant where juniper and pinyon are absent, and more pinyon where the trees are present. The surface samples which have been collected to the south are from a region which supports almost pure grass communities (desert grasslands), and oak or oak-juniper savannas where trees are present. Both saltbush and sagebrush are essentially absent in the south. Thus the empirical approach must be applied with caution and the interpretations based upon it must be considered only the best available estimates.

A major distinction which can be drawn between surface samples collected from the steppes and savannas to the north and the deserts, grasslands and savannas to the south is in the amount of arboreal pollen contained. Table 1 diagrams the known range of AP frequency (on the basis of an adjusted pollen sum) for the various vegetation patterns. It will be noted that values greater than 50 per cent are restricted to the northern savannas. Values less than 10 per cent are restricted to southern grasslands and deserts. Applying the empirical approach, we should be able to characterize a pollen spectrum as more probably a reflection of southern than northern vegetation patterns if it contains less that 10 per cent AP.

Both the empirical approach and the ecological approach agree that samples containing any frequency of pollen of *Salix*, *Typha* or Cyperaceae indicate particular edaphic conditions. It has been empirically determined that pollen of cattails and sedges is not disseminated over any great distances, and collections made directly under willow trees rarely contain more than a few per cent willow pollen. Judging by surface samples collected in the north, however, it seems that when peculiar edaphic conditions are evidenced by the occurrence of pollen of hygric plants, the AP frequencies do not accurately reflectthe vegetation pattern. Probably this occurs because the pollen shed by the local flora is over-represented and also because the edaphic situation allows unusually good preservation of grains which are ordinarily destroyed.

Pollen grains referable to the Ambrosieae are found in surface samples, but usually in low frequency. Martin (1963) argued that high frequencies of Ambrosieae (low-apine Compositae) pollen were indications of high water tables and undissected floodplains, but recent work on surface samples in southeastern Arizona has tended to nullify this conclusion. It would seem that high frequencies of Ambrosieae pollen occur commonly at some times and not at others, and therefore they are a good stratigraphic index fossil. The ecological significance of their occurrence is still debatable, however.

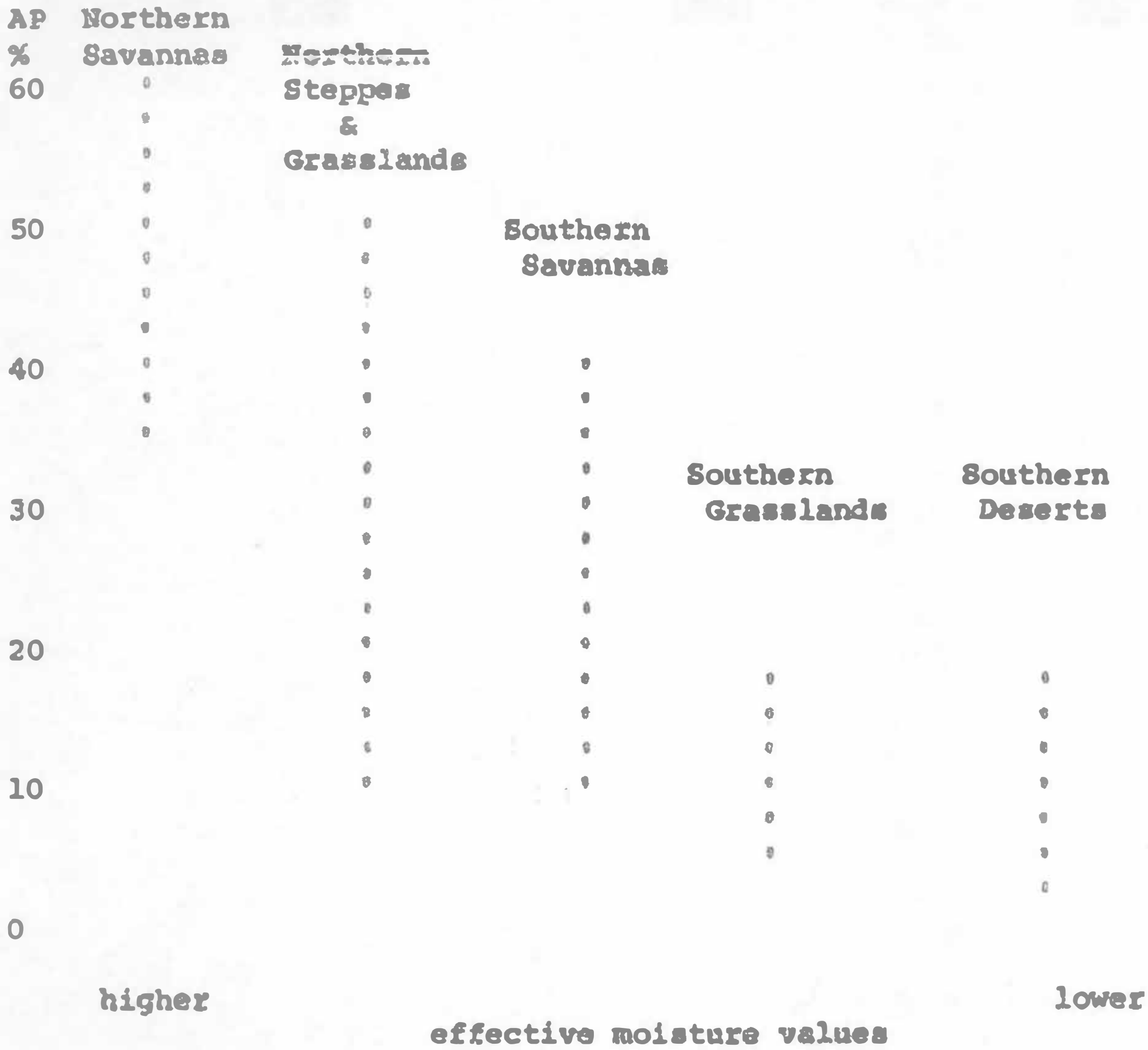
AP
%
60
50
40
30
20
10
0
Northern Savannas
~~Northern~~
Steppes & Grasslands
Southern Savannas
Southern Grasslands
Southern Deserts
higher
lower
effective moisture values

TABLE I

Martin has demonstrated (1963, p. 51) that the occurrence of the two morphologically distinct varieties of Ephedra pollen has some ecological significance. Sites containing significantly more than 50 per cent nevadensis-type pollen are distributed in that part of the Southwest which enjoys more of a winter-dominant precipitation pattern, while sites containing more of the torreyana-type pollen are in that part which gets more of a summer-dominant rainfall pattern. Variations in nevadensis and torreyana-type Ephedra pollen, then, seem to be a significant ecological index.

Applying the principles of interpretation discussed above, Zone I would appear to indicate some vegetation pattern less moist than a northern savanna and more moist than a southern grassland or desert. The relatively low Gramineae values are not inconsistent with an interpretation of grassland. In view of the high Chenopodiaceae values and the unusually high juniper values, I believe that the ecological approach might justify interpretation of a saltbush-dominated steppe vegetation pattern similar to that of the area today with juniper savannas nearby.

In Zone II times, the vegetation pattern at the site was probably not much different from that during Zone I times, but some change had occurred. The junipers seem to have been located further from the site area than occurred later. The occurrence of the nevadensis-type of Ephedra pollen (without the torreyana-type)would indicate more definite influence of conditions presently represented more frequently to the north of the area.

The AP frequencies of the Zone III spectra are not a reliable index to the basic vegetation pattern because of the evidenced peculiar edaphic conditions. The locality was probably on the margin of an ephemeral cienega throughout Zone III time. The finely laminated condition of the alluvial unit tends to support this environmental reconstruction. The higher frequencies of Artemisia pollen in Zone IIIa may be interpreted as an indication of a more northerly vegetation pattern occurring at that time. It seems possible that the overall ecological condition may have been one of a northern steppe pattern. In Zone IIIb times, the grass pollen frequency is increased. This may simply be a reflection of the cienega environment, if it is not an artifact produced by people bringing grass into the rock-shelter. As it occurs in conjunction with low Artemisia and Chenopodiaceae values, it may be interpreted as an indication of the occurrence of a vegetation pattern now more usual to the south.

During Zone IV time, the AP value is consistent with an interpretation of a more southerly vegetation pattern. The reduced grass frequency, however, indicates that it is not of the same sort as occured during Zone IIIb time. The Chenopodiaceae values seem to justify an interpretation of a saltbush dominant ecology, like present, albeit with fewer tress near the site than occured during Zone I times.

The sample from Zone V has a higher AP frequency than is expectable in the southern grasslands or deserts, but not one higher than is found today in the southern savannas. The increased grass frequency appears more consistent with such an ecological niche than a more northerly steppe or savanna where more Chenopodiaceae and Artemisia might be expected. The same argument holds for Zone VI. The high grass frequencies appear more probably a reflection of a southerly environmental influence and are most consistent with a grassland or desert interpretation.

Put another way, the environmental conditions at the site can be considered in three categories: (1) essentially similar to today (Zones I and IV); (2) indicating ecological influences now more effective in the north (Zones II and IIIa); and (3) indicating ecological influences now more effective in the south (Zones IIIb, V, and VI). This conclusion is in basic accord with other palynological studies of the post-glacial environments of the American Southwest (Martin, 1963; Hevly, 1964) which have indicated variations occuring through time in the winter-dominant (northern) and summer-dominant (southern) rainfall conditions. When a summer-dominant condition is apparent in other areas, the Armijo shelter record should indicate either conditions similar to those of today or conditions reflecting influence of more southerly vegetation patterns. When a winter-dominant condition is evidenced in other areas the Armijo shelter record should indicate conditions reflecting influence of more northerly vegetation patterns.

Thus the shift in conditions between Zone I and Zone II times could be interpreted as due to a shift from a summer-dominant rainfall regime (Zone I) to a winter-dominant one (Zone II). As this occurs within the range of Basketmaker III time, it could well be correlative with a similar shift dated to AD 750-800 in northern New Mexico (Schoenwetter and Eddy, 1964).

In Zone IIIa times the pattern of winter-dominant conditions was also in effect, but this changed to a summer-dominant condition in Zone IIIb. By correlation with a similar shift in the Arizona pollen chronology (Martin, 1963), this variation at the end of San Jose time would date about 2000B.C. This date seems somewhat erroneous in view of estimates about the age of the cultural materials associated, but it must be recognized that the date of 2000 B.C. for the Zone IIIa-IIIb shift is mostly guesswork. It is obtained by a correlation of interpretation of ecological conditions at Armijo Tank with a similar interpretation in southern Arizona. In southern Arizona there are two radiocarbon dates available for the palynological unit under consideration, and the best estimate of age for the relevant pollen shift there is 2000 B.C. This date could easily be a whole millenium, or even one and a half millenia, off in either direction.

In Zones IV, V and VI, as in Zone IIIb, we seem to be dealing with a summer-dominant condition. By correlation with Martin's chronology, the indicated zones would all date between 2000 B.C. and 6000 B.C. The rather remote possibility exists that a winter-dominant condition occurs in the samples which yielded insufficient pollen (70-88 inches). If it is the case, Zones V and VI would date older than 8000 B.P. by pollen correlation of the hypothetical winter-dominant condition with that recognized in Martin's chronology at 6000-8000 B.C.

CULTURAL ECOLOGY

The most interesting result of this study, from the archaeological point of view, is the lack of maize pollen in the Basketmaker samples. Maize is definitely known to have been grown in the Southwest on this cultural horizon and much before. Maize pollen is found in association with macrofossils of maize from Basketmaker and Archaic sites (Martin, n.d.; Schoenwetter, 1962; Hevly, 1964a; Irwin and Irwin, 1959; Schoenwetter and Eddy, 1964), and it is also found when no macrofossils are recovered (Martin and Schoenwetter, 1961; Martin, 1963; Schoenwetter, 1962; Hevly, 1964a; Schoenwetter and Eddy, 1964). Thus the lack of maize pollen is probably significant, but there are a number of explanations possible. The economic function of the site, for example, or the season of occupation, or some cultural peculiarity in the handling of the maize plants and/or pollen.

If the lack of maize pollen on the Basketmaker and Santa Ana-Airisco horizons is significant, then its presence on the San Jose horizon is even more significant. If there is a cultural continuum here, it must be recognized that the people did know of corn but for some reason were definitely not following cultural patterns which would allow for incorporation of corn pollen in the sedimentary matrix of their habitation area.

A rather simple explanation would be that the site was not occupied during the season when corn was being grown. In view of the fact that the site was on the margin of a cienega during much of its period of occupation, this would be reasonable. During the growing season of corn the site was probably too wet and soggy for comfortable occupancy, but during the winter months, when the cienega dried out, it would afford a dry sheltered location near a small but reliable water source. It would also be located near a supply of edible cattail and sedge roots. If corn was brought into the site in the winter season, it might be expected that it would be already shelled, and perhaps already ground to flour. The pollen would not be carried into the site in quantity, since it clings to the silk and exterior foliage of the maize plant after dissemination from the tassels. The pollen grain never comes into contact with ovule for fertilization of spermatophytes; it therefore is not expected to cling to the seeds.

What natural resources may have been available to the occupants of Armijo shelter at various times? During the pre-San Jose and the San Jose horizons the resources would have been about the same ones available to the Chiricahua and Mescalero Apache during historic times. During Santa Ana-Atrisco and BM II times the resources would have been about the same as those historically available at Cochiti, San Felipe and Santo Domingo. During late BMIII times, the present resources of the region were more probably available. The exploitation of those resources, however, is a cultural pattern, and no amount of paleoecological reconstruction can yield data on what environmental opportunities were, or were not, exploited.

All that paleoecological reconstruction can do is allow the recognition of a range of probable resources which can serve the archaeologist as a framework within which respectable hypotheses can be formulated. If one does not know the nature of the environment, the occurrence of a large number of "woodworking tools" is simply a criterion for differentiating one horizon from another. When one can demonstrate that, on the horizon on which such tools occur in quantity, there was little available wood, the tools and their associations can be reconsidered in cultural terms and their meaning and function investigated.

PROPOSALS

The results of this preliminary investigation can be considered extremely valuable in that they have pointed to the direction of necessary supplementary research. First, it is evident that distinctive palynological horizons can be recognized as occurring through the Basketmaker and Archaic cultural periods as has been demonstrated for later periods in the Southwest. Such horizons should be extremely valuable stratigraphic tools to the archaeologist, since so very few sites of this time period are stratified.

Second, the value of the technique for the interpretation of the cultural ecology of this time period cannot be over-emphasized. The underlying philosophy to the "stages of culture" approach of most archaeologists deals with a progressive evolution of economically oriented technology. This philosophy must be put to the empirical test whenever the opportunity allows. To undertake such a study adequately we cannot continue with the assumption that the environment presently observed at a site is equivalent to that which the occupants encountered. We must not only know <u>if</u> the environment was different, but <u>when</u> it was different and <u>how</u> it was different as well as what cultural variations are associated with what environmental variations. Of the paleoecological techniques the archaeologist can utilize to resolve these matters, pollen analysis is the most precise, the most comparative, the most obtainable, and the least expensive per unit of recovered information. Other techniques can, and should, supplement the paleoecological investigation of the pollen analyst. Geomorphological, geochemical, malacological, faunal and paleobotanical techniques also should be applied to the archaeological project, and the wider the horizon one seeks to investigate, the more time-consuming and expensive the project becomes. The nature of the site and the nature of the archaeological problem are the two factors which must carry most weight in making the decision of which, if any, paleoecological techniques are to be utilized. The value of pollen analysis for this area seems fairly well demonstrated in this report.

Third, though pollen studies have been undertaken on the time horizon involved in other areas, the attempt at correlation of the Armijo Shelter samples with those from other areas yielded only very rough dates. It seems highly unlikely that this was due to an error, or fault, of the method. Pollen sequences in the Southwest in the A.D. 100-1960 time period have shown very close correlation in various areas, and there is some evidence that ecological variations recognized in the Southwest are correlative with variations general in the northern hemisphere. It seems more likely that the available pollen sequences are correct, insofar as they go, but lacking in sufficiently specific dating control. The potential cultural chronology, especially if it can be equated with internal stratigraphy, alluvial units, and radiocarbon and tree-ring dates, can provide the necessary specific dating control on the pollen spectra. This, in turn, will make the dating potential of the pollen analytic technique more effective in situations where other controls are lacking.

To accomplish the three research problems outlined above, I suggest the following approach to be undertaken in conjunction with the future research plans of Dr. Williams:

(1) In conjunction with the survey-and-testing phase of her proposed project, two kinds of pollen samples should be collected. From each site or site area located, a surface pollen sample should be taken and observations recorded on the presently occurring flora. These samples will act as controls on the subsurface materials, allowing an empirical index of "present conditions" and the expectable range of variation. From each site excavated or tested, a suite of stratified samples should be collected with the same degree of control (i.e., 4-inch or 6-inch levels) as the cultural materials and in direct association with them. Some of the sites investigated will probably be alluvial profiles of interest and concern to the project geologist.

It is not expected that all of the surface or all of the sub-surface samples will be analyzed. When the results of the test excavations have been analyzed, it should be possible to delimit accurately a cultural chronology for the area studied. Pollen samples associated with well-defined horizons in this chronology--probably only a small proportion of those collected--can be processed and analyzed and the resultant pollen chronology will be controlled by the cultural one. This chronology would at once be a paleoclimatic chronology and a cultural ecological chronology since it comes directly from the sites.

(2) In conjunction with the Armijo Shelter excavation phase of Dr. William's project, an expanded pollen program should be undertaken to take advantage of the rare opportunity offered by this stratified site. Samples should be analyzed at 4-inch intervals from this locality to obtain a second chronology which will act as a check on the survey chronology. Between the two there is every reason to expect that there will be sufficient detail to allow correlations with other pollen chronologies from the Southwest and the emergence of much information of stratigraphic and cultural ecological value. Other pollen samples from this site could also be analyzed for the resolution of specific cultural problems, such as the correlation of lithologically distinctive strata in different parts of the shelter.

It is to be expected that research approach (1) will necessitate the analysis of about 100 subsurface samples, and research approach (2) will necessitate analysis of an additional 40 samples.

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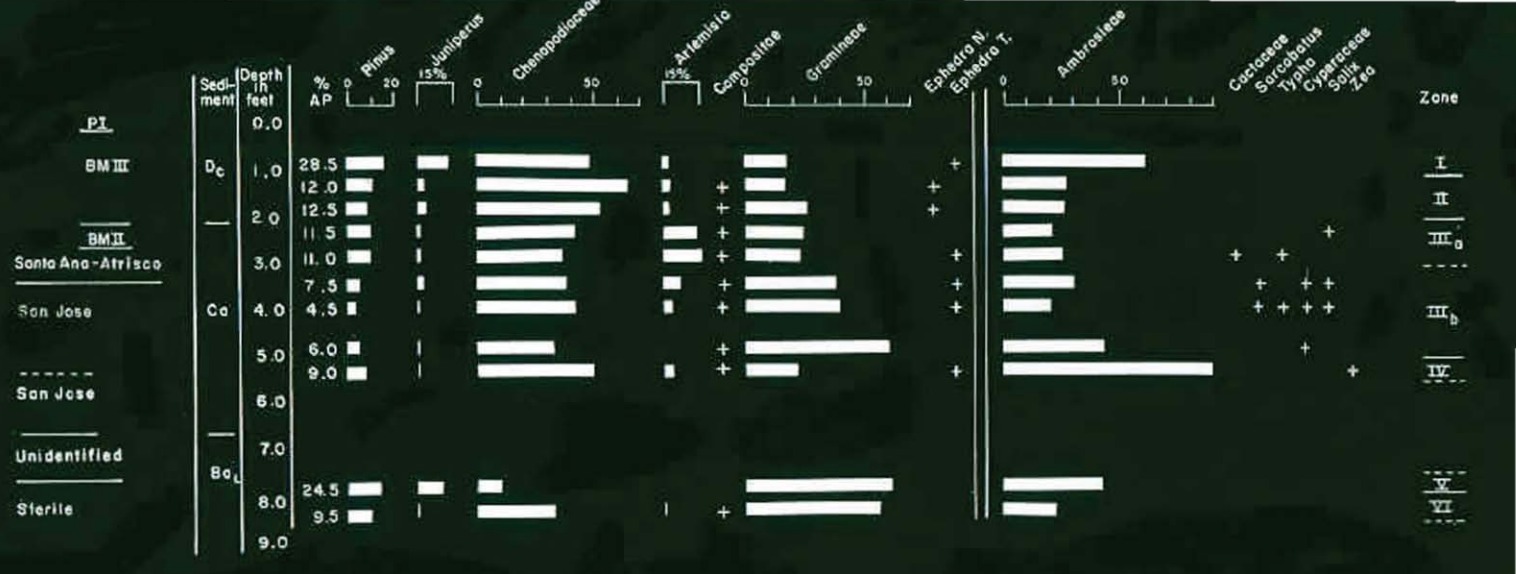

P I
BM III
BM II
Santa Ana-Atrisco
San Jose
San Jose
Unidentified
Sterile
Sedi-ment
Dc
Ca
Ba
Depth in feet
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
% AP
28.5
12.0
12.5
11.5
11.0
7.5
4.5
6.0
9.0
24.5
9.5
Pinus
0
20
Juniperus
15%
Chenopodiaceae
0
50
Artemisia
15%
Compositae
Gramineae
0
50
Ephedra N.
Ephedra T.
Ambrosieae
0
50
Cactaceae
Sarcobatus
Typha
Cyperaceae
Salix
Zea
Zone
I
II
III a
III b
IV
V
VI