REPORT TO: National Park Service DATE: October 20, 1964

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TITLE: Utah W:5:50: Palynological Analysis

Three pollen samples were received, one from the surface of the site which presumably represents the modern pollen rain, and two from Room B. One sample from room B was designated as a sample of the aboriginal fill, six inches below burned timbers; the other was of posthole fill. The surface sample and the fill sample were more productive of pollen. Enough pollen was recovered from the posthole sample, however, to give reliable evidence that it was essentially like the fill sample.

Analysis

Because pollen analysis is a statistical technique, the system utilized in obtaining the statistics is of some importance. In calculating the percentage representations of the various pollen taxa, one need not deal with the absolute frequency of a taxon. In European pollen studies, for example, it is general practice to base the percentages on the number of grains of tree pollen in the count and not on the total number of pollen grains observed. In this analysis I have excluded from the "base count" pollen of certain taxa. My intention in this regard is to de-emphasize the importance of pollen taxa which have little value for either dating or vegetation reconstruction purposes. By deleting the counts of these taxa from the base count, the percentages of other taxa necessarily increase.

This is not yet a standard practice in palynological analysis in the Southwest. Most of the few published pollen records (Martin and Schoenwetter, 1960; Martin and Hevly, 1962; ~~Martin, 1962~~; Martin, 1963; Schoenwetter, 1960; Schoenwetter, 1962) have all based their analyses on absolute frequency. I have tested the idea of adjusted pollen sums in two works (Schoenwetter, MS; Schoenwetter and Eddy, 1964) and feel that for the purposes of archaeological research it has much more value.

The reason for excluding the pollen of agricultural plants will be clear to prehistorians: the various ways in which agricultural plant parts (including the pollen itself) are culturally handled would indicate that the distribution of pollen of these plants is not subject to the same controls as the distribution of the pollen of wild plants. By deleting agricultural pollen from the base count, its relationship to the other kinds of pollen is placed in a special category. Various other pollen taxa which have unusual distribution problems are also deleted from the base count: taxa which indicate special edaphic conditions, as pollen of the low-spined Compositae, a morphological pollen taxon involving the genera _Iva_, _Xanthium_, _Hymenoclea_, _Ambrosia_ and _Franseria_. These genera are all indicators of disturbed soils, but some are indicative of wet and others of dry habitats. While they are common in palynological records (often lumped together under the rubric Ambroseae) the pattern of distribution of this pollen taxon seems quite locally controlled. I have somewhat arbitrarily excluded them.

Upon this analytic basis a pollen chronology for the Navajo Reservoir district of the San Juan basin has been proposed. (Schoenwetter and Eddy, 1964) I used the same analytic base for the samples from Utah W:5:50 for comparative purposes.

Results

The relevant pollen results are shown in the table:

	SURFACE (N=200)	FILL (N=200)	POSTHOLE (N=50)
% Arboreal pollen	81.5	28.5	28.0
% Juniperus pollen	32.0	21.0	12.0
% Chenopodiaceae pollen	8.5	43.5	50.0
% Artemesia pollen	3.5	14.0	14.0
grains Zea pollen	0	4	0

The percentage of arboreal pollen in the surface sample is that expected from a fairly dense woodland. Almost identical results have been obtained from woodland surface samples in the San Juan basin. According to Schroeder (pers. comm.) this is the sort of vegetation now existing at the site.

The percentage of juniper pollen in the surface sample is surprisingly low, as the site is now some distance from trees of any other type. Though juniper trees compose the present woodland, the amount of juniper pollen in the sample is less than half of the total Arboreal Pollen (AP) frequency. The percentage of AP, then, is a reflection of coverage by trees, not the type of trees.

The differences between the posthole sample and the fill sample are not significant at the 0.05 level of confidence. The differences between the surface and the floor samples are all statistically significant.

The difference in % AP in the surface and fill samples indicates a far lesser quantity of arboreal coverage at the site during occupation. The difference between the proportion of juniper pollen in the AP frequencies of the two samples indicates that while there were less trees at the time of occupation, almost the only type of tree available for some distance was juniper.

The difference between the surface and fill samples in Artemesia (sagebrush) pollen frequencies would indicate that the lessened coverage by trees during the period of occupation was mostlu compensated for by an increase in sagebrush.

The occurrence of Zea (maize) pollen in the fill sample indicates the agricultural orientation of the occupants--an indication well supported by the archaeological evidence. The lack of Zea pollen in the posthole sample is not significant, considering the small number of pollen grains observed.

The difference in the Chenopodiaceae records is great but the ecological interpretation of these values is difficult. First, since we are dealing with percentage values a decrease in the frequency of one category must be compensated for by an increase in the other taxa or, as of ten occurs, an increase in only one other taxon. In part this is a matter of actual replacement of the plants of one category by the plants of another through time, but in part it is also a function of competition for preservation between the pollen types, without the plants being involved. All plant types do not produce or disseminate the same amounts of pollen, so a small number of chenopodiaceous plants could well be better represented in the fossil record than a large number of plants of some other species, such as rabbit brush (Chrysothamnus sp.).

Second, taking the high Chenopodiaceae record at face value, that is as an indication of a large number of plants of this group in the area, the ecological tolerances of this group have two major orientations. On the one hand certain species are adapted to saline soils; on the other hand certain species are adapted to disturbed soils. Unfortunately, species identification on the basis of pollen morphology is impossible at this time so we are not sure which species we have here.

In studying southwestern pollen records from Arizona, Martin (1963) and myself (1960, 1962) have argued that high Chenopodiacea (the pollen taxon is also called cheno-am) values are indications of numerous summer storms. Almost all of the Chenopodiacea flower in response to summer rainfall, and in that area summer storms create erosion with a consequent development of the disturbed soils habitat to which Chenopodiacea are well adapted.

This interpretation is well indicated for Arizona, and seems evidenced in the geological record there as well. There is no a priori reason, however, that this interpretation will be applicable to this area of Utah which today, at any rate, has a different winter/summer rainfall ratio and other major climatic distinctions.

If the Chenopodiaceae record from the fill sample has any real ecological meaning, it is probably that of soil disturbance. This may be due to agriculture but that is simply a possibility, not a probability. Presently available data would indicate that digging stick agriculture is not conducive to general soil disturbance.

Conclusions

At present the site is located in fairly dense juniper woodland. During occupation it was probably located on the lower edge of a juniper-sagebrush ecotone. The climate was semi arid, as at present.

Palynological research undertaken on archaeological horizons in the Southwest (Schoenwetter, 1962; Hevly, 1964; Schoenwetter and Eddy, 1964) has indicated that the semi-arid climatic zones have undergone variations in environmental conditions through the range of post-glacial time. These variations have usually not been sufficiently critical to alter the climatic patterns to the effect that the region was no longer semi arid, but they have been sufficient to shift vegetation patterns and to have some impact on agricultural and settlement patterns.

It is, of course, impossible to evaluate the condition of affairs in this area of Utah from the two samples available. All that can be done at the moment is to compare this pollen horizon in Utah with those of the same date in Arizona and New Mexico and, from an evaluation of contrasts and similarities, attempt to deal with the matter.

The tree-ring dates for the structure relegate the period of occupation to the time between the mid 500's and the mid 600's A. D. One pollen sample from this time horizon is known from Arizona (Hevly, 1964: 77-79) and a number are available from New Mexico (Schoenwetter and Eddy, 1964). All such samples show a more densely forested condition that obtains at present, and alluvial stratigraphy in New Mexico indicates that this vegetation pattern was being sustained by an environmental condition which involved a greater winter/summer rainfall ratio than the present one.

The Utah samples show a far less densely forested condition than obtains at the present and, if the Chenopodiaceae frequencies are interpreted as a response to summer rainfall, a lesser winter/summer rainfall ratio than the present one.

In all probability the dating of this horizon is as good to the south as it is at this site, or at the very most is not off by as much as 100 years. Thus it becomes evident that the pollen chronology developed in Arizona and New Mexico is not applicable to southeast Utah in general. The most reasonable explanation is that as the two areas are now in somewhat different climatic zones (BSk as opposed to BWk) they were similarly in different climatic zones at the time Utah:W:5:50 was occupied. Though environmental variations were probably occuring in the same directions in both areas, since such variations were being controlled by shifting patterns of major atmospheric pressure systems, the vegetation responses to the variations were different.

Until such time as a pollen chronology is developed for the BWk climatic zone, to yeild information on the vegetation changes through time, and until other sorts of paleoecological research indicate the reasons for such vegetation changes as have occurred, all that can be done is extrapolation from the available data to the south. This data would indicate that at the time of occupation, winter rains were affording a greater percentage of the total annual moisture receipt than they do at present, with the probable effect of a longer, colder, winter season and, conversely, a shorter growing season.

That the growing season was not too short for maize agriculture is evidenced by the presence of corn pollen -- almost certainly from plants grown at the site. This particular site location may have selected for occupation because of its lack of arboreal cover, which reduced problems of land clearance.

Hevly, Richard H.
1964 Pollen Analysis of Quarternary Archaeological and Lacustrine Sediments from the Colorado Plateau. PhD dissertation, Botany, University of Arizona. Tucson.

Hevly, R. H. and Martin, P. S.
1961 The Geochronology of Pluvial Lake Cochise I. Pollen analysis of the shore deposits. Jour. Ariz. Acad. Sci. 2:24-31.

Martin, P. S.
1963 The Last 10,000 Years. University of Arizona Press.

Martin, P. S. and Schoenwetter, J.
1960 Arizona's oldest cornfield. Science 132:33-34.

Schoenwetter, J.
1960 Pollen Analysis of Sediments from Matty Wash. Master's Thesis. Dept. Botany. University of Arizona.

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1962 Pollen analysis of eighteen archaeological sites in east-Arizona and west-central New Mexico. <u>in</u> Martin, Rinaldo, Longacre, Cronin, Freeman and Schoenwetter. Chapters in the Prehistory of Eastern Arizona I. Fieldiana, Anthropology. V. 53.

Schoenwetter, J. MSa. Pollen analysis at Picuris Pueblo.

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1964 Alluvial and Palynological Reconstruction of Environments, Navajo Reservoir. Papers in Anthropology No. 13. Museum of New Mexico, Santa Fe.

SAMPLE: 122 + 50 | SEDIMENT:

DEPTH: Surf | COUNTER: 8 | DATE: 6/10/64

ARBOREAL POLLEN		%
Abies		
Picea		
P. edulis	96	
P. pond.	1	
1/3rds	/	
Total Pinus	97	48.5
Juniperus	64	32
Quercus	2	1
Alnus		
Juglans		
Betula		
Ulmus		
Celtis		
Total AP	163	81.5

NON-ARBOREAL POLLEN		
Chenopods	17	8.5
Artemesia	7	3.5
lo-spine	(26)	
hi-spine	2	1
Liguliflorae		
Total Compositae		
Gramineae	6	3
Ephedra N	3	1.5
Ephedra T		
Sarcobatus		
Malvaceae		
Onagraceae		
Cyperaceae		
Typha		
Umbelliferae		
Polygonum		
Total NAP	35	17.5

Unknowns 2 1.0

TOTAL POLLEN: 200 + 26

SAMPLE: 222+50 ; Room B

DEPTH: Floor COUNTER: JS

SEDIMENT:

DATE: 6/10/64

ARBOREAL POLLEN		%
Abies		
Picea		
P. edulis	14	
P. pond.		
1/3rds		
Total Pinus	14	7
Juniperus	42	21
Quercus	1	0.5
Alnus		
Juglans		
Betula		
Ulmus		
Celtis		
Total AP	57	28.5

NON-ARBOREAL POLLEN		%
Chenopods	87	
Artemesia	28	14
lo-spine	50	
hi-spine	1	0.5
Liguliflorae		
Total Compositae		
Gramineae	15	7.5
Ephedra N	7	3.5
Ephedra T		
Sarcobatus		
Malvaceae		
Onagraceae		
Cyperaceae		
Typha		
Umbelliferae		
Polygonum		
Zea	4	
Total NAP	138	68.0

Unknowns 5 2.5

TOTAL POLLEN: 200 + 54

SAMPLE: 222+50; Room B

DEPTH: Posthole

COUNTER: J

SEDIMENT:

DATE: 6/14/64

ARBOREAL POLLEN

Abies		
Picea		
P. edulis	7	14
P. pond.		
1/3rds		
Total Pinus	7	14
Juniperus	6	12
Quercus	1	2
Alnus		
Juglans		
Betula		
Ulmus		
Celtis		
Total AP	14	28

NON-ARBOREAL POLLEN

Chenopods	25	50
Artemesia	7	14
lo-spine	(11)	
hi-spine	1	2
Liguliflorae		
Total Compositae		
Gramineae	2	4
Ephedra N		
Ephedra T		
Sarcobatus		
Malvaceae		
Onagraceae		
Cyperaceae		
Typha		
Umbelliferae		
Polygonum		
Total NAP	36	70

Unknowns 1 2.0

TOTAL POLLEN: 50 + (11)