

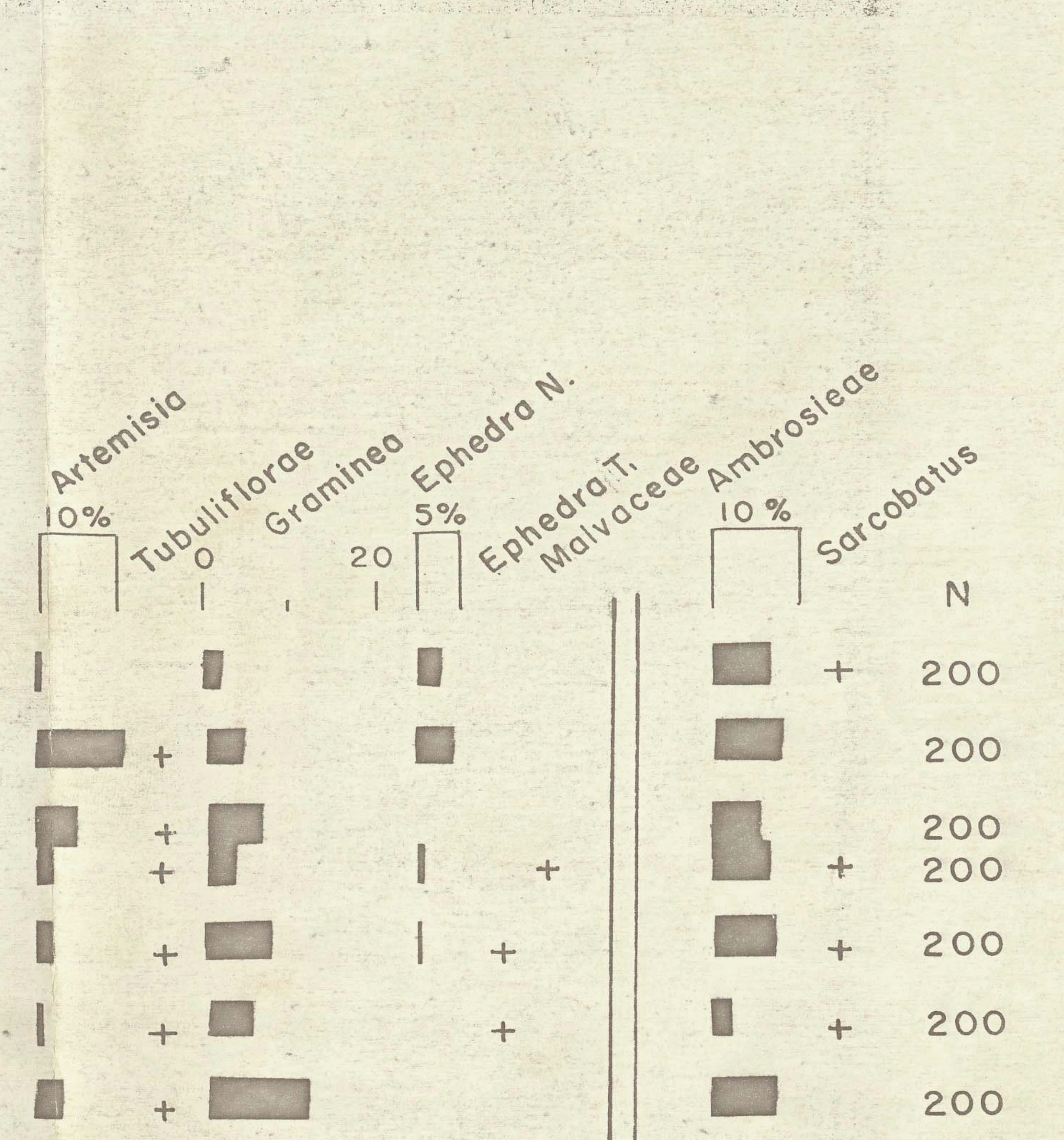
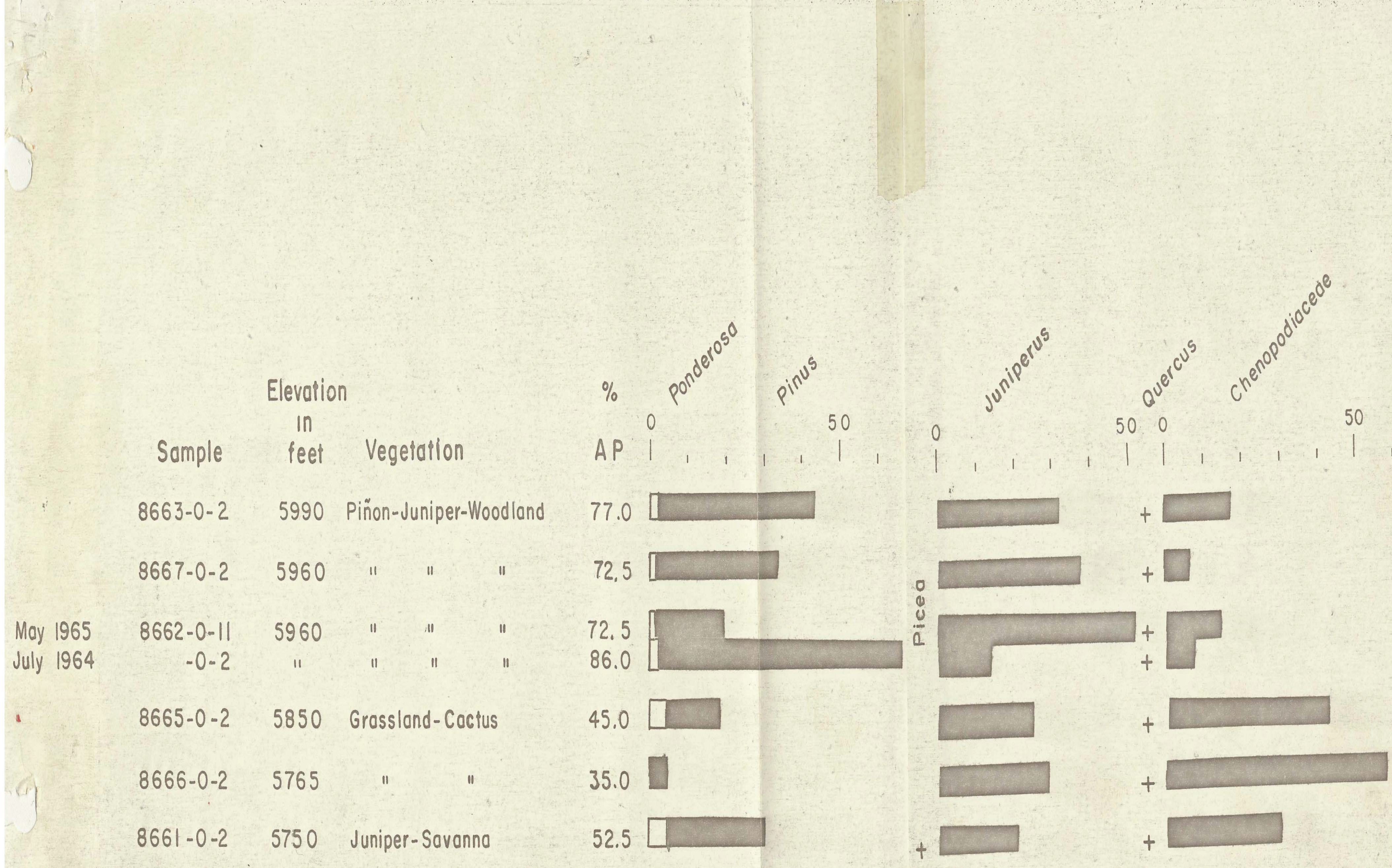
Palynological Analysis of Sediment Samples  
from the Largo-Blanco Sites

By

James Schoenwetter

As a part of the environmental research program in the Navajo Indian Irrigation Project, the Museum of New Mexico Palynological Laboratory undertook the analysis of twenty-seven sediment samples from the Largo-Blanco sites. Eight of these were collected from the modern surface as representative of the pollen rains of various ecological conditions in the district. The other nineteen samples were in association with prehistoric artifacts and represent ecological conditions at an earlier time.

Data derived from the samples suggest that the ecology extant during the occupation of sites LA 8662 and LA 8667 differed from modern conditions. The climate probably was drier and warmer at that time. Archaeological estimates of age of the samples was based on associated ceramics together with correlations with dated pollen spectra from the Chuska Valley, northwestern New Mexico, and the Little Colorado district in Arizona. It appears that all of the pit house and surface room floors sampled for pollen at LA 8662 dated between A.D. 850 and 900. About A.D. 875, a change in local ecological conditions occurred which may have been a factor in the ultimate abandonment of the site. In any event, the occupants of LA 8662 were witness to an ecological change



86 - Surface pollen record

which could be reflected in the artifactual remains at the site.

#### Surface Pollen Records

While undertaking an archaeological survey of the Largo-Blanco area in July 1964, Brew collected surface pollen samples from seven archaeological sites and recorded observations on local flora. Although the records are necessarily brief and generalized, some understanding of the ecology of the district can be garnered from his notes and from the observations and photographs made by Warren in 1965.

The two dominant controls on the arboreal vegetation of the region appear to be elevation of the locale and nature of the substratum. At higher elevations, such as the ridges on which LA 8662 and LA 8667 are situated, woodlands of pinyon and juniper occur on rocky substrata and on sandstone outcrops and scarps. However, at these elevations trees will be absent on dunes or substrata of alluvium. Lower, for example, on the bench where LA 8664 is located some 50 meters (165 feet) below LA 8662, the arboreal coverage thins to juniper savanna on rocky substrata and sandstone scarps. With decreasing elevation the amount of alluvium and dunes increases, the grass-cactus association is more prevalent, and the junipers become noticeably fewer. The reduction in arboreal coverage seems to occur principally because of the change in substratum. The lower elevations would otherwise support juniper savanna.

The nature of the substratum also seems to be effective in determining the location of various non-arboreal associations

at the lower elevations. The grass-cactus association is most prevalent where the substratum is sandy. Sagebrush-dominated communities occur in finer-grained soils, and other plant communities occur on gravel hills and alluvial terrace remnants above the rivers. At the higher elevations, however, the grass-cactus association occurs wherever the substratum is too deep for woodland.

The surface samples were collected at both higher and lower elevations. Three were from the higher elevation grassland; one from the lower elevation grassland; and two from the lower elevation savanna. One sample from the lower elevation savanna failed to yield sufficient pollen for analysis; the other surface samples collected in 1964 were successfully analysed. A second surface sample from LA 8662 was collected just prior to the 1965 excavations and also was analysed.

The analytical design of the pollen work followed the "adjusted sum" values which have been previously proved successful in the region (Schoenwetter and Eddy 1964; Harris, Schoenwetter, and Warren 1967). This analytical design offers a palynological expression of the density of arboreal coverage at a locality. It is not particularly informative about the nature of the plant community at the locality, the species of plants involved, or other critical botanical matters. This design was principally developed to be of value in dating periods of aboriginal occupation palynologically. Other designs are needed to express information of more direct paleoecological and paleoclimatic value. As will be made

evident, there are factors of seasonality in pollen dispersal which affect the pollen record drastically but do not affect this analytical design because such seasonality does not reflect the density of arboreal coverage. In short, the analytical design accomplishes its purpose, but is not an efficient device to accomplish other related purposes. This must be kept in mind when interpreting the palynological data presented in this report.

It was demonstrated in earlier reports that, utilizing the adjusted-sum design, the frequency of arboreal pollen increases in a regular fashion as the density of arboreal coverage increases. In the Navajo Reservoir and the Chuska Valley, surface samples from various degrees of arboreal coverage regularly contain characteristic AP (arboreal pollen) frequencies. Samples from parkland contain 70 to 90 per cent AP, samples from woodlands contain 60 to 70 per cent AP, samples from savannas contain 50 to 60 per cent AP, and samples from locales collected/without any arboreal coverage contain less than 50 per cent AP. The AP frequency seems also to decrease as the distance from the savanna border increases. Within ~~two~~<sup>three</sup> kilometers (1 to 2 miles) of the savanna border, the frequency of AP lies between 30 and 50 per cent; at greater distances the frequency is between 10 and 30 per cent (Schoenwetter and Eddy 1964: 64-72; Harris, Schoenwetter, and Warren 1967: Table 3).

If the same principals apply to Cañon Largo, we would expect that the AP values of the samples from sites now in woodland would be over 70 per cent, as the woodland at the higher elevations is fairly dense. Indeed, this proved to be

true (Fig. \_\_). Similarly, we would expect that the AP frequency of the juniper savanna sample would be between 50 and 60 per cent, and that of the two grassland samples would be between 30 and 50 per cent. Although there were no trees at the sampled grassland loci, trees are not far away. The expected percentages were found. It appears, then, that the AP frequency of a surface pollen sample from the Largo-Blanco district is a reliable index of arboreal coverage at the locality. Consequently, it is assumed that a pollen sample from a prehistoric time horizon is a reliable index.

A valuable illustration of the non-reliability of the adjusted-sum research design for evaluation of the floritics of the plant community is evident in the comparison of the two samples collected at LA 8662. The sample collected in May 1965 was taken soon after the pollination season of juniper; this pollen spectrum yields 52 per cent juniper pollen and 20 per cent pine pollen. The sample collected in July 1964 yields 70.5 per cent pine pollen and 14.5 per cent juniper pollen. Clearly, the amount of pollen of a given genus in a sample is not related to the number of trees of that genus at the locality, using this design. Yet the total frequency of AP, 72.5 per cent at one time and 86 per cent at the other, falls within the range characteristic of dense woodland arboreal coverage. Thus, the analytical design appears to be adequate for its purposes: giving palynological expression only to the conditions of arboreal coverage.

This does not mean that no statements of paleoecological reconstruction are possible other than that of arboreal coverage. One may interpret the meaning of arboreal density changes through time in any reasonable fashion. The controlling variables on modern arboreal coverage in the Largo area seem to be a function of effective moisture. Rocky sites at lower elevations are more arid than those at higher elevations, and thus support fewer trees. Deep-substrata localities at higher elevations are less arid than those at lower elevations, and they support more grass and few of the hardier shrubs. As far as the tree species are concerned, the rocky sites are less arid than the deep-substrata sites. This may be so because the arboreal root systems branch deeply on a deep substratum and thus do not tap significant quantities of water when precipitation does not penetrate the surface to respectable depths,

It may be concluded that, in this district, changes in arboreal coverage through time at a given locality are functions of variations in effective moisture due to climatic factors, so long as the substratum undergoes no change. In the archaeological past, according to excavation data, the substratum at any one locus has probably not undergone change (see Warren, this report). While this conclusion is reasonable, it must be recognized for what it is. There is no direct evidence for changes in effective moisture values through time because of climatic factors. There is only evidence for changes in the density of arboreal coverage. We may conclude that climatic variations occurred, but we are then working in the realm of interpretation rather than evidenced fact.

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## Prehistoric Pollen Records

Of the nineteen prehistoric pollen samples submitted, eight were unanalysable and four yielded less pollen than is considered optimally desirable (Fig. \_\_\_). Ordinarily, a pollen sum of 200 grains was available, but in one example 100 grains had to be accepted, and for three other samples, counts of only 50 grains each were viewed. It appears that these lower pollen counts are reliable since they are in agreement with other larger counts known to be of the same time horizon. The lower counts are probably functions of sediment samples which simply did not trap much pollen per unit volume.

On the basis of AP frequency, the eleven prehistoric samples arrange themselves in four groups. One sample, 8662-8-19, yields an AP frequency indicating a woodland coverage; three samples, 8662-33-10, 8662-10-16, and 8662-18-8, have AP frequency values indicative of savanna coverage; five samples, 8662-9-34, 8662-9-33, 8662-2-9, 8662-8-20, and 8667-1-7, have values indicating open conditions near trees; and two samples, 8662-16-28 and 8662-15-5, have AP frequencies indicative of open conditions some distance from trees. The first sample, 8662-8-19, which indicates woodland conditions, is suspected of having been contaminated by modern pollen. It was collected on the floor of a surface room which had been disturbed by pothunting and could have been influenced by heavy rains just before the date of collection. The similarity of the pollen statistics of this sample to those of the modern surface from the same site, and its dissimilarity to the other

prehistoric samples, are deemed sufficient (under the given conditions) for considering it contaminated and an unreliable indication of prehistoric ecology. The second sample, from an undisturbed portion of the floor from the same structure, 8662-8-20, is much more in accord with other samples from the excavations.

The two samples with the AP frequency values indicating open conditions some distance from trees also call for an evaluation. The AP value of the sample 8662-15-5 is 29.9 per cent, and it is difficult to justify <sup>excluding</sup> it from the rather arbitrary 30 to 50 per cent category. In the other sample, 8662-16-28, only 100 grains were observed, and the AP statistic is somewhat less reliable. It seems judicious, without other evidence, to place some measure of doubt on the conclusion that an open ecological condition some distance from trees ever actually occurred on the time horizon involved. An open condition is suggested by the sample, but there may not have been a time when trees were relatively distant from the site.

The ceramics associated with the pollen samples show two clear temporal divisions and one temporal division which is indistinct (see Bussey, this report). Pottery associated with the sample from the pit house at LA 8667 is clearly dated prior to A.D. 850; pottery associated with samples from site LA 8662 dates after A.D. 850.

At LA 8662, the ceramics associated with the pollen samples from Pit House 1 and Pit House 3 date between A.D. 850 and 875. In Pit House 9 and Pit House 6, the ceramics

ceramics date between A.D. 850 and 900. The pollen spectra thus dated thus dated to the A.D. 850 to 875 range have AP values less than 50 per cent; the pollen spectra dated to A.D. 875 to 900 have AP values greater than 50 per cent.

One sample from Surface House 2 is not associated with significant quantities of pottery for accurate dating. The frequency of this sample is more than 50 per cent and, by correlation with the pollen samples from Pit House 6 and Pit House 9, the floor of Room 6 in Surface House 2 would date in the A.D. 875 to 900 horizon.

Two pollen spectra from the floor of Pit House 5 yield AP frequencies of less than 50 per cent. When this AP value is correlated with the spectra from Pit House 1 and Pit House 3, the floor should date A.D. 850 to 875. The ceramics, however, date in the A.D. 875 to 900 range.

Ceramics associated with the pollen sample from Room 4 of Surface House 4 also date in the A.D. 875 to 900 range. Again, AP values less than 50 per cent are evident in the pollen spectrum.

It would seem that AP values less than 50 per cent are characteristic of samples known to date prior to A.D. 875. Some of the samples dating A.D. 875 to 900, however, have AP values greater than 50 per cent. Apparently, AP values rose above the critical 50 per cent boundary at some time within the quarter century from A.D. 875 to 900. This would mean that Pit House 5 and the associated Surface House 4 date a decade or so earlier than Pit House 6 and Pit House 9. This interpretation is in agreement with Table \_\_\_.

*Check for samples  
of Pit House 2  
x-11 associated  
to Surface  
House 2*

AP frequencies of less than 50 per cent are considered indicative of open ecological conditions, and AP frequencies of 50 to 60 per cent indicate savanna conditions. This suggests that, from some unknown date preceding A.D. 850 to approximately A.D. 875, the ridge which now supports woodland vegetation at the Largo-Blanco sites was devoid of trees. About A.D. 875, trees began to invade this ridge. Before A.D. 900, a savanna had been established on the ridge. It is reasonable to postulate that the other locales in the district which now support vegetation were undergoing similar changes at the same time.

Indeed, there is some evidence to indicate that a relative increase in arboreal density occurred elsewhere on the Colorado Plateau between A.D. 850 and 900. In the Chuska Valley, arboreal pollen frequencies increase in pollen samples dated between A.D. 875 and 900. There, it appears that trees did not invade the sites as at LA 8662, but they did move closer to the sites at this time. At sites in the Little Colorado drainage in eastern Arizona, Hevly (1964) records a lower AP frequency at a site radiocarbon-dated to A.D. 790±180, and a higher AP frequency at a site estimated to date about A.D. 900. The latter site seems to have witnessed arboreal invasion like that at LA 8662. Yet, all available evidence is not in agreement. In the Navajo Reservoir District (Schoenwetter 1966) pollen records dating between A.D. 850 and 950 do not indicate any variation of consequence; if anything, the arboreal density at A.D. 900 was rather less than at A.D. 850 to 875. I suspect

that the Navajo Reservoir cores do not accord with the other three because of local conditions. The Navajo Reservoir District records come from sites located on a then-dissecting floodplain which was being utilized for agriculture. We might expect that a dissecting floodplain would have a lower arboreal carrying capacity, and also that tree seedlings might be uprooted in the course of agricultural activity. Thus, I believe that the Reservoir pollen record for this period, while meaningful, is not representative of the general conditions occurring on the Colorado Plateau.

Turning to the matter of paleoclimatic reconstruction, it would appear that sites LA 8667 and LA 8662 were occupied during a period of greater aridity than exists there today, since the sites did not support woodland vegetation as they do now. Some of this apparent aridity may have been caused by the clearing of the trees by the occupants, but this hypothesis is difficult to evaluate. The period preceding A.D. 875 in the area seems to have been sufficiently arid that vegetation patterns were displaced over <sup>60 meters</sup> (200 feet) upwards on the elevational gradient relative to the present situation. Savanna was not located at the sites then, though it does occur 60 meters (200 feet) below the sites now. About A.D. 875 conditions were somewhat ameliorated, but the area was still more arid than it is today.

It is clear that Pueblo occupation began and persisted under these arid conditions, since rooms continued to be built and occupied between A.D. 850 and 900. Abandonment, in fact, occurred after a period of less arid conditions was established.

It seems that the climatic aridity was not a factor detrimental to Pueblo life at this time; if anything, their culture seems to have been able to tolerate the drier environment better than the somewhat wetter one. The occurrence of maize seeds in the sites, and the general similarity of these occupations with others of the same time in the area, is testimony to the fact that the occupants of these sites were agriculturists dependent on a maize-beans-squash economy. The occurrence of more arid conditions of climate might be expected to have affected their farming in a detrimental fashion. However, given the conditions reconstructed, such an expectation appears unfounded.

There is one matter of particular paleobotanical interest. It was pointed out that the frequency values of particular species in the pollen record are a matter of unknown significance. At the very least, it must be acknowledged that such variations as might occur cannot be understood with any accuracy, and only the AP value can be interpreted. It does seem, however, that some significance may be attached to one particular observation in the pollen record, the presence of a grain of walnut, Juglans sp., pollen in sample 8662-2-9.

According to Benson and Darrow (1954: 113), the nearest source of walnut trees is now some 160 kilometers (100 miles) to the south. Either walnut trees once extended their northern distribution, or the pollen of this plant became trapped in the floor sediments in Pit House 3 in some artificial fashion. Under drier, and presumably warmer, climatic conditions postulated for the period, it is not unlikely that the walnut tree

had a different northern distribution than it does today. The tree might have flourished in Cañon Largo if the water table was higher than at present and the floodplain was undissected. Walnut is a riparian genus in the Southwest. On the other hand, this single pollen grain could have been transported over a long distance by the wind and happened to find its resting place in this sample. Another alternative is that the pollen was inadvertently transported to the site by man through trade in the nuts and/or bark of the plant. Walnut bark is known to have been used as a tanning agent and could have been traded widely for this purpose. Walnut pollen has been recovered in the Galisteo Basin at LA 6869 in association with archaeological materials dating about A.D. 1250 or slightly later (Schoenwetter ms.), and was recovered at Long House on Wetherill Mesa (Mesa Verde National Park), Colorado (Schoenwetter 1960). These records point to the improbability of long-distance transport as an explanation, but the other two possibilities are not affected. For the moment, we can only continue to be puzzled by this evidence and hope that the explanation will become clear as more research on the paleobotany of the A.D. 800 to 1250 is linked with archaeological analysis.