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The Altithermal Revisited:

Pollen Evidence from the

Leonard Rockshelter

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DURING the past thirty years, there has been a continuing debate among students of Great Basin prehistory over the nature and significance of postglacial climatic change (Aikens 1970; Antevs 1948; Aschmann 1958; Baumhoff and Heizer 1965; Bryan and Gruhn 1964; Harper and Alder 1970; Jennings 1957; Martin 1963; Swanson 1966). Several symposia have been devoted to the subject (Fowler 1972, 1977; Elston 1976), but there are still no signs of a consensus. One basic issue is the validity of the Antevs three-part model. Mehringer (1977), for example, has cautioned against the acceptance of paleoclimatic models which claim relevance for the Great Basin as a whole. The question remains, however, as to whether or not the Antevs' reconstruction is valid. Was the Altithermal, for example, a period of warmer and drier climate? And, if so, was it warm and dry enough to account for changes in human sub-

sistence and settlement patterns? In this paper, we present evidence that relates directly to the first question and indirectly to the second. More specifically, we report on the fossil pollen content of two series of sediment samples from the Leonard Rockshelter, Pershing County, Nevada.

Leonard Rockshelter (NV-Pe-14) is one of a limited number of sites in the Great Basin with a clear record of human occupance that dates back to the early Holocene. The site was excavated in 1937 and 1950 by University of California archaeological field parties and produced a varied assemblage of artifacts. Wooden atlatl foreshafts have been radiocarbon dated at 7038 ± 350 B.P. (5088 B.C.), and indirect evidence in the form of obsidian flakes from a basal bat guano layer radiocarbon dated at 11,199 ± 570 B.P. indicates that the site may have been occupied as early as 9000 B.C. (Heizer 1951).

The site is also of interest in that it provides clear evidence of environmental change during the Holocene. The rockshelter was formed by wave action along the southern shore of an arm of Pleistocene Lake Lahontan, and has since

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been partially filled by a distinctive sequence of sediments, including beach gravels, bat guano, aeolian silt, and rockfall. In 1950, Antevs investigated the stratigraphy of the site and interpreted it as supporting evidence for his reconstruction of postglacial climatic change in the Great Basin (Antevs 1955). In 1955, in the hope of obtaining further evidence on the environmental history of the site, Heizer sent H. P. Hansen (Oregon State University) samples of guano for pollen analysis. Unfortunately, the results proved to be negative and no further pollen work was attempted at that time.

In this paper, we report on a second attempt to recover pollen from the Leonard Rockshelter sediments. In 1976, we directed our attention to two series of samples that included the whole of the stratigraphic sequence. The samples were collected during the 1950 excavation, and had since been stored in the Lowie Museum of Anthropology (Berkeley). Like Hansen, we found it impossible to extract pollen from the lower bat guano layer, but the overlying silt and rockfall layers yielded reasonably well-preserved pollen in countable quantities. The results of the analysis in large part support the Antevs model and also throw new light on the "significance" of climatic change in the Great Basin.

THE REGIONAL SETTING

Leonard Rockshelter is located 17 miles south of Lovelock, Nevada, on a north-facing slope of the West Humboldt Range (Figs. 1 and 2). This area of the Great Basin has numerous cave and open sites, several of which have been excavated or surface collected (Loud and Harrington 1929; Heizer and Krieger 1956; Roust 1966; Baumhoff 1958; Elsasser 1958; Heizer and Clewlow 1968; Heizer and Napton 1970; cf. Ranere 1970 for an overview). Less than a half-mile to the west of the site is the broad and flat expanse of the

Humboldt Sink (Fig. 3). The Humboldt River drains through this area into Humboldt Lake. The lake is now shallow (<20 ft. deep) and during the historic period has been highly variable in area. In 1883, for example, it covered an area of 20 mi.[2] and the eastern shoreline was less than a mile from the rockshelter. In 1951, however, the lake had an area of only 11 mi.[2], and the eastern shoreline was more than seven miles from Leonard (Fig. 2). During the period of European settlement, irrigation has drastically reduced the flow of the Humboldt River and during drought years the lake has dried up completely (Antevs 1938). This recent variability in the area of Humboldt Lake underlines the fact that even small changes in hydrological conditions can have significant effects on a shallow lake of this kind. We shall reemphasize this important point later in the paper.

The present climate of this part of Nevada is semi-arid. Mean annual precipitation totals vary from the less than 5 in. at 3800 ft. to 30-35 in. at 8000-9000 ft. Most of the precipitation is received in winter from mid-latitude cyclones, although summer thunderstorms can also produce locally significant totals. The annual temperature regime is character-

Fig. 1. Location of the study area within the Great Basin.

istically continental with hot summers and cold winters; Lovelock, Nevada, for example, has a mean January temperature of 27° F. and a July average of 75° F. (Brown 1960).

The vegetation of the area reflects the semi-arid nature of the climate and is dominated by several species of xerophytic shrubs. On a regional scale, the site is close to the boundary between the Sagebrush-Grass Zone of the northern Great Basin and the more
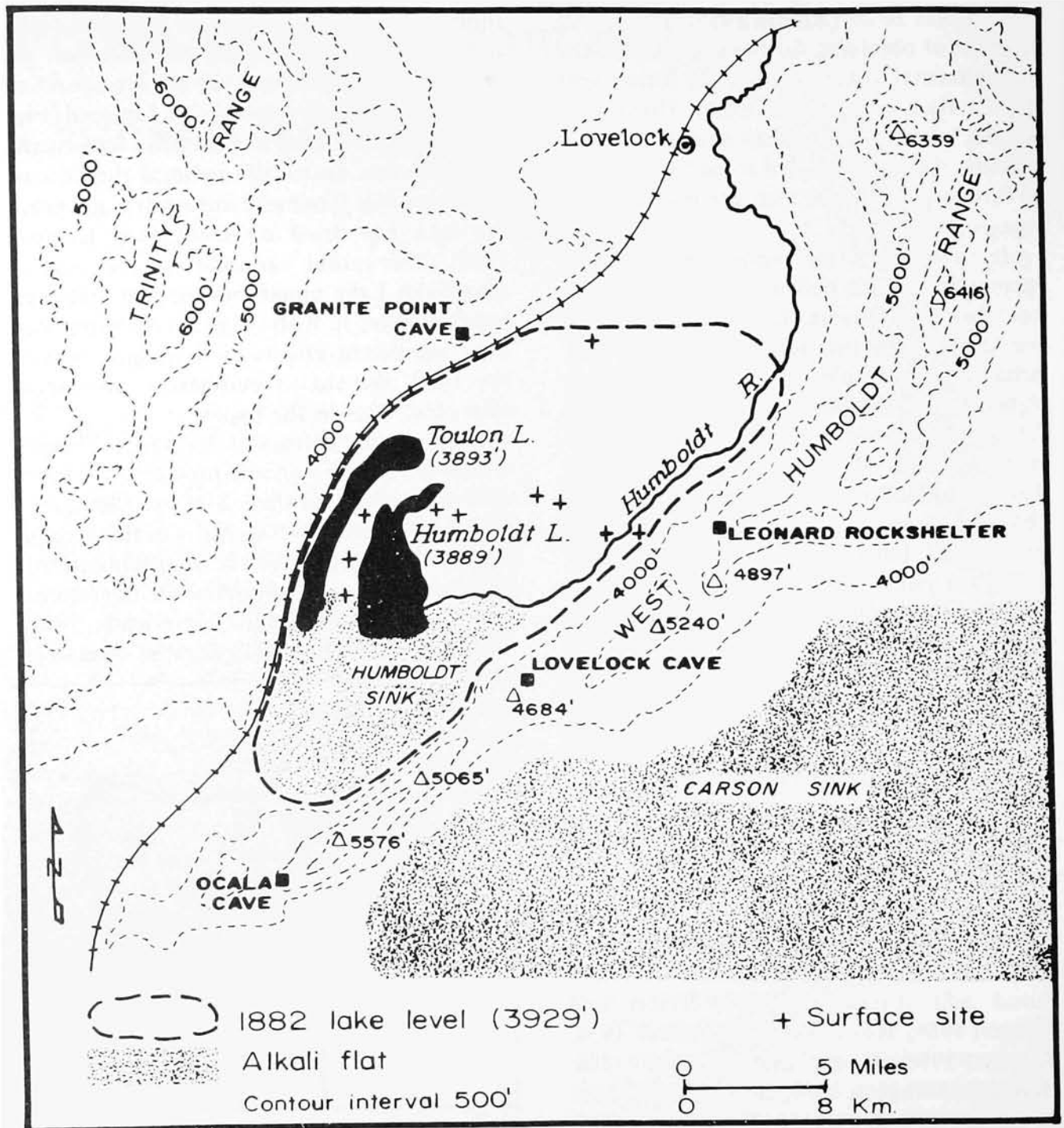

Fig. 2. Map of the study area indicating major topographic and cultural features.
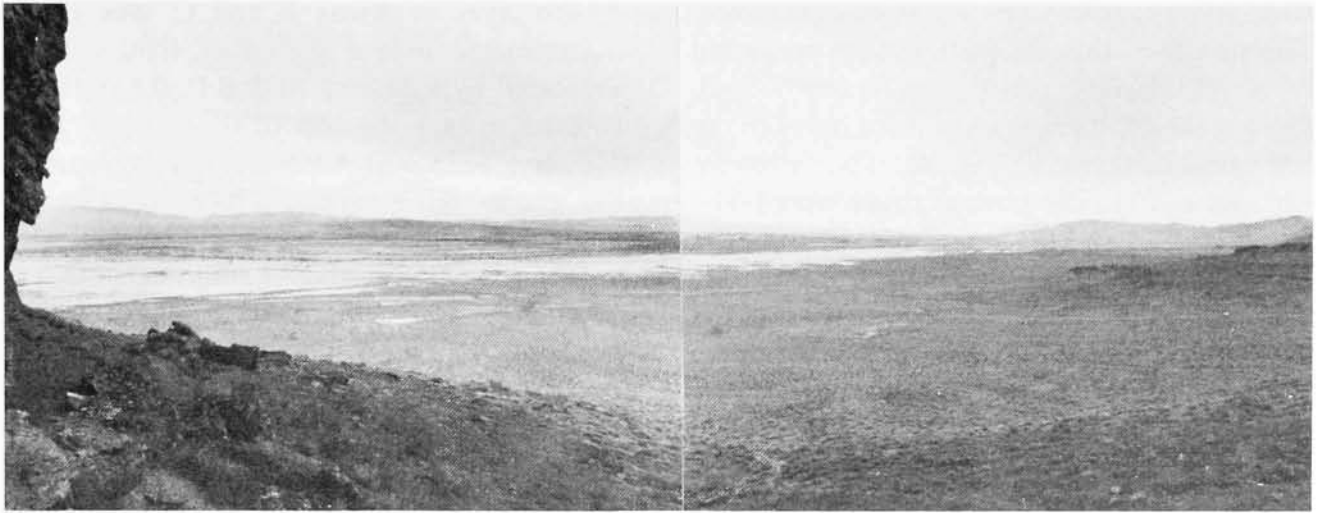
Fig. 3. The Humboldt Sink from the Leonard Rockshelter.

centrally-located Shadscale Zone (Billings 1951:104). Local variation in species composition is largely a function of edaphic conditions. The following summary is based on Billings (1951) and Cronquist *et al.* (1972).

On the higher ground, sagebrush (*Artemesia tridentata*) is the dominant species. On the lower slopes and on the well-drained Lahontan sediments, greasewood (*Sarcobatus baileyi*) and shadscale (*Atriplex confertifolia*) are more important. These spiny shrubs are generally evenly spaced and provide a rather thin cover. Other species less commonly encountered are bud sagebrush (*Artemisia spinescens*), Mormon tea (*Ephedra nevadensis*) hop sage (*Grayia spinosa*), and winter fat (*Eurotia lanata*). Perennial herbs and annuals may have been more common prior to grazing by cattle and sheep, but are now rare. On clayey soil and in poorly drained depressions at the edge of the sink greasewood (*Sarcobatus vermiculatus*) is dominant, but gives way to iodine bush (*Allenrolfea occidentalis*), saltgrass (*Distichlis spicata* var. *stricta*), and *Salicornia europaea* subs. *rubra* on the more xeric sites. Cottonwoods (*Populus fremontii*) form gallery forests along the river, and sagebrush (*Artemisia tridentata*) is also encountered in the valley bottoms. During the nineteenth century, extensive areas of freshwater marsh covered the area to the north of the sink. Most of this area has since been reclaimed for agriculture by deep drainage canals, and only a few relic areas remain. The dominant species here are cattail (*Typha domingensis*) and tules (*Scirpus americanus, S. acutus*).

THE SITE AND ITS STRATIGRAPHY

In 1936, the Leonard Rockshelter was mined for bat guano by Thomas Derby. During the mining operation, Derby discovered and saved several artifacts which were later described by Heizer (1938). In 1937, a University of California field party made some preliminary archaeological investigations at the site, and several more artifacts were recovered from a basal guano layer. It was recognized at the time that these artifacts might represent an early period of occupation, although no means of absolute dating were then available. In 1949, samples of the guano and three greasewood atlatl foreshafts were sent to W. F. Libby for radiocarbon dating. The dates proved to be unexpectedly old, 8600 ±300 B.P. (6710 B.C.) and 7038 ±350 (5088 B.C.), respectively (Arnold and Libby 1950), and it was therefore decided to excavate the site more thoroughly. A University of California field party spent five weeks at the site in 1950 and established the natural

stratigraphy and history of human occupance. The results of this excavation were presented in a preliminary report by Heizer (1951). During the 1950 excavation, four areas of the site were excavated (Fig. 4). The sediment samples used in the present study were taken from Areas B and C. Area B proved to be the most productive archaeologically and also provides a useful basis for a discussion of the stratigraphy of the site (Fig. 5).

The rockshelter, which has a basal elevation of 4175 ft. above sea level, was formed by wave action along the shoreline of Lake Lahontan. The bedrock is intrusive volcanic material of Tertiary age. The age of the rockshelter itself is not certain, although it presumably dates to a time when the lake level was relatively stable. It must have been cut prior to the last Lahontan high stand, as the inner wall is encrusted with calcareous tufa, clear evidence of submergence (Fig. 6). According to recent work on the chronology of Lake Lahontan (Benson 1978), the last high stand (4360 ft.) occurred ca. 12,000 B.P., and prior to this (22,000 B.P. to 15,000 B.P.), the lake level was at approximately the same elevation as Leonard (4000-4200 ft.). It therefore seems reasonable to conclude that these dates provide maximum and minimum age estimates for the formation of the shelter.

After the lake dropped below the level of the rockshelter for the last time, tufa began to spall off the overhanging cliff face and accumulate on top of the beach gravel (Fig. 5, unit E). Resting unconformably on the beach gravels and rock fall is a layer of bat guano (Fig. 5, unit D). A sample from the base of this layer was dated at 11,199 ±570 B.P. (9249 B.C.) (Heizer 1951). The guano shows no evidence of having been disturbed or submerged so this date can be taken as marking the beginning of the period during which the shelter was open for human occupation. It was apparently soon occupied because obsidian flakes were recovered from the base of the

guano layer in Areas B and C. The guano accumulated over a period of 4000 years as indicated by a date of 7038 B.P. for the atlatl foreshafts near the top of the deposit. Both Heizer (1951) and Antevs (1955) interpreted the guano layer to be evidence of a humid climate and high lake levels; chronologically, it corresponds with the Anathermal 12,000 to 7500 B.P. Above the basal guano layer is a layer of fine sand intermixed with angular rock fragments (Fig. 5, unit C). The rock fragments account for some 20-30% of the total deposit. No radiocarbon dates were obtained from this unit in Area B. Above unit C, and intergrading with it, is unit B, a layer of stratified, whitish gray sand and silt. These sediments were interpreted by Antevs to have been blown into the shelter from the Humboldt Sink. This interpretation has since been confirmed by Dr. R. L. Hay of the Geology Department, University of California, Berkeley. The unit B sediments are mineralogically the same as sediments from Humboldt Lake. Furthermore, the unit B sediments contain diatoms and ostracods which also indicate a lacustrine origin (R.L. Hay, personal communication, 1977). Few dates were obtained from unit B but dates from above and below it suggest that it was deposited between 6500 and 4500 B.P. In terms of the Antevs model, unit B is Altithermal in age. Above unit B is unit A, a mixture of windblown sand and silt, tufa rockfall, bat guano, and packrat nest material. It was encountered in all four areas excavated. In Area D, it produced numerous artifacts, mostly of basketry and wood. No radiocarbon dates were determined from Leonard unit A, but dates on similar artifacts from nearby Lovelock Cave indicate that this stratigraphic unit covers the time period from *ca.* 4500 B.P. to the present (Heizer and Napton 1970). Chronologically, this corresponds well with Antev's Medithermal.

Unfortunately, the sediment samples taken in Area C do not include the whole of the
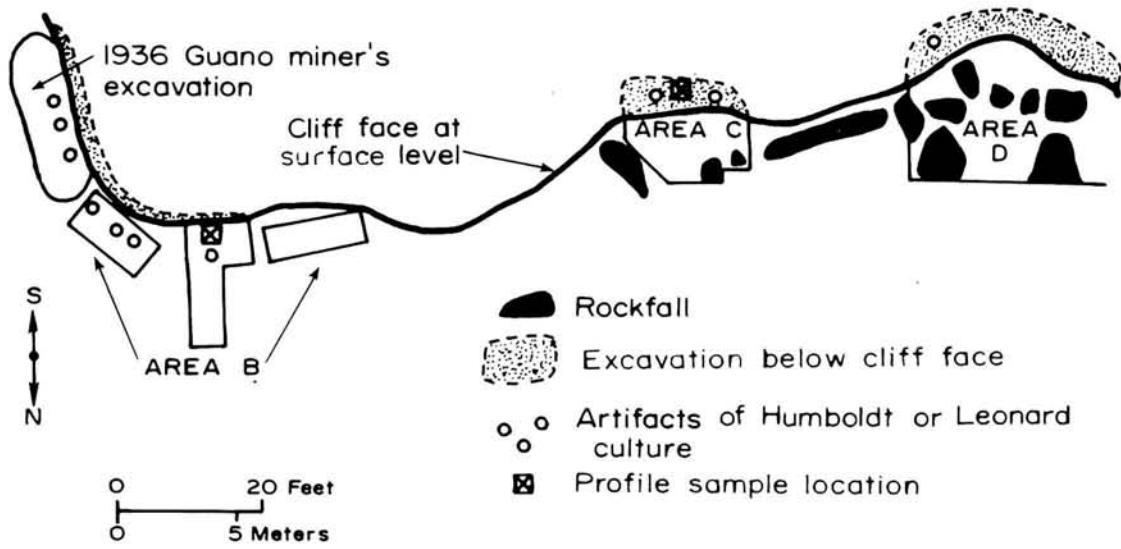
Fig. 4. Site map of Leonard Rockshelter indicating sample areas analyzed.
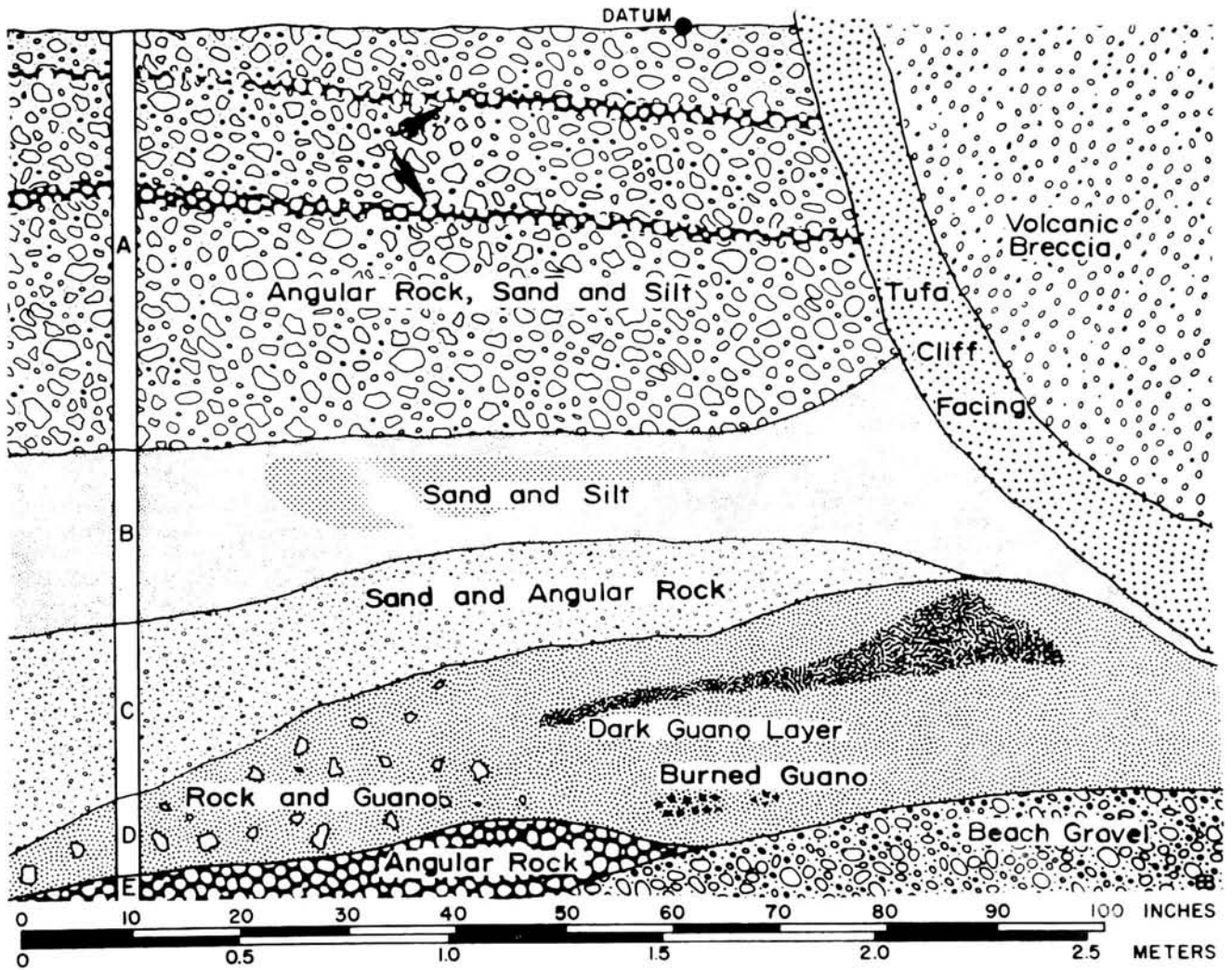

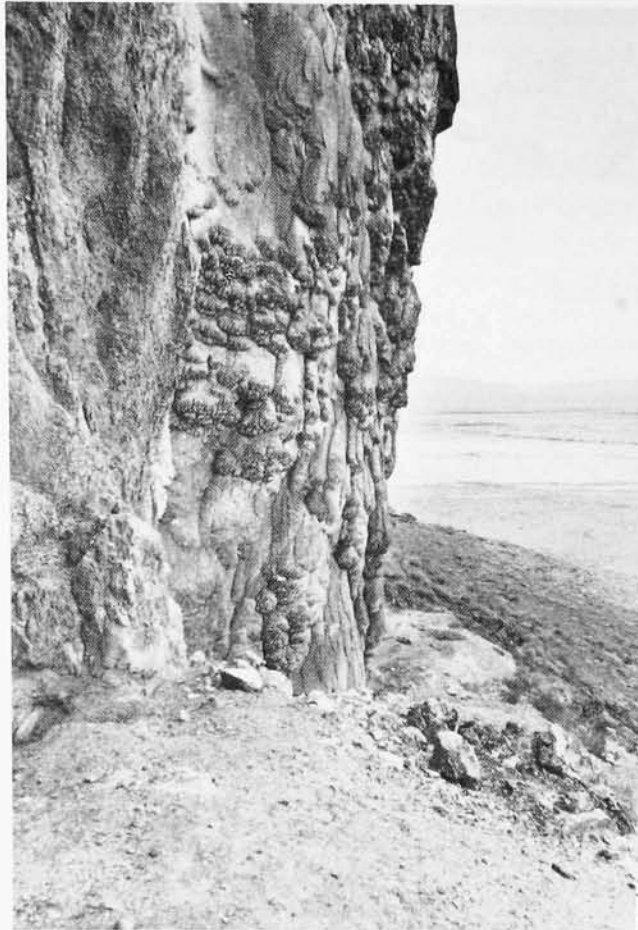Fig. 5. Stratigraphy of the east wall of the trench in Area B.

Fig. 6. Tufa deposits above the rockshelter in Area D.

stratigraphic sequence. This is apparently due to the fact that the excavation in Area C extended back under the overhang. The sediments are uniformly fine sand and silt and correspond to unit C in Area B (Fig. 5). As we shall indicate later, this difference in stratigraphy is reflected in the pollen diagrams.

POLLEN ANALYSIS

The samples collected during the 1950 excavation were taken from the east wall of trench B, Area B, and the south wall of Area C (Fig. 4). The exact provenience of the samples is not known, but is close to the area indicated. Each series was taken in consecutive 6-inch increments from the surface to the base of the profile, and the samples numbered according to depth (e.g., 0"-6", 6"-12", etc.).

In 1975, the site was visited again by a University of California field party and the opportunity was taken to collect surface samples. Four samples of 10 cm.³ each were collected from within 50 m. of the site. These were then combined to provide a composite surface sample.

As a first step prior to pollen analysis each sample was well-mixed and sieved through a screen mesh of 250 microns. Subsamples of 5.2 cm.³ were then taken for processing. Standard extraction procedures were followed including HCl (10%), KOH (10%), HF (conc.), and acetolysis. The residue was stained with safranin and mounted in silicone oil (2000 cts.).

In most of the samples, pollen was recovered in good condition and in countable quantities. This was not the case, however, with the guano samples. Here the high concentration of chitinous material diluted the pollen concentration to the point that a statistically reliable count could not be obtained. We therefore limited our analysis to those samples from above the guano.

Counts were made on a Lietz Dialux microscope with a 40X planacromat objective. The pollen was identified with the aid of the University of California Museum of Paleontology Reference Collection, published keys (Kapp 1969), and general accounts of Southwestern pollen types (Martin 1963; Martin and Drew 1969; Mehringer 1967). On taxonomic matters, we followed the precedents established by Martin and Mehringer.

No attempt was made to identify pine pollen below the generic level, although several size classes were evident in the samples. Similarly, Cheno/Am pollen was very variable in size and this type undoubtedly includes several species. *Typha* pollen encountered as tetrads were listed as *Typha*, monads were listed as *Typha/Sparganium*.

The results of our analyses are presented in two diagrams (Figs. 7 and 8). The pollen

sum includes all of the pollen counted and at each level the total was at least 200 grains. The Area B diagram shows marked changes in pollen frequencies. Pine and Cheno/Am pollen dominate the record and together account for more than 50% of the total count at all levels. These taxa are also negatively correlated. Pine dominates the lower levels,

Cheno/Am increases to equal and in some cases exceeds pine in the five intermediate levels, and pine returns to dominance in the three upper levels.

None of the other taxa appears to correlate well with the two major types, and we are therefore reluctant to establish pollen zones. For example, the three aquatic pollen types
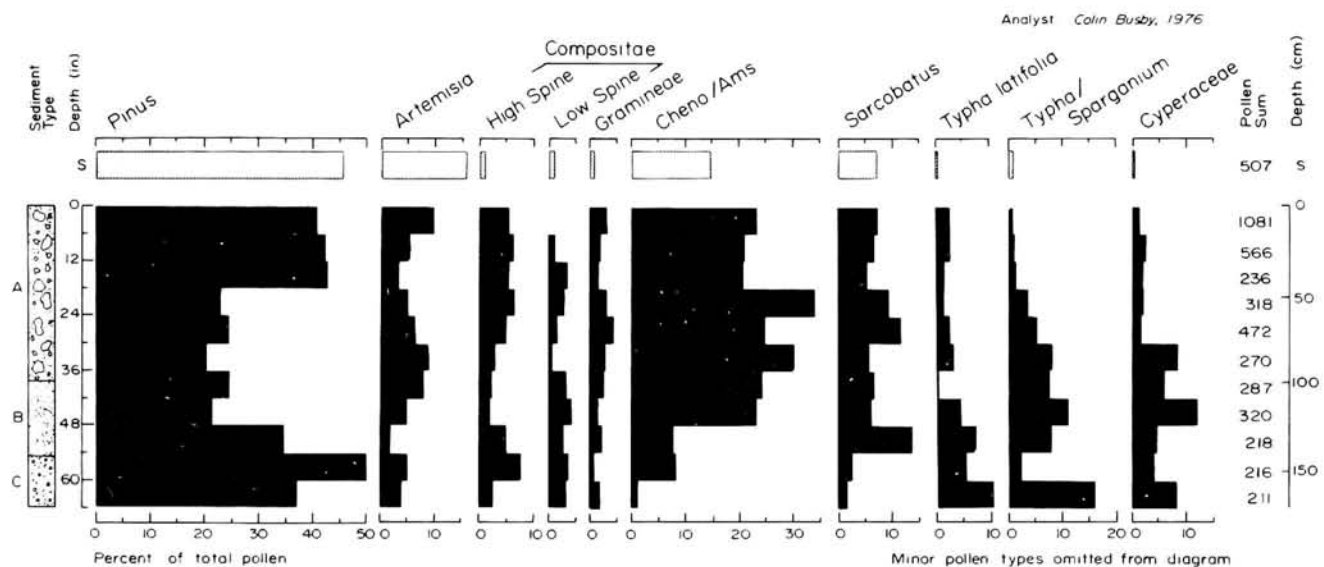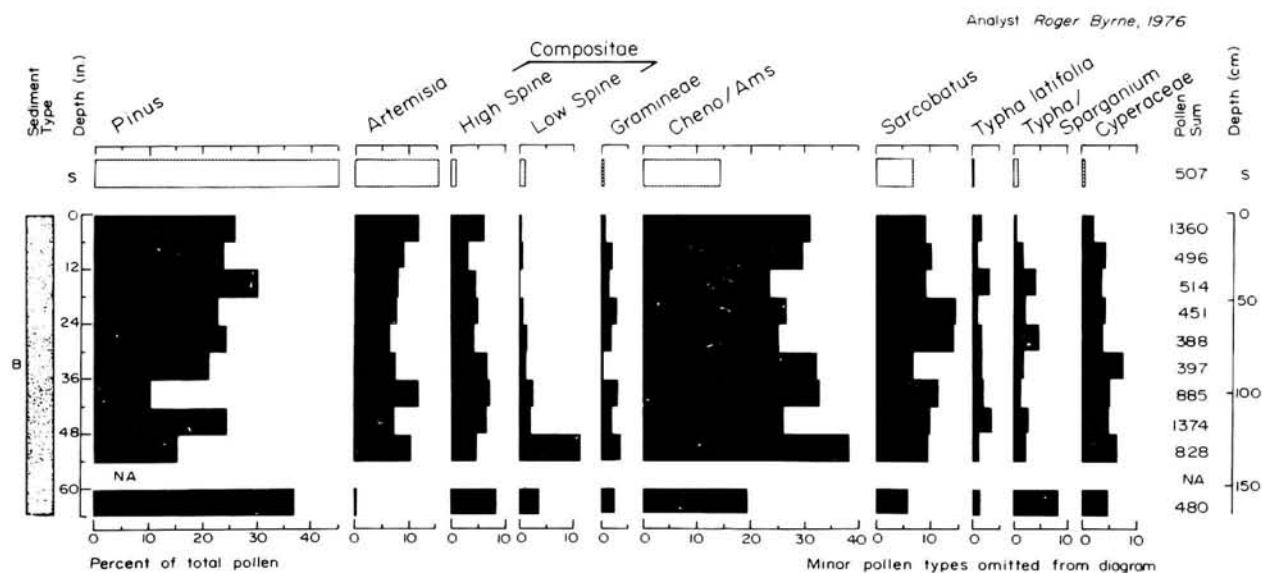

Fig. 7. Area B percentage pollen diagram.

Fig. 8. Area C percentage pollen diagram.

(*Typha, Typha/Sparganium,* and Cyperaceae) all reach high values at lower and intermediate levels. Conversely, *Artemisia* reaches its highest percentages at intermediate and upper levels.

Unfortunately, the uncertain provenience of the Area B samples prevents us from establishing a firm connection between the pollen data and the stratigraphic units described earlier. It is clear, however, that the Pine-Cheno/Am-Pine oscillation does not correspond exactly with the stratigraphic units assigned by Antevs and Heizer to the Anathermal, Altithermal, and Medithermal.

In the Area B diagram (Fig. 7), the three lower levels (54"-60", 60"-66", 66"-72") all have high pine values, and yet according to the Antevs-Heizer interpretation they are chronologically equivalent to the early Altithermal (unit C in Fig. 5). The basal guano layer, which was assumed to be equivalent to the Anathermal, is not represented in the diagram. Similarly, the five high Cheno/Am levels represent 30 in. of sediment (24" to 54"), and must therefore include not only the aeolian sand/silt layer (unit B) but also some of the overlying mixed silt, rockfall, guano layer (unit A).

Several radiocarbon dates were obtained by Heizer (1951) from the guano layer in Area B, but none from the aeolian silt or upper rockfall units. The date of 5088 B.C. from the top of the guano layer indicates that the diagram represents approximately the last 7000 years. Unfortunately, the dates of the Pine-Cheno/Am-Pine oscillation can only be estimated by extrapolation from dates in other areas of the site. As a rough approximation, we would suggest that the pine minimum lasted from *ca.* 6000 B.P. to *ca.* 4000 B.P.

The Area C diagram (Fig. 8) is basically a truncated version of the Area B diagram. These samples were taken from a more interior location within the rockshelter and therefore represent less "time." This is reflected in the pollen diagram, particularly in the pine and Cheno/Am curves. For example, level 60"-66" in Area C probably corresponds with level 54"-60" in Area B. Likewise, level 0-6" in Area C probably corresponds with level 18" to 24" in Area B. Other than the shift from high pine to high Cheno/Am between levels 60" to 66" and 54"-60", there are no major changes in pollen frequencies.

Stratigraphically, the Area C diagram is roughly equivalent to the aeolian silt layer (unit B in Fig. 3). Carbonized basketry from the base of this layer in Area C was radiocarbon dated at 5779 ±400 B.P. (3829 B.C.) and 5694 ±325 B.P. (3786 B.C.) (Heizer 1951).

Although there are some minor discrepancies between the two diagrams, when their stratigraphic relationship is taken into account, they can be seen to be basically similar. Furthermore, the regularity of the curves for most taxa suggest that the sediments had not been seriously disturbed by the shelter's prehistoric occupants, human or otherwise. The question now arises as to what the changes in pollen frequencies represent.

DISCUSSION OF RESULTS

We interpret the Leonard pollen record as being primarily a reflection of climatic change. The justification for this conclusion lies not so much in the Leonard diagrams alone but in their correspondence with other pollen diagrams from the Great Basin.

In southern Oregon, Hansen (1947:116) has documented the same postglacial sequence that is apparent at Leonard. Pine dominates the early Holocene and is replaced by Cheno/Am pollen in the mid-Holocene, and returns to dominance in the late-Holocene. More recently, Bright (1966) has produced a similar diagram from Swan Lake in southern Idaho. His diagram shows how pine again dominates the early Holocene, declines during the mid-Holocene (8000 B.P. to 3000 B.P.), and increases again during the last three thousand

years. In this area, however, *Artemisia* and not Cheno/Am is the dominant mid-post-glacial pollen type.

For Nevada there are no diagrams yet available that cover the whole of the Holocene. Mehringer's (1967) well-dated Tule Springs record is unfortunately incomplete after 7000 B.P. In southeastern Nevada, Madsen's (1972) diagram from the O'Malley Rockshelter is chronologically equivalent to the Leonard Area B diagram and likewise indicates marked changes in vegetation. Here the lower levels are dominated by sagebrush and juniper, but at *ca.* 5200 B.P. there is a shift to grass and sagebrush, followed by a reversal to sagebrush and juniper at around 3900 B.P. A similar trend towards more mesic conditions in the late-Holocene is evident in a diagram from Toquima Cave in central Nevada (Kautz and Thomas 1972). This diagram has a basal date of 3420 B.P. and shows a gradual shift from high grass and Compositae percentages in the lower levels to high pine and juniper near the surface.

The Great Basin pollen record is still fragmentary, but when viewed as a whole it clearly supports the Antevs model of climatic change. In different areas different species are involved, but in all the sequences that we are aware of there is an increase in xerophytic types during the mid-Holocene. In other words, the controversial Altithermal was a period of warmer and drier climate.

Less certain, however, is the magnitude of climatic change and the degree to which local environments were affected. Unfortunately, the pollen record is of limited value in this context. The interrelationships between climate, vegetation, and the pollen rain are not yet well understood in the Great Basin and detailed interpretation of pollen diagrams is therefore difficult.

A major problem is long-distance dispersal of pine pollen. The Area B diagram (Fig. 7) illustrates the point well. The surface sample contains 42% pine and yet there are no pines in the West Humboldt Range. The nearest trees are in the Stillwater Range twenty miles to the southeast. It follows therefore that changing pine percentages in the Leonard diagrams cannot be interpreted in terms of local changes in the importance of pine.

One possible explanation might be that the Leonard record reflects changes in the importance of pine in the mountains to the west. A cooling of climate, for example, would bring about a lowering of tree lines and an expansion of pine in the Sierran foothills. Alternatively, a change in climate could mean a change in the strength and direction of prevailing winds and this in turn would mean new patterns of pine pollen dispersal.

Another, perhaps more plausible, explanation is that the variation in pine pollen percentages at Leonard is a statistical artifact. As Mehringer (1967) has emphasized, changes in pine in Great Basin pollen diagrams may simply reflect changes in the local production of non-pine pollen. In other words, a local increase in the production of Cheno/Am pollen would cause a percentage decline in pine, even though the absolute concentration of pine did not change very much. Unfortunately, we cannot be conclusive on this point as the absolute concentration values are in part a function of the sedimentation rate, and without better chronological control these cannot be accurately determined.

In the same context, it is interesting to note that in both the Area B and Area C diagrams, the high Cheno/Am levels correspond reasonably well with the wind-blown silt layer (Figs. 7 and 8). One possible explanation for this is that during the mid-Holocene falling lake levels in the Humboldt Sink not only exposed the former lake floor to wind deflation but also provided an extensive new area for colonization by plants. Furthermore, several of the invading species would be members of the Chenopodiaceae or Amaranthaceae, and

Cheno/Am pollen would therefore be blown into the rockshelter in increasing quantities. Today one of the dominant species on the former lake bed is shadscale (*Atriplex confertifolia*), and there appears to be no reason for assuming this was not also the case during the Altithermal. In brief, we interpret the rise in Cheno/Am pollen as an indication of lowered lake level and therefore an indirect reflection of climatic change.

If the lake level thesis is correct, the high percentages of aquatic pollens in the lower and intermediate levels of both diagrams present something of a paradox. None of these pollen types is effectively wind dispersed (Durham 1951), and the question arises as to how they were deposited in the rockshelter if the lakeshore was no longer close by. One possibility is that aquatic pollen was introduced into the site by man. Cattail (*Typha*) pollen is known to have been eaten by the Indians of the area in both historic and prehistoric time (Napton 1970), and theoretically, it could have been stored in the rockshelter and accidentally incorporated into the sediments.

An alternative explanation, that we favor, is that aquatic pollen was first deposited in the shallow water around the edge of the lake, incorporated into the surface sediment, and then later blown into the rockshelter as the lake bottom was exposed and underwent deflation. Perhaps significantly, the highest percentage values of aquatic pollen are encountered in the lowest levels of the wind-blown silt, suggesting that the maximum influx occurred when the lake margin was still quite close to the rockshelter. The rather regular nature of the aquatic curves argues against the idea of cultural introduction and suggests that wind was the primary mechanism.

THE NATURE AND SIGNIFICANCE OF THE ALTITHERMAL

We should emphasize that the Leonard

pollen record is not a particularly sensitive measure of Holocene climatic change. The temporal resolution, for example, is less than ideal, all short term (<500 years) oscillations having been averaged out by the 6-inch sampling interval. Furthermore, the pollen record in itself does not permit an accurate reconstruction of the magnitude of climatic change. On the other hand, the Leonard pollen record does confirm Antevs's reconstruction of the environmental history of the site, and, in the broader sense, his three-part division of Holocene climate. We would also suggest that it provides a logical explanation for the persistent confusion as to the significance of Holocene climatic change. The Pine/Cheno-Am oscillation clearly indicates that during the last seven thousand years there have been major environmental changes in the Humboldt Sink. It does not follow, however, that the environmental changes in the Humboldt Sink were the result of major changes in climate. As we indicated earlier, the present climatic conditions in the Humboldt watershed are marginal as far as the existence of a lake in the Humboldt Sink is concerned. The important point here is that in areas such as this even small changes in climate can have major environmental consequences.

This problem of scale underlies much of the confusion in the debate as to the significance of Holocene climatic change in the Great Basin. Antevs himself contributed to the confusion when he characterized the Altithermal as "the long drought" and suggested that extremely dry conditions persisted from 7500 B.P. to 4000 B.P. (Antevs 1955). Various lines of evidence now indicate that the climatic conditions of the Altithermal were not very different from those of the present (Mehringer 1977). Probably the best evidence on the magnitude of Holocene climatic change in the Great Basin is the Bristlecone Pine tree ring record (La Marche 1974), and the complementary evidence of changes in altitudinal

position of the Bristlecones (La Marche 1973). Both lines of evidence cover approximately the last 6000 years, and indicate that summer temperatures were 1°-2°F. above the long-term mean during most of the period 6000 B.P. to 4000 B.P. This change in temperature was not very great, but it represents a change in climate that was significant enough to cause the desiccation of most of the postpluvial lakes in the Great Basin, including the one that occupied the Humboldt Sink. According to Benson (1978), geochemical analysis of lake sediments indicates that Pyramid Lake was probably the only lake in the Lahontan Basin that did not desiccate during the mid-Holocene.

In the Humboldt Sink region, prehistoric populations were heavily dependent upon lacustrine resources such as fish, waterfowl, and aquatic plants (Heizer and Napton 1969, 1970; Napton 1969, 1970; Cowan 1967; Ambro 1967; Roust 1967). It follows therefore that changes in lake level must have had an important impact on human population densities. The relationship between lake level and carrying capacity is clearly not a simple one, but by definition a subsistence economy based on lacustrine resources cannot exist without a lake.

It also seems likely that relatively minor changes in climate would have had significant effects on non-lacustrine food resources. For example, a shift towards more mesic conditions would lead to an increased growth of grasses and forbs in upland areas and this in turn would lead to denser game populations. According to Harper and Alder (1970), such a change occurred in northwestern Utah during the late Holocene, and conceivably similar changes characterized the Humboldt Sink area.

CONCLUSION

The Leonard Rockshelter pollen record largely confirms Antevs's interpretation of the site's chronology. The Pine-Cheno/Am-Pine oscillation corresponds reasonably well with the stratigraphic units assigned to the Anathermal, Altithermal, and Medithermal, and is best interpreted as a reflection of changing lake levels in the Humboldt Sink.

In the broader context, Antevs' climatic model is also endorsed. The Area B diagram, like several other diagrams from the Great Basin, clearly indicates that the controversial Altithermal was a period of warmer and drier climate. Unfortunately, the pollen record in itself does not permit an accurate estimate of the magnitude of climatic change. We would emphasize, however, that in areas such as the Great Basin even small changes in climate can have far-reaching consequences. Climatic conditions in the Great Basin during the mid-Holocene may not have been very different from those of the present, but they were different enough to cause the desiccation of nearly all the postpluvial lakes. It follows, therefore, that prehistoric populations heavily dependent upon lacustrine resources would have been drastically affected.

The real significance of the Leonard pollen record is that it lends support to the thesis that during the Holocene the climate has changed in a regionally coherent and recognizable way. The Antevs' model is in many respects oversimplified, but in essence it appears to be valid.

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