REPORT ON PALYNOLOGICAL INVESTIGATIONS

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FIELD WORK

In December, 1966, Mrs. Helene Warren and I spent three days with Mr. Sutton in the Hopi Buttes area. Our objective was to devise a project which would determine the value of pollen analysis as a technique for determination of the geological history of this district. Prior to our field trip, it had been thought that palynological analysis of sediments from the archaeological sites of the district would prove valuable. It soon became apparent, however, that the problem of correlation of alluvial sequences (probably Pleistocene in age) was of greater priority. We therefore designed a palynological sampling program to accomodate this latter problem.

Our sampling program was limited by two factors: on the one hand, funds were not available for an extensive pollen analytic project; on the other hand, geological mapping of the alluvial sub-units had not yet been undertaken so there was poor

stratigraphic control for a large-scale sampling program. We therefore decided on a sampling program that would fulfill the aims of a pilot project. Our goal was to determine if a larger program of palynological investigation could be justified on the basis of preliminary results.

Field observation led to the recognition that the mapping of the alluvial sub-units would be an involved and complicated matter. The source areas of the alluvial sub-units could not be assumed similar over the entirety of the district, so lithological similarity might or might not be an index of contemporaneity. Mr. Sutton, Mrs. Warren, and I concluded that the most likely indices of contemporaneity of the various alluvial sub-units would be microfossils. In particular, we considered pollen spectra to be most useful in this regard. However, we felt that an enormous problem of sampling and analysis would result from an attempt to use pollen as the only index of contemporaneity. Samples would have to be taken at 10 cm. intervals from a number of very long alluvial sequences. Years of research time would then be needed for analysis.

A second index of contemporaneity lay in the various fossil soil zones trapped in the alluvial sequences. The CCa horizons of these zones are quite visible and can be mapped easily. We felt that if it were possible to extract and analyze the pollen of these CCa horizons, and thus demonstrate which of them were likely to be contemporaneous in the various

sequences, geological mapping would resolve most of the other problems of correlation. This would be a much less expensive and less time-consuming approach to the basic problem.

We thus designed a sampling program to determine the value of the CCa horizons as a source of pollen microfossils. Since we were limited to the analysis of twelve samples because of available funds, we selected two stratigraphically superimposed CCa horizons. As these were necessarily distinct in time, they should have provided distinctive pollen spectra. In each CCa horizon we selected three sampling stations about 100 yards apart. Correlation between CCa horizons in different parts of the Hopi Buttes district could not be expected unless the pollen of one CCa horizon was uniform throughout its horizontal extent; the three sampling stations allowed a test of the horizontal uniformity of pollen spectra within one CCa horizon. At each sampling station samples were taken from the upper, middle, and lower parts of the CCa horizon. It was not known whether pollen was uniformly distributed in the CCa horizon or concentrated at some level. These samples offered a test of the matter.

Eighteen samples, each amounting to about five pounds of sediment, were collected in the field. Our plan was to analyze nine samples from one CCa horizon and, on the basis of the information garnered, to then select three critical samples from the other horizon for contrast.

LABORATORY WORK and RESULTS

The nine samples collected from the first (or upper) CCa were processed to extract contained pollen. It was recognized that these sediments might contain pollen in low frequency. Therefore, about one pound of sample was processed in hopes of obtaining significant quantities of pollen for analysis. The samples were soaked overnight in dilute HCl to reduce their volume and to decompose the cementing carbonates. They were then swirled and the light supernatant, containing pollen, was decanted for further processing. Treatment with HF, HNO_3, H_2SO_4, and KOH was given to reduce and destroy the various inorganic and organic materials in the sample, thus concentrating the amount of pollen per unit volume. The sample with which we began amounted to ca. 400 cc's volume. The final matrix had been reduced to about 2 cc's volume. Three samples from the 2nd (or lower) CCa were later processed in the same fashion.

An amount of matrix from each sample was spread upon a microscope slide and stained for observation. Pollen was recovered from 2/3 of the samples, and this pollen tended to be very well preserved. However, there was very little pollen obtained in any sample.

The most pollen occurring on any micro-slide amounted to 24 grains. Assuming five slides could be recovered, this would allow approximately 125 grains to be recovered from one sample of 400 cc's volume original sediment. At least five times this number of pollen grains would be needed for a statistically reliable pollen count for purposes of correlation of the alluvial sub-units. If we were able to consistently do as well as our best pollen sample from this series, then, we would need to expend five times as much labor as a normal pollen investigation requires. This would probably treble the costs of the pollen study.

There is little reason to suspect even that such an investment would be profitable. Our next best sample gave a count of only 6 pollen grains, and the third best gave a count of 3 pollen grains. One third of the samples had no pollen on a micro-slide. Besides this, no two samples from any single horizontal plane in a CCa horizon appeared correlative. Even were the pollen available in quantity, it seems that CCa horizons are not likely to be correlative by virtue of their pollen floras.

The very well preserved nature of the pollen from these samples is difficult to explain in light of the low concentration per unit volume of sediment. If the sediment once contained pollen but the pollen was subsequently destroyed by oxidation and/or microbial action, why should the remaining pollen be well preserved?

None of the pollen recoverdd was of plants that do not now exist in the immediate area (juniper, pinyon, grass, various components). There is a definite probability that all of the pollen recovered is due to a natural contamination of the samples.

CONCLUSIONS

This pilot study has indicated

(1) The pollen content of CCa horizons in the Hopi Buttes district is so low that a very extensive and expansive palynological program would have to be instituted to yield significant data.

(2) The pollen content of CCa horizons in this district may not be reliable as an index of temporal correlation.

(3) The pollen content of CCa horizons in this district may be a function of recent contamination.

It would thus seem judicious to rely upon other types of microfossils, or upon more traditional geological techniques, for correlation of Pleistocene alluvial sub-units in the Hopi Buttes area. A larger program of palynological investigation of alluvial sub-units in this district is not justified by the results of this pilot study. However, there remains a good possibility that correlation of Holocene alluvial units would prove

profitable through pollen studies. The value of pollen analysis for interpretation of environment on archaeological horizons has been amply demonstrated in districts surrounding the Hopi Buttes.