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The Hodges Site

II. Geology of the Hodges Site, Quay County, New Mexico

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GEOLOGY OF THE HODGES SITE, QUAY COUNTY, NEW MEXICO

By Sheldon Judson

INTRODUCTION

The archeology of the Hodges site occupies a critical position in the "Alluvial Chronology" of eastern New Mexico. The study of the geologic antiquity of the nearby San Jon, N. Mex., site (Roberts, 1942) begun by the writer in the summer of 1941 demanded the development of this chronology.[1] Moreover the Hodges site presented ideal conditions for cooperation between the archeologist and the geologist. At this place occur bodies of sandy silts representing a known period of wind activity of wide geographic extent and related to a well-known geologic sequence. These deposits contain cultural material and thus appeared susceptible to relatively precise dating. In addition, the cultural objects promised to throw some light on the peoples living in this section of New Mexico at this particular time. The results of the study presented in this report and the companion paper by Dick would seem to justify preliminary expectations.

The site was first seen by the writer in September 1942, in the company of the late Dr. Kirk Bryan, of Harvard University, and Dr. Franklin T. McCann, of Alabama Polytechnic Institute. It was not until August 1947, after a reexamination of the site by Bryan and Judson, that excavation was possible. The companion paper by Dick presents the archeologic results of the investigation. Judson visited the site on two occasions during its excavation.

PHYSICAL SETTING

The site consists of two rock shelters in a sandstone cliff on the west bank of the Plaza Larga Creek, one of the tributaries of the Canadian

[1] The study, of which this paper is a semi-independent part, was undertaken in conjunction with the excavation of the San Jon site. The continuing interest, cooperation and assistance of Dr. Frank H. H. Roberts, Jr., Smithsonian Institution, has greatly facilitated the work of the geologist in both field and office. Financial support was provided by the Smithsonian. The late Dr. Kirk Bryan, Harvard University, supervised the field work and has criticized the manuscript for this paper.

River in the so-called Canadian Valley. It lies in the N½, NE¼, sec. 31, T. 11 N., R. 37 E., N. M. Pr. M. and B. and is 2¼ miles south of United States Highway 66, 1¼ miles east of New Mexico Highway 18 and 8 miles south and east of Tucumcari (fig. 31).

The Plaza Larga is a steep-sided, sandy-bottomed, intermittent stream which carries water only during and immediately after local rains. It is cut in comparatively soft clayey sand and silt of previously deposited alluvium, but locally, as at the site, is bordered by rock cliffs. The introduction of irrigation water into the area [2] already tends to increase the period of flow and to keep the stream

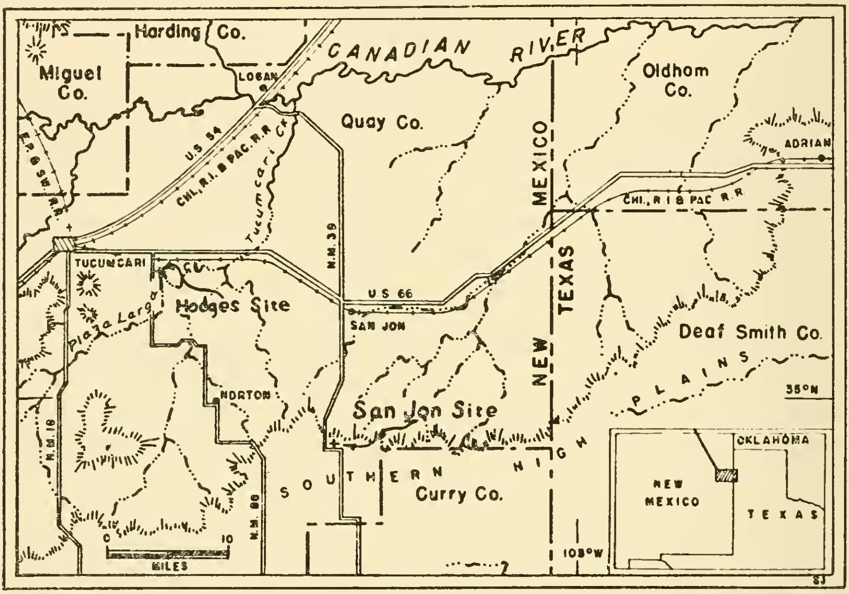

Figure 31.—Index map showing location of the Hodges and San Jon sites.

bed moist for considerable lengths of time. Hence, grass, trees, and bushes will grow and for this reason the regime of the stream will be changed and some aggradation of its channel will be induced. Thus the irrigation project will very probably effect an artificial and local change in the stream which will reverse the present trend.

The Chinle formation, of Triassic age, forms the floor of the valley plains of the Canadian River throughout this section of New Mexico. It is predominately brick-red in color, but locally green to buff. It consists of an upper member, the Redondo (Dobrovolny, Summer-

[2] The Arch Hurley Conservancy District, centering around Tucumcari, will eventually consist of 45,000 acres of irrigated land. Water is being drawn from the lake behind Conchas Dam, just below the confluence of the Conchas and Canadian Rivers, 30 miles northwest of Tucumcari. The dam was built before the war by the U. S. Army Engineers as a flood control project.

son, and Bates, 1946) characterized by thin-bedded, fissile shale, and a lower unnamed member, composed chiefly of massive, cross-bedded sandstone.

The block diagram of figure 32 pictures the salient features of the Hodges site. The two shelters are shallow caves formed in the sandstone of the lower member of the Chinle formation. They are separated from each other by about 150 feet of near-vertical standstone cliffs, 25 to 30 feet in height. The floor of the northern shelter (Dick's Area B) lies 10 feet above the modern grade of Plaza Larga, and the floor of the southern shelter (Dick's Area A) is 18 feet above this local datum. The cultural material is contained within a deposit of sandy silt laid down in the shelters as wind-borne dust during and after their occupation.

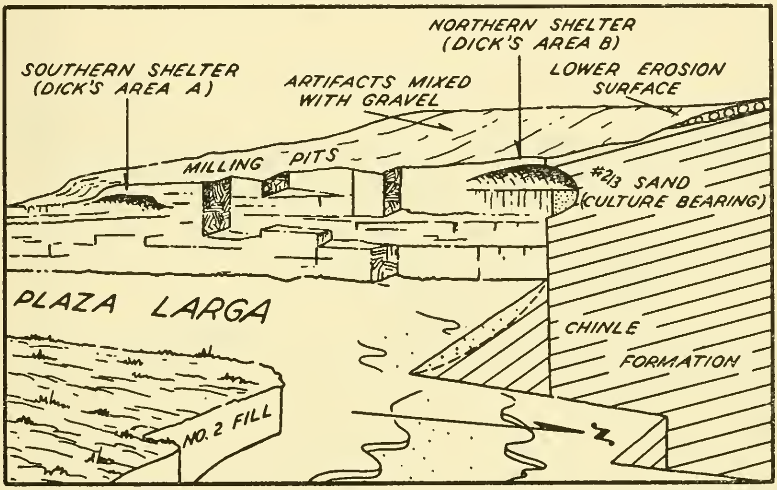

FIGURE 32.—Block diagram to show the salient features of the Hodges site.

In addition to these two shelters the culture-bearing sand extends 75 feet southward from the southern shelter along a rock bench continuous with the shelter floor. Furthermore, artifacts are found mixed with gravel along the high surface reaching back from the lip of the cliff in which the shelters are located.

In places near the cliff edge, where the gravel has been stripped away, milling pits have been sunk into the sandstone ledge. Their position presents an interesting correlation between a minor geologic feature and human activity. The Triassic sandstone is criss-crossed by polygonal dessication cracks two to three feet in maximum dimension. The milling pits have, almost without exception, been sunk along these cracks or at their points of intersection. These weaknesses in the rock obviously afforded the easiest places for pit construction.

THE GENERAL PLEISTOCENE[3] SEQUENCE

South of the site the broad valley of the Canadian butts abruptly against the northern escarpment of the Llano Estacado or Southern High Plains. The valley, in places 50 miles wide, was cut during the Pleistocene epoch by the Canadian River and its tributaries. The detailed record of valley development is fragmentary, however, and includes only the most recent events in an otherwise long time interval.

Two gravel-covered surfaces, cut chiefly in the Triassic rocks, form the floor of most of the valley as shown in figure 33. The higher of these two surfaces, approximately 50 feet above the modern stream grades, is best preserved along the headwater reaches of the tributaries to the Canadian. It represents a long period of plantation during

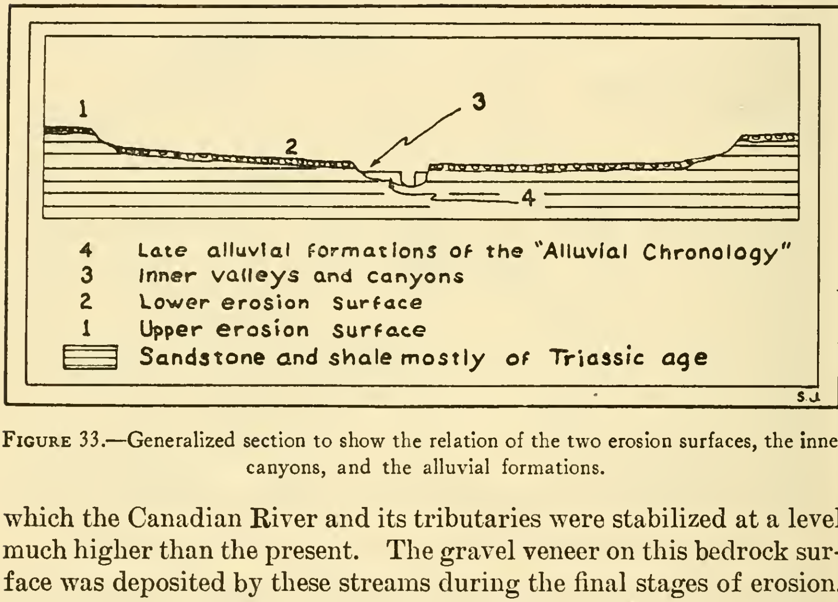

Figure 33.—Generalized section to show the relation of the two erosion surfaces, the inner canyons, and the alluvial formations.

which the Canadian River and its tributaries were stabilized at a level much higher than the present. The gravel veneer on this bedrock surface was deposited by these streams during the final stages of erosion.

The second and lower surface is approximately 30 feet above modern stream grade. It has been widely and well developed at the expense of the higher surface. This surface marks a second planation when the local streams were graded to a lower level than that of the higher surface. The capping gravels represent the closing period of this event. Both surfaces are mantled by more recent wind-blown sand and by alluvium.

Comparatively narrow inner valleys and canyons have been cut into the lower of the two surfaces and form the modern bedrock grades.

[3] Pleistocene is here used to include all time which has elapsed since the end of the Pliocene. Such terms as "Recent" or "Post-glacial" are used only in an informal and local sense. (See Flint, 1947, p. 209.)

The Canadian River itself flows in a bedrock gorge incised in places to a depth of 200 feet below the general grade of these tributary valleys. Figure 33 illustrates the relations of the modern bedrock channels of the tributary of the Canadian to the remnants of the higher and lower surfaces.

The formation of the erosion surfaces and the later stream incision just described were followed by various events of deposition and erosion which are of intimate concern to the archeologist. Although unspectacular when viewed against the immense scope of geologic time these brief events, mere incidents in earth history, coincide with the human occupation of the valley from the day of the Paleo-Indian to the present. The changes from alluviation of the valleys to erosion, and then the reverse, form a sequence of events which undoubtedly had a profound effect on human activity. Cultural patterns must have been influenced in ways as yet but dimly perceived and appreciated.

The sequence of these events is deceptively simple. It is this very simplicity, this monotonous, rhythmic repetition which dulls the mind's retentiveness. Yet retention is important. The sequence is widespread not only in eastern New Mexico but throughout the Southwest. When man and his activity can be related to the sequence we have an unparalleled stratigraphic tool to aid in the determination of the relative and, in some cases, exact ages of the peoples concerned and the environment in which they lived.

The sequence, the "Alluvial Chronology," is basically an alternation of stream alluviation with stream cutting. During certain periods in the immediate geologic past the streams of the Southwest have filled their bedrock channels with silt, sand, and gravel. When the filling was complete the alluvial flood plains in some valleys were marked by shallow stream channels, whereas in others they were grassy and smooth, marked only by quiet water holes, the *charcos* of Spanish days. These intervals of alluviation are separated one from the other by periods of arroyo cutting, a process so characteristic of the area today. Concurrently with the incision of channels strong winds carrying additional eolian material from the dry stream beds reactivated old sand dune areas.

The sequence, discussed in general terms above, may be outlined briefly as suggested in the following tabulation. The tabulation in one sense is misleading. It suggests that the events have an approximate equality in time, i. e., that each had the same duration as any other. This is not true. Exact durations cannot be assigned to all the incidents but in general the earlier the event the longer it lasted. Thus the bar graph in figure 34 indicates in a very crude fashion these time relationships. The higher the bar the greater the time involved in each incident.

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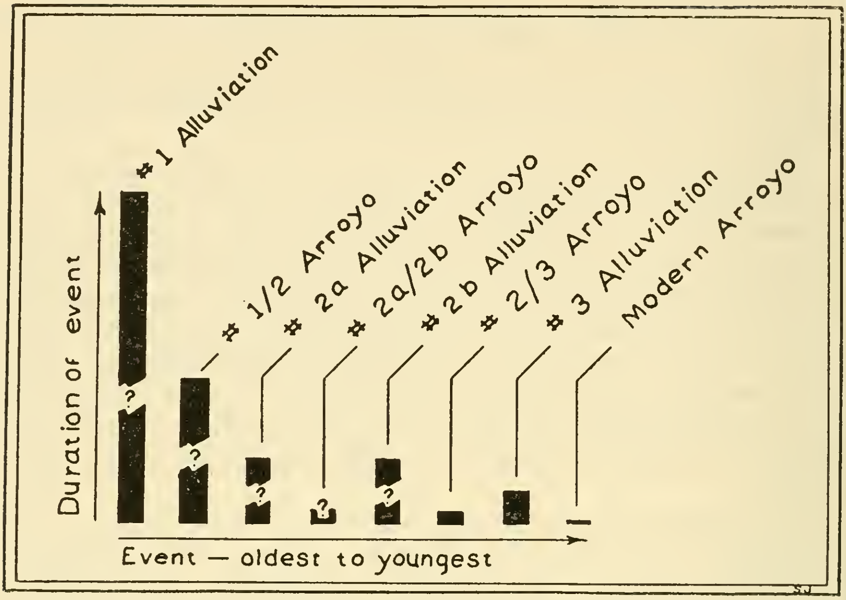

FIGURE 34.—Bar graph to illustrate the relative duration of the various events in the "Alluvial Chronology."

The Alluvial Chronology

(Events and deposits are listed in order from the youngest to the oldest.)

Event	*Deposit*
Arroyo cutting and sand-dune formation	Modern sand and dunes.
Stream alluviation	No. 3 Fill (given various local names)
Arroyo cutting and sand-dune formation	No. 2/3 sand and dunes.
Stream alluviation	No. 2b Fill (Undifferentiated in many places and given local names).
Arroyo cutting and sand movement	No. 2a/2b sand (Undifferentiated in many places and given local names).
Stream alluviation	No. 2a Fill (Undifferentiated in many places and given local names).
Arroyo cutting and sand-dune formation	No. 1/2 sand and dunes.
Stream alluviation	No. 1 Fill (contains extinct animals and is given various local names).

THE SEQUENCE AT THE SITE

Because of the vagaries of deposition and preservation, the complete alluvial sequence is seldom displayed in any one place. But throughout a given drainage basin the sequence can be pieced together from scattered exposures of stratigraphically overlapping sections. Thus it is not surprising that the sequence at the site is incomplete. In this vicinity the No. 1 Fill, part of the No. 2 Fill, and the intervening sand deposits are missing, as is the highest erosion surface. These can be found at other places within the drainage of the Plaza Larga, more particularly near the base of the escarpment of the Llano Estacado or around outlying mesas, once integral parts of the Llano. A description of the sequence at the site is presented below.

THE LOWER EROSION SURFACE

The higher erosion surface is not preserved in the vicinity of the site but the lower surface is widely developed and here forms the major part of the valley floor. Through it the Plaza Larga has cut its modern bedrock grade in a relatively narrow channel about 30 feet deep.

THE ALLUVIAL SEQUENCE

Within this bedrock channel a partial record of alluviation, arroyo cutting, and eolian deposition is recorded. Part of the No. 2 Fill, the No. 3 Fill, intervening wind-borne material, and the modern wind-borne deposits are present. Thus only a part of the "Alluvial Chronology" need be discussed.

NO. 2 FILL

This is a red sandy alluvium exhibiting a rudimentary jointing system. It is fairly compact but can be crumbled between the fingers with some difficulty. Lime-filled tubules and films of lime along the joint planes are characteristic. Toward its upper limit it contains a dark humic zone. In the vicinity of the site the alluvium reaches a maximum thickness of 8 feet, and forms a small terrace along the stream. Elsewhere in the valley this formation is divisible into two units on the basis of two humic zones, separated in places by erosion and concurrent wind-deposited sands. The No. 2 Fill here described is believed to represent the upper of these two units, Fill No. 2 A of figure 34 and table 1.

NO. 2/3 SAND

A period of erosion or channel cutting similar to that of today followed the deposition of the No. 2 Fill. Wind activity accompanied this trenching and at favorable localities eolian deposits collected. This material is a reddish, well-sorted, fine-grained silt or sandy-silt resembling a loess in texture. Over 50 percent of the deposit has a grade size less than 0.062 mm. It crumbles easily but nevertheless, in natural and artificial banks, stands with a vertical wall. It varies in thickness from a few inches to 7 feet. This is the deposit which entombs the cultural material within the two shelters and also on the rock bench continuous with the floor of the southern shelter. The shelters trapped the sandy-silt as the wind carried it from the dry arroyo bottom. The sand can be traced south from the southern

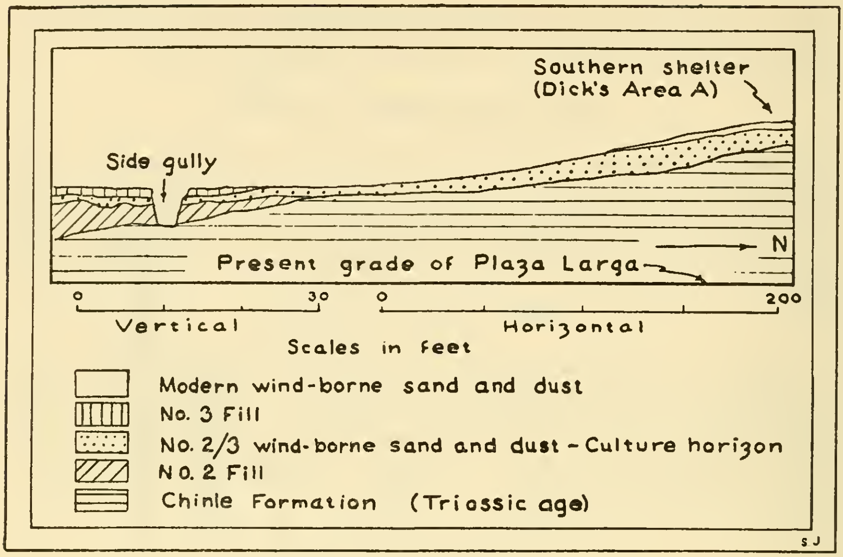

FIGURE 35.—Diagram to show the relation of the sand (No. 2/3 sand) containing the culture horizon to the other deposits at the Hodges site.

shelter to a point where it is interbedded with alluvium and separates the Nos. 2 and 3 Fills as shown in figure 35.

NO. 3 FILL

Following the preceding erosion period the Plaza Larga began the aggradation of its channel and the No. 3 Fill was laid down. This is a gray, loose, friable alluvium containing little or no lime. In this vicinity it does not exceed 2 feet in thickness. The great bulk of it has been removed in the modern channel trenching but thin remnants of it mantle the stream banks and overlie the No. 2 Fill. In some places the two fills are separated by a few inches of the No. 2/3 Sand.

MODERN SAND

About 1900 the Plaza Larga began to cut its present channel. In so doing it scoured out much of the No. 3 Fill until it again reached its bedrock grade. With this cutting came another period of wind activity and concurrent eolian deposition. At the site the sand forms a discontinuous cover ranging from a thin film up to 6 inches. It is a gray, loose, sandy to loessic deposit. It is best developed within the shelters overlying the preceding wind-blown sand. Elsewhere in the area active sand dunes of considerable size and destructiveness mark this period of wind activity, and also the deep red scars of the modern arroyos testify to the effectiveness of stream erosion.

GENERAL CONSIDERATIONS AND CONCLUSIONS

Several conditions must be satisfied before the geologic method can successfully be applied to an archeologic site. Bryan and Ray (1940) list these conditions as follows: (1) A well-defined culture-bearing horizon related to a definite geologic event; (2) a local sequence into which this event may be fitted; (3) a general sequence of wide geographic extent which includes this local sequence; and which (4) can be related to an absolute time scale.

The Hodges site well illustrates the importance of satisfying the conditions outlined above. The open site above and behind the shelters defeats the geologist before he begins. The artifacts found mixed with the gravels of the lower erosion surface, can hardly be considered contemporary with that relatively ancient period of gravel deposition. Aside from the gravels there is no geologic clue as to the age of the artifacts, either relative or absolute. It seems apparent, however, from an examination of the site that the artifacts were intruded into the gravels long after the gravels were laid down. Thus, because the artifacts cannot be tied to a local geologic event the first condition is not satisfied and the geologist can go no farther.

The shelters are altogether different. Their stratigraphy provides an ideal point of departure for the geologic method. The cultural material is entombed within a natural deposit representing a definite geologic event, the blowing of fine dust out of the sandy bed of the Plaza Larga. Condition number one is satisfied. The second condition is met because this dust can be traced southward where it lies along the disconformity between the Nos. 2 and 3 Fills. Thus the single event is related to a local sequence of successive intervals of erosion and of alluviation of the stream channel. This local sequence is a fragment of the larger sequence, the "Alluvial Chronology," which although not well displayed at the site can be established elsewhere in the Plaza Larga and in nearby streams. This chronology is now established not only in eastern New Mexico but also at many other localities in the Southwest. Requirement number three is met. The final condition is answered by the archeology. The cultural material provides a reasonably precise date for the local geologic event. The date is in accord with that arrived at for similar events recorded through three Southwestern States.

On the basis of the physical evidence, it is indisputable that at the time of the occupation of the shelters the Plaza Larga was suffering from a period of channel trenching, wind activity, and eolian accumulation of sand and dust. The conditions must have paralleled very closely those of the present day. The Plaza Larga was then, as now, an intermittent stream. During most of the year the stream bed was dry and winds funneled down its channel, picking up sand and dust and showering it on the occupants of the shelters.

It is also evident that the Plaza Larga had a completely different aspect between this erosion and the modern channel trenching. The stream bed filled with alluvium (the No. 3 Fill), the old arroyo scars healed, and water holes lined its now-eroded course, a condition recorded by the pioneers of the area. We further know that, immediately preceding the erosion period during which the shelters were occupied, the Plaza Larga was aggrading, and the stream had much the same appearance as did the grassy-bottomed draws of 50 years ago.

This fragmentary record of events keys into the "Alluvial Chronology" of Eastern New Mexico and the Southwest. This correlation is presented in table 1. The importance of the Hodges site lies in the fact that a given event in this chronology can be dated. The wind-borne material representing the erosion interval between the Nos. 2 and 3 Fills contains pottery and artifacts. Dick suggests that the material falls between A. D. 1300 and 1540. Thus the sand which contains this material and the arroyo cutting with which it is correlative must share these dates. The dates cannot be considered exact limits for this interval but probably approximate such limits. The arroyo cutting in the vicinity of the site is known to have occurred throughout the Canadian Valley. The date determined at the Hodges site may be applied to this event throughout the general area.

The "Alluvial Chronology" of eastern New Mexico is similar in most details to the late Pleistocene sequence throughout the Southwest. The complete correlation of these sequences, as developed at various points in Texas, New Mexico, and Arizona, is not here presented.[4] Table 2, however, lists various localities at which are present erosion intervals equivalent to the period of arroyo cutting during which the shelters at the Hodges site were occupied. At several of these localities, as indicated in the table, an estimate of the time period involved by this arroyo cutting and some statement concerning contemporary human activity is possible.

The actual date of this arroyo cutting undoubtedly varied from place to place throughout the Southwest, even as has the initial date

[4] For a complete summary of these chronologies, the reader is referred to Bryan, 1941; Bryan and McCann, 1948; and Hack, 1942.

for the modern epicycle of erosion. The magnitude of this variation, however, was probably not great enough to account for the discrepancies among the various dates listed in table 2. The reason for these discrepancies appears, rather, to reflect the method of dating.

An exact date for the interval at any locality is extremely difficult, if not impossible, to establish. Two conditions must be met before an exact date can be determined. First, the cultural material must be related to both the beginning and to the end of the interval. Second, this material must be so diagnostic that the archeologist can narrowly restrict it in time. The difficulties arising from these two conditions are illustrated by the Hodges site. First, there is at this site no evidence, either archeologic or geologic, that the occupation period in the shelters spans the entire period of the coincident arroyo. It probably does not. Therefore no date arrived at via the cultural objects can represent the entire span of the arroyo. Second, even were the time interval bracketed by cultural horizons—and it isn't—the material from the site cannot be dated as precisely as might be wished. Dick states that the material has a range from A. D. 1300 to 1540 and may even range somewhat before A. D. 1300. But he can adduce no evidence that the occupation is actually defined by this span. On the contrary, although the pottery and artifacts have these maximum dates, they more probably represent a period of time shorter by some unknown amount. Dick suggests that the actual time range represented by the material lies closer to A. D. 1300 than to A. D. 1540.

TABLE 1.—*Correlation of the sequence at the Hodges site with that developed elsewhere in the Canadian Valley and at the San Jon site along the northern edge of the southern High Plains*

Event	Hodges site (Judson)	Eastern New Mexico (Judson)[1]	
		Canadian Valley	San Jon site
Arroyo cutting and wind activity.	Modern arroyo and eolian material.	Modern arroyo, sand dunes and minor deposits of wind-transported material.	Modern arroyo.
Deposition No. 3	No. 3 Fill	No. 3 Fill	Low terraces.
Arroyo cutting and wind activity.	Wind-borne dust containing culture horizon and coincident with arroyo.	Arroyos, sand dunes, and minor deposits of wind-transported material.	Arroyo.
Deposition No. 2b	No. 2b Fill	No. 2b Fill	
Arroyo cutting and wind activity.	No record	Arroyos, minor deposits of wind-transported material and possibly sand dunes.	Sand canyon formation.
Deposition No. 2a	No record	No. 2a Fill	
Arroyo cutting and wind activity.	do	Arroyos, sand dunes, and minor deposits of wind-transported material.	Arroyo.
Deposition No. 1	do	No. 1 Fill	San Jon formation.

[1] Submitted to Smithsonian Institution for publication.

Table 2.—*Correlation of the erosion intervals between the No. 2 and No. 3 fills, which is represented at the Hodges site by wind-borne silts, with similar events in Texas, New Mexico, and Arizona*

Locality and investigator	Event	Date (A. D.)	Culture
Hodges site (Judson and Dick)	Arroyo cutting and deposition of wind-borne dust.	1300 to 1540	Late hunting-gathering stage.
West Texas High Plains (Huffington and Albritton, 1941).	Monahans Formation (wind-blown sand).	No date	No record.
Big Bend, Tex. (Albritton and Bryan, 1940) (Kelley, Campbell, and Lehmer, 1941).	Arroyo cutting	Before 900 to 1300	Livermore focus (in part) Chisos focus (in part).
Tule Canyon, Tex. (Judson)[1]	do	No date	No record.
Galisteo Creek, N. Mex. (Bryan, 1941).	do	Before 1400	Pre-glaze I.
Rio Puerco (of the east), N. Mex. (Bryan, 1941).	do	No date	No record.
Grants, N. Mex.,[2] (Bryan and McCann, 1943).	Sand dune formation	875 to 1100	Lobo Complex.
Chaco Canyon, N. Mex. (Bryan, 1941).	Arroyo cutting	After 1200; before 1400	Evacuation of canyon by Puebloan people.
Zuñi River, N. Mex. (Bryan, 1941).	do	No date	No record.
Hopi Country, Ariz. (Hack, 1942).	Arroyo cutting, possibly wind action.	After 1200; before 1500	Late Pueblo III and Early Pueblo IV.
Whitewater Draw, Ariz. (Sayles and Antevs, 1941).	do	1100 to 1300	Undefined pottery culture.
Tsegi Canyon, Ariz. (Hack, 1945).	do	Cut by 1300	Late Pueblo III.

[1] Unpublished.
[2] This event at this locality may not be equivalent to the other events listed.

Several of the dates listed in table 2 were arrived at by a variation of the method discussed above. The cultural material, instead of being related directly to the arroyo interval was related to the last stages of the preceding No. 2 Fill and the first stages of the subsequent No. 3 Fill. The dates thus determined are considered as approximate terminal dates for the arroyo interval. Nevertheless, the same difficulties still obtain; i. e., the cultural material probably does not coincide with the exact beginning or end of the arroyo interval, nor is the archeological control of the date of this material exact.

With the pitfalls of dating understood and the shortcomings of the method appreciated, the discrepancies in dates from locality to locality can be discounted to some extent. The dates, although not exact, are not without a preciseness even though this preciseness varies in degree depending upon the success with which the conditions for absolute dating are met. These dates suggest a synchroneity through the Southwest for the event, the arroyo cutting, which cannot easily be denied. All dated localities, with the exception of the Grants site which may not be related to this general event, have one date in common, A. D. 1300.

This date may well represent the average date for this particular arroyo development throughout the Southwest. Bryan (1941) has pointed out that, in those localities where the evidence is good, the arroyo began to cut certainly after A. D. 1100, probably after A. D. 1200, and the No. 3 Fill which clogged this arroyo began to accumulate prior to A. D. 1400. In addition, he suggests at least a partial relation between arroyo cutting and the shifts in Puebloan populations which date from slightly prior to A. D. 1250 through 1400. Furthermore, the coincidence between this arroyo cutting with the drought of A. D. 1276 and 1299 as recorded in the tree rings of the Southwest (Douglass, 1935, and Schulman, 1938) has been pointed out by several investigators (Bryan, 1941; Sayles and Antevs, 1941; and Hack, 1942). Thus a growing body of geologic, archeologic and botanical evidence gives ever-increasing support to the inference that a period of arroyo cutting existed throughout the Southwest between A. D. 1200 and 1400 and centered around A. D. 1300.

The Hodges site enjoys an importance out of all proportion to its antiquity or archeologic plunder. Its stratigraphy and archeology combine to establish it as another link in the "Alluvial Chronology," the chronology which promises to add much to our understanding of the complex history of the Late Pleistocene in the Southwest.

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