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E. B. SAYLES

With the collaboration of

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About the author . . .

E. B. Sayles devoted nearly fifty years to archaeological research in the southwestern United States before his death in 1977. He began work in 1931 with Gila Pueblo, a private research organization in Globe, Arizona, and from 1943 to 1961 he was Curator of the Arizona State Museum in Tucson. Although his formal education was limited to extension courses in anthropology and related fields at the University of Texas and Columbia University, he developed a professionalism respected by his colleagues. In southern Arizona he not only pioneered research dealing with early man cultures, but was among the first to include specialists from other scientific disciplines in his pursuit of knowledge about how people lived thousands of years ago. His first report on the Cochise culture was co-authored with geologist Ernst Antevs. In addition to his scientific publications, Sayles wrote several children's books on archaeological and Indian subjects, one of which won the Cokesbury Juvenile Award in 1960.

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CONTENTS

Figures

Tables

FOREWORD

The publication in 1941 of "The Cochise Culture," by E. B. Sayles and Ernst Antevs (Medallion Paper XXIX), introduced a new aspect to the problem of Early Man in America. The Hunters of the day when megafauna ranged the Southwest were replaced by Gatherers as the big game vanished, dependent to a large extent on the vegetal products of the land. That concept, together with the geological and typological data related to artifacts that supported it, has raised many questions over the ensuing years. Acutely aware of those doubts, Sayles determined that a full review of his and Antevs' investigation was in order, stressing particularly the chain of events leading to the published conclusions and summarizing new thoughts and information assembled since 1941. To assist him in specialized areas, he enlisted the help of several supporting authors.

Sayles began this task in 1953, working on it periodically until his death in 1977. His 40 years of watching Cochise materials emerge from the ground provided the basis for his strong feeling and firm belief in the reliability of the geological stratigraphy as the natural framework for the chronology. Changes in the associated artifacts then provided the basis for the related cultural chronology.

As Raymond H. Thompson has noted in the Introduction, this monograph is more in the nature of a historical progress report than a definitive treatise designed to resolve all problems related to the Cochise culture. The chapters Sayles has authored have been little changed or rewritten so as best to preserve his thinking. Although these pages represent an updating of the landmark 1941 publication, findings bearing on the Cochise culture after the early 1970s have not been included. Similarly, recent advances in Early Man studies in the Western United States have not been referenced, although Sayles was well aware of their relevance to the larger picture of the Cochise culture. The inventory of radiocarbon data in Chapter 5 does not extend beyond the mid-1960s. The chapters contributed by Ernst Antevs and William W. Wasley have been left essentially as submitted by them before the time of their deaths.

The collections described by Sayles are housed in the Arizona State Museum, and his notes are in the archives of the Arizona State Museum Library, University of Arizona.

In addition to the collaborators, other participants include Jan Bell and Carol Gifford, who provided editorial and other assistance; Wilma Kaemlein, compiler of the bibliography; Robert G. Baker, who provided the map of the Double Adobe area; Dick Shutler, Jr., adviser on radiocarbon dating; Stanley J. Olsen, adviser on vertebrate terminology; Martha Orr, Sally Greenleaf, Gloria Smith, and Doris Sample, manuscript typists; and the late Ralph D. Zepp, who assisted Sayles in a variety of ways. We are especially indebted to Doris Sample, who expertly typed final pages for photoreproduction; her proficiency with the word processor has greatly enhanced this volume.

The illustrations in the book were produced at various times over the last 25 years. Most of the drawings in Chapters 2-7 and 9-11 are the work of the late James C. Gifford and were made in the 1950s. These drawings were reduced to zinc plates in 1959 when the book was initially scheduled for inclusion in the Memoir Series of the Society for American Archaeology. The original drawings were destroyed in a laboratory fire in Philadelphia in 1972, and although the quality of reproduction now available from the zinc etchings is less than satisfactory, we feel it is important to make available Sayles' final review of the Cochise culture in the form he had envisioned it. The complex profiles in Chapters 8 and 12 were drafted more recently by Charles Sternberg.

The artifact photographs in Chapter 8 are by Helga Teiwes, photographer for the Arizona State Museum. The remaining photographs are from the Gila Pueblo files, most of them taken by Sayles. We are grateful to the University of Arizona Press for making this material available to scholars.

Emil W. Haury
October, 1982

View of 1926 excavations at Double Adobe. Left, local residents; right, Byron Cummings in excavation pit and Lyndon Hargrave (white shirt).

1. INTRODUCTION

Raymond H. Thompson

The year 1926 was a double turning point in the study of the antiquity of man in the New World. Discoveries made in that year led to the definition of two major cultures in ancient North America--the food-gatherers, exemplified by the Cochise culture, and the early-hunters, represented by the Folsom culture.

In 1926 the now justly famous discovery of a fluted projectile point in association with fossil bison bones in a geological context was made at Folsom, New Mexico (Figgins 1927). The find dramatically set the stage for a vigorous search for the archaeological record left by those ancient Indian hunters who are often called the big-game hunters (Wormington 1957).

However, the very recognition of the presence of ancient hunters preying on now extinct Pleistocene animals in central North America at a remote time in the past raised serious chronological and developmental problems. In the days before radiocarbon dating, it was generally agreed that these hunters of Pleistocene animals should be assigned an age of about 10,000 years. Yet, few workers then were willing to date the better-known, pottery-making, village-dwelling, and agricultural Indians of later times even as early as the beginning of the Christian era. This chronological situation left a tremendous gap in the prehistoric record for which there was no evidence. Moreover, it was difficult to visualize any meaningful cultural connection between the big-game hunters and later farming peoples.

It is, therefore, interesting from a historical point of view to note that the discovery of evidence bearing on these problems was also made in 1926 (Cummings 1927, 1928, 1935; Tanner 1954: 12-14). The discovery of simple grinding tools in association with the bones of fossil horse and bison stratigraphically below the skull of an elephant at Double Adobe in southeastern Arizona (ill., p. x) demonstrated that people with an economic base quite different from that of the big-game hunters must have been present at a very early period of time. Other finds of milling stones, for which some antiquity was claimed, had been made in other parts of North America (Rogers 1929; Sayles 1935) but the Double Adobe find was the first reported in association with the bones of extinct animals.

In 1935 the Gila Pueblo Archaeological Foundation initiated a program of field research to learn more about these food-gatherers by capitalizing on the potential offered by the Double Adobe find (Fig. 1.1). Field work was carried out in southeastern Arizona and adjacent areas by E. B. Sayles, E. W. Haury, and Ernst Antevs, and in 1941 Sayles and Antevs presented the Cochise culture as a partial solution to the chronological and cultural problems that had been raised by the discovery of early projectile points on the Plains (Sayles and Antevs 1941).

Definition of the Cochise culture was based on a series of milling stones, core tools, and other artifacts found in a geological context. This stratigraphic sequence of artifacts began at a time when extinct Pleistocene animals were still living and extended in an unbroken typological development to the time of the introduction of pottery in southern Arizona. These stages--from early to late, Sulphur Spring, Chiricahua, and San Pedro--were defined on the basis of both archaeological and geological criteria.

The Sulphur Spring stage was defined in 1941 on the basis of finds at Double Adobe and similar sites in the arroyo-bank exposures of Whitewater Draw, the stream that drains the southern portion of the Sulphur Spring valley. The bones of an extinct fauna, including horse, bison, mammoth, camel, and dire wolf, were found in sand and gravel beds containing artifacts. Antevs assigned this stage to a geological period of pre-8000 B.C., the Provo Pluvial, and interpreted the

a

b

Fig. 1.1. Double Adobe area (Arizona FF:10:1, GP Sonora F:10:1), south bank of Whitewater Draw in 1935. a, E. Antevs (in helmet) and H. S. Gladwin at Locality 4, site of excavation by B. Cummings. b, south arroyo bank, showing relation of Locality 4 (left) with Locality 3; the Cazador stage type site, Locality 2, is at the extreme right, concealed by fill against the bank.

climate as being moister and cooler than at present. The most common artifacts were grinding tools consisting of nether milling stones made from flat slabs and matching flat handstones or one-hand manos. Other types included pebble hammerstones and some percussion-flaked plano-convex knives, scrapers, and choppers, but no projectile points.

The Chiricahua stage artifacts were found in a large peat-covered midden near the mouth of Cave Creek on the eastern flanks of the Chiricahua Mountains and in erosion channels stratigraphically later than the Sulphur Spring stage deposits in the Whitewater Draw exposures, and geologic evidence indicated the climate was both drier and warmer than during either the earlier times or subsequent prehistoric periods. Antevs called it the Altithermal and with the evidence available in the late 1930s estimated its duration from about 8000 to 3000 B.C. Typical artifacts were handstones, milling stones with shallow basins, both plano-convex and bifacial percussion-flaked tools, and hammerstones, as well as a few pressure-flaked projectile points. Typologically, the artifact complex was derived from the Sulphur Spring assemblage and was ancestral to that of the San Pedro stage.

Evidence for the San Pedro stage was found in silts geologically later than the Chiricahua-producing deposits at several sites. The climate was generally comparable to that of recent times and was designated by Antevs as the early part of the Medithermal, 3000 to 500 B.C. Typical milling stones had a large, deep, oval basin, and handstones were larger than in earlier stages. Mortars and pestles were present. Chipped implements were more common than grinding tools, and pressure flaking was important. Many earlier types of flaked tools persisted into the San Pedro stage, but new forms were added. The most distinctive new artifact was a large projectile point with broad lateral notches. Storage and cooking pits were excavated; larger pits were tentatively identified as houses.

The Cochise culture was considered significant on three counts: (1) the oldest stage, which was associated with an extinct fauna, was older than 8000 B.C.; (2) the stratigraphic sequence and the typological development continued without break from that time until the introduction of pottery; and (3) the predominantly grinding-tool assemblage was distinct from the early projectile point complexes such as Folsom (Clovis points of the Llano culture had not been defined at that time). The Cochise culture was presented in the conclusion of the 1941 report as an intermediate stage of cultural development between the culture of the big-game hunters and that of later farming peoples (Sayles and Antevs 1941: 30):

> More significant...than the relative age of the Cochise and Folsom Cultures, is the fact that there is an ancient grinding tool culture--the Cochise. At first this may appear to add confusion since we have come to think of the oldest American inhabitant as being a hunter, best represented in the Folsom culture. But if besides the hunter there was another early inhabitant who was essentially a gatherer of natural foods, many later developments are more readily understood.
>
> The cultural gap between an early hunter and a late agriculturist seems a wide one. With the presence of an early food-gathering economy, the step to a more sedentary economy based on agriculture appears less great. We believe these steps are demonstrated in the various stages of the Cochise Culture.

The idea that simple desert dwellers very early developed specialized tools for processing plant foods, was not as dramatic--nor as romantic--as the concept of ancient hunters stalking extinct Pleistocene animals. Despite the fact that investigators in many parts of western North American had been presenting evidence for the antiquity of grinding tools (for example, Rogers 1929), there was little enthusiasm for such ideas.

The report on the Cochise culture, therefore, appeared in an atmosphere of doubt. In fact, it was not until the important stratigraphic record from Ventana Cave was published (Haury 1950) that the Cochise culture was generally accepted. The presence of the Chiricahua and San Pedro stages at Ventana Cave provided an important confirmation of the arroyo stratigraphy on which the original Cochise sequence had been based. Despite this evidence, the fact that the food-gatherers with their grinding tools possessed an antiquity comparable to that of the big-game hunters and their specialized projectile points was not widely admitted until the radiocarbon dates from Danger Cave forced its acceptance (Jennings 1957). Moreover, even those who accepted the comparable antiquity for the two early assemblages continued to question the validity of the association of the earliest stage of the Cochise culture with an extinct fauna (Kelley 1959: 279; Willey and Phillips 1958: 91), so that Haury, who participated in the original Double Adobe discovery, felt it necessary to restate the evidence for that association (Haury 1960).

However, lack of detailed publications on the various food-gathering cultures must share the responsibility for the slow acceptance of cultures such as the Cochise. The fact that the publication of the full documentation of the Ventana and Danger cave sequences has been so influential in promoting better understanding of the food-gatherers clearly reflects this situation. The 1941 monograph on the Cochise culture must be viewed, therefore, as the first progress report of a long-range program of field research in southeastern Arizona rather than as the definitive statement on the Cochise culture. The present study is a second progress report to summarize the evidence that Sayles and his colleagues accumulated between 1950 and 1970, leading to the definition by Sayles of a new stage, the Cazador, that is transitional between the Sulphur Spring and Chiricahua stages.

The very nature of the evidence for the Cochise culture and the circumstances under which much of it is discovered make it difficult to gather large bodies of data rapidly. Much of the information on which the Cochise culture has been based has come from the freshly exposed banks of the arroyos or erosion channels of the region. The capricious nature of the erosional forces that create the arroyos is illustrated by the fact that although new areas are constantly being exposed, some previously known sites have been completely washed away and others have been concealed by the filling of channels.

The field program that began at Gila Pueblo in 1935 was gradually transferred to the University of Arizona, first under the direction of Haury in 1937 when he became head of the Department of Anthropology, and later in 1943 continued by Sayles when he became curator of the Arizona State Museum. So much information had been obtained by 1950, including that of other investigators, that the Arizona State Museum accelerated its investigation. A low-level aerial survey of the area greatly facilitated the checking of the many drainages. This survey was undertaken because previous work provided detailed knowledge of the various geological strata in all drainages in which sites had been located. From the air, the changes that had taken place in the arroyo banks could be observed. In many areas, erosion had brought about the concealment of former sites by changes in the stream channel, as a result of the partial filling of the earlier stream bed, shifting of sand and gravel bars, and the growth of desert plants. Such areas did not warrant checking on the ground and attention could be concentrated on the places where the arroyo banks were well exposed.

As a result of the air check, new sites were discovered, and a number of localities where future erosion may expose sites were identified. All of these new sites were examined on the ground, both for geological and archaeological evidence, and all previously known sites were rechecked. Artifacts found in place in geological context were collected and have been included in the present analysis. A number of sites were excavated. The procedures used included the clearing of the face of the exposure, measurement of the geological strata, identification of the sterile nature of the overlying beds, removal of the overburden, and excavation by hand of the artifact-bearing layer.

Other potential site areas were examined less thoroughly, such as beach lines (except those of ancient Lake Cochise), some tributary drainages, open shelters, and caves. These localities will receive greater attention in future work.

At the same time that Sayles and his associates were probing more deeply into the nature of the Cochise culture in the area of its discovery, workers in surrounding regions were increasing our knowledge of the Southwestern food-gatherers in general as well as expanding the range of the Cochise culture itself. A major contribution to Cochise studies has resulted from the work of

Chicago Natural History Museum personnel under the direction of Paul S. Martin near Reserve, New Mexico, about 150 miles northeast of the Double Adobe site. Excavations carried on there for a period of 16 years following 1939 have led to a fuller understanding of the Chiricahua stage (Martin, Rinaldo, and Antevs 1949), as well as the establishment of a cultural continuum from Chiricahua times through various phases of the Mogollon culture (Martin and others 1952). Of special importance is the information on perishable material obtained from dry caves. A late Chiricahua--San Pedro version of the Cochise culture has been found at the Cienega site in the Point of Pines region of east central Arizona (Haury 1957). Cochise material has been reported from Bat Cave on the eastern edge of the Plains of San Augustin (Dick 1952, 1965) and in the Rio Grande valley near Albuquerque in New Mexico (Campbell and Ellis 1952; Agogino and Hibben 1958; Agogino 1960a, 1960b). A group of Cochise remains called the Peralta complex has been found in Sonora (Fay 1955, 1967).

Another development of significance to this summary of what is now known of the Cochise culture is that a number of archaeologists have discovered and reported on the relationships to the Cochise culture of the various food-gathering cultures of western North America (Quimby 1954, Wormington 1957, Willey and Phillips 1958, to name only a few). [A summary of post-Pleistocene archaeology in the Southwest appears in the Handbook of North American Indians (Irwin-Williams 1979).] The most significant effort in this direction is the work done by Jennings and his associates in which they synthesized various regional cultures as the Desert culture and emphasized the need for delimiting in detail the regional differences (Jennings 1957: 287). The reports by Jennings are also of particular added value in providing much information concerning the nature of early perishable artifacts. While investigations were carried on by many others concerning early food-gatherers, they were also continued in the Cochise area proper under the direction of Arizona State Museum archaeologists as described in the following pages.

The Cochise culture differs from the broader food-gathering concept in four major aspects. First, it is found in the same area as kill sites containing Clovis points of the elephant-hunting Llano complex (Haury, Sayles, and Wasley 1959; Haury 1960). Second, as evidenced at Ventana Cave, its origin may eventually be traced to an early hunting base. Third, the Cochise culture exhibits considerable change through time in contrast to the stability and lack of change characterizing the Desert culture in particular. Fourth, the developmental sequence of the Cochise culture provides detailed evidence of the introduction of agriculture to the Southwest and the emergence of the later farming cultures (Sayles 1945; Haury 1962). It is hoped that the summary of the Cochise culture in the following pages will contribute to a fuller understanding of the concept of food-gathering as a way of prehistoric life that is definable regionally in different parts of North America and will call attention to the potentials for further and more intensive research.

2. ENVIRONMENTAL SETTING

William W. Wasley

Cochise County in southeastern Arizona has not only produced the greatest amount of archaeological and geological information about the Cochise culture, but it also exhibits many of the topographic, climatic, and ecological aspects of the Southwest that are pertinent to the study of the Cochise culture. Thus, Cochise County may be considered as ideally representative of that part of the greater Southwest in which the Cochise culture has been found.

This larger area is in the Basin-and-Range Physiographic Province, extending chiefly over the northern part of the Mexican Highland Section. The distinctive characteristics of this portion of the Southwest are the alluvium-filled enclosed basins, or valleys with little slope, and the parallel northwest-southeast trending ranges (Fig. 2.1). Elevations vary from sea level along the Gulf of California to more than 12,000 feet in the San Francisco Mountain area north of

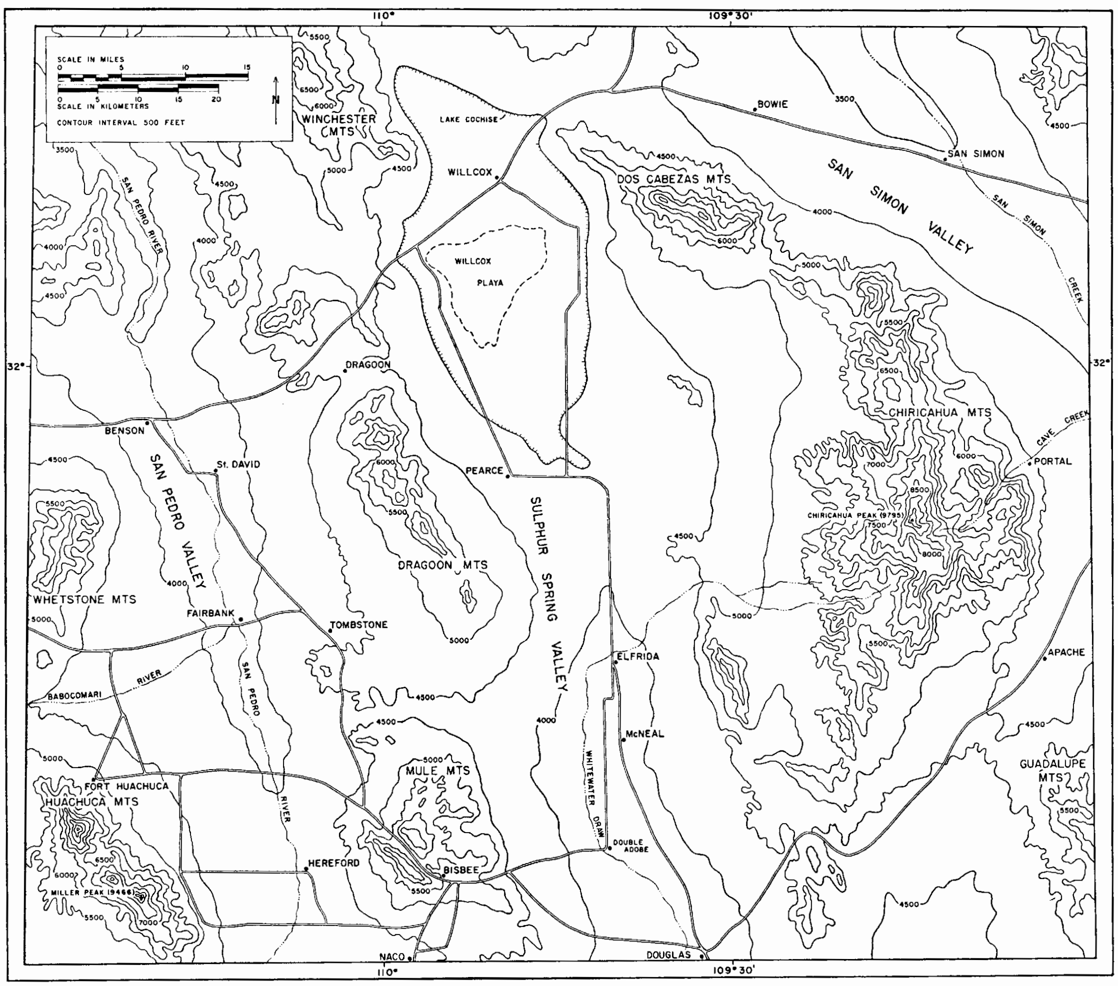

Fig. 2.1. Topographic map of Cochise County, Arizona. (Based on U.S. Geological Survey Topographic Map of the State of Arizona, 1923, revised 1933.)

Flagstaff, Arizona. Reflecting this range of altitude is a series of life zones extending from Lower Sonoran through Arctic-Alpine (Haskell and Deaver 1955: 23).

Representative of only a slightly more limited range in altitude and life zones, Cochise County includes a large part of the Chiricahua Area of the Basin-and-Range Province (Sauer 1930: 339-41). Elevations range from about 3500 feet in the San Simon and San Pedro valleys at the northern border of the county to between 9000 and 10,000 feet in the Chiricahua and Huachuca mountains (Fig. 2.1). Between these two mountain ranges, located at the eastern end and the western edge, respectively, of Cochise County, are three lesser ranges: the Winchester, Dragoon, and Mule mountains. Three major drainages parallel the mountain ranges. The San Pedro valley in the western portion of the county and the San Simon valley along the eastern edge of the county drain north into the Gila River. Through the central part of the county the Sulphur Spring valley drains south into a tributary of the Rio Yaqui in Sonora.

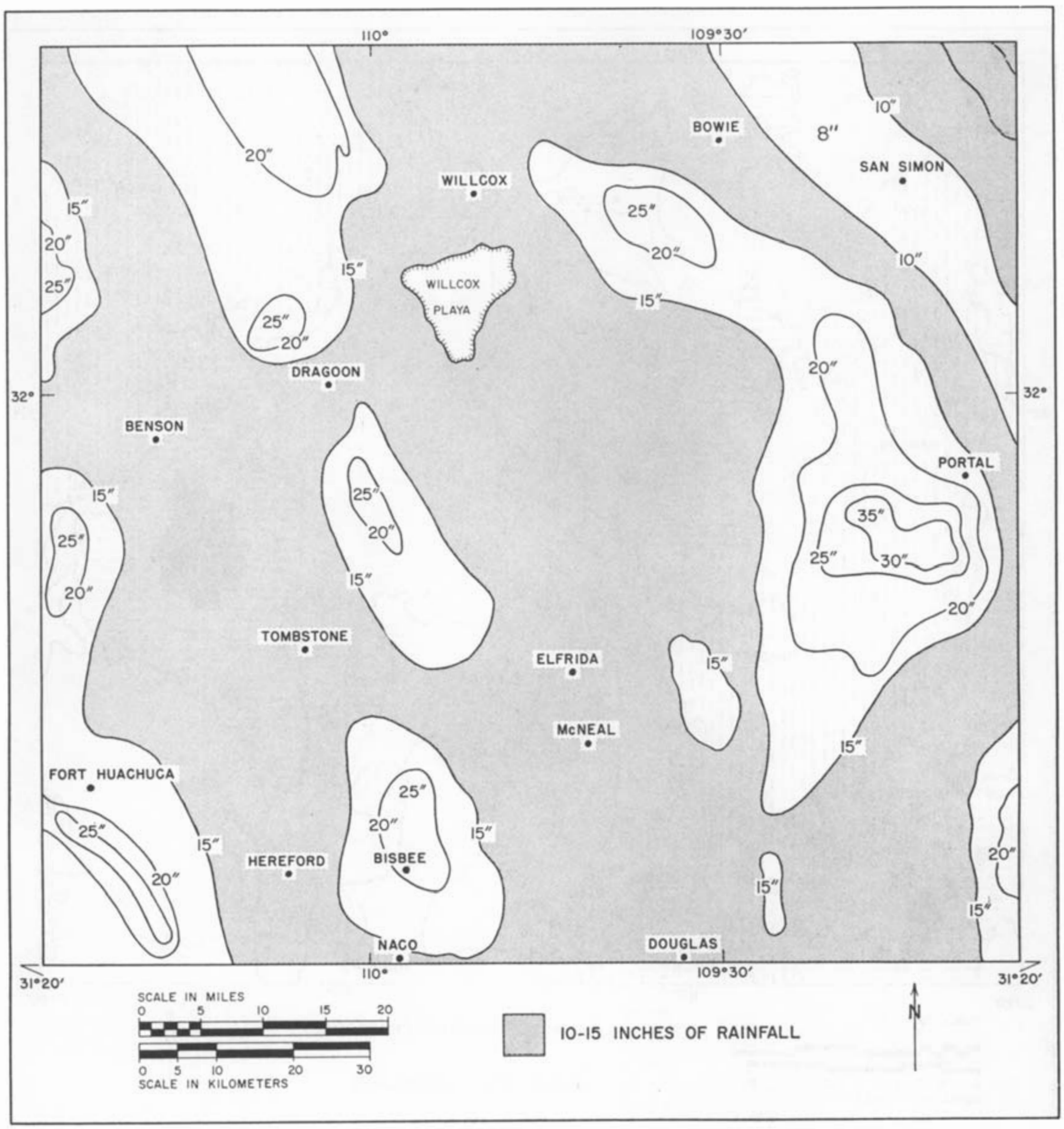

Fig. 2.2. Map showing annual precipitation, Cochise County. (Based on Darrow 1944, Fig. 1.)

PRESENT ENVIRONMENT

Precipitation

In Cochise County precipitation is highly variable, generally ranging from less than 5 inches to more than 20 inches annually. Normal differences in precipitation at different altitudes reflect even more strongly the diversified environments (Fig. 2.2). The average annual rainfall for the lower elevations in Cochise County ranges from 8 inches at San Simon to about 15 inches, while the average for the highest altitudes is from 30 to 35 inches.

Life Zones

In this arid and semiarid environment (Thornwaite 1948, Pl. 1) of Cochise County, the vegetation may be discussed in terms of four life zones. In each of these are one or more vegetational types (Fig. 2.3). The four life zones, Canadian, Transition, Upper Sonoran, and Lower Sonoran (Fig. 2.4), are the result of extremes in elevation and precipitation. However, in terms of areal representation the Canadian and Transition life zones are found only in the higher elevations of the Chiricahua and Huachuca mountains and together occupy only one percent of Cochise

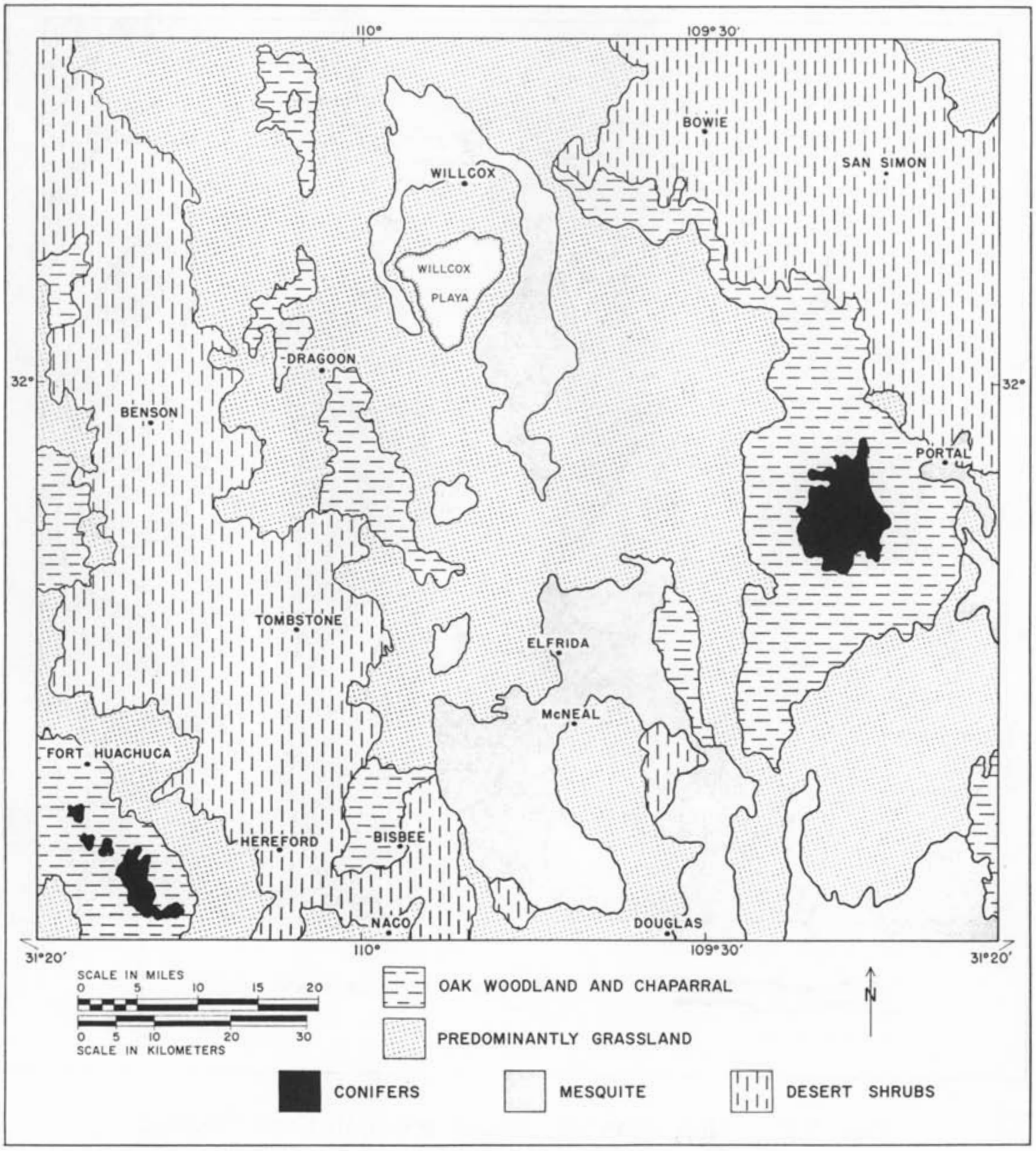

Fig. 2.3. Map of vegetation zones, Cochise County. About two percent of the zone between 5000-7000 feet is occupied by Chaparral. (Based on Darrow 1944, Pl. 1.)

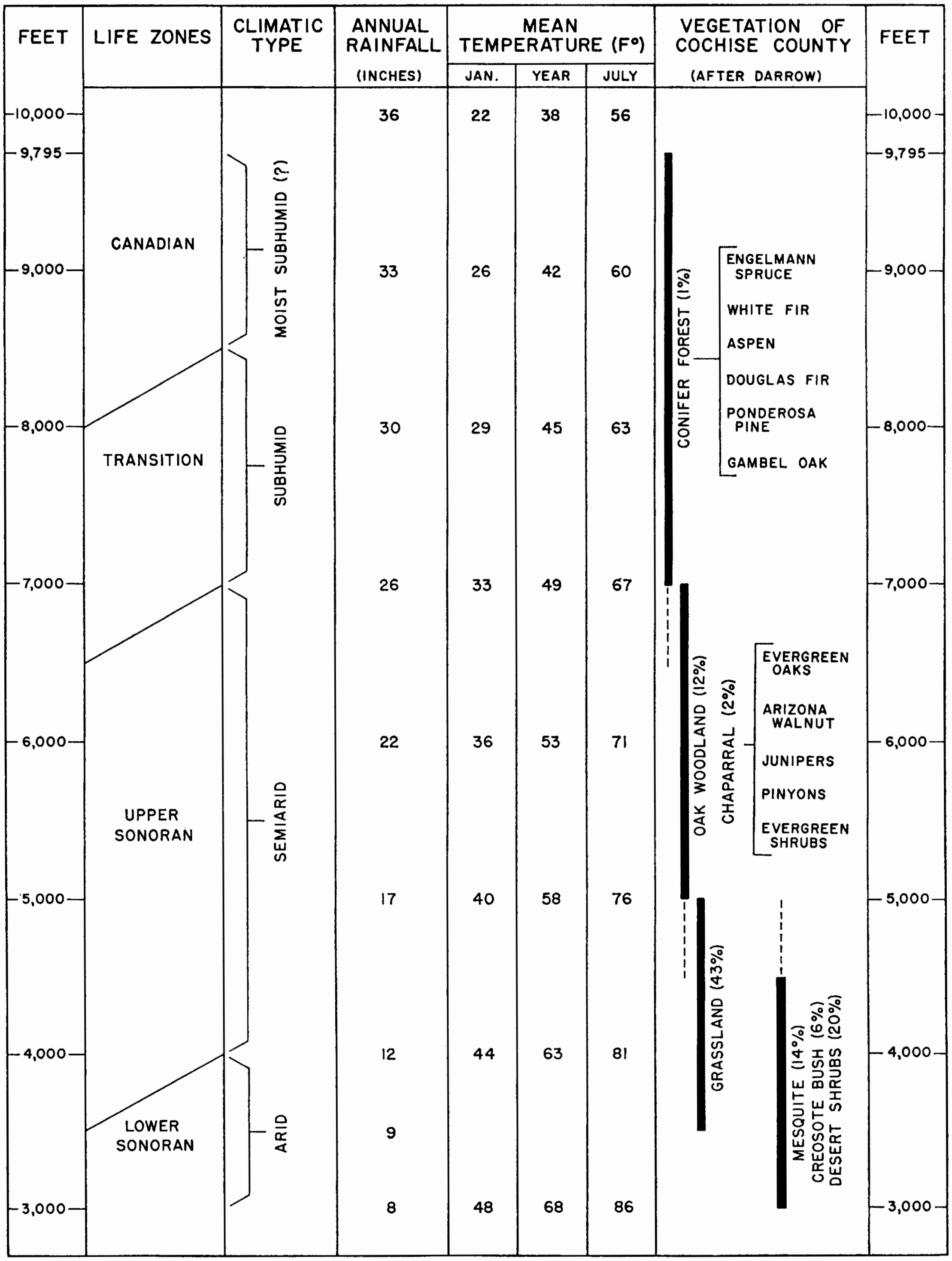

Fig. 2.4. Chart correlating life zones, elevation, climate, rainfall, temperature, and vegetation, Cochise County. (After Benson and Darrow 1954.)

County, while the upper Sonoran life zone occupies well over 50 percent of the land area.

Canadian and Transition (Fig 2.5)

Coniferous forest types of vegetation characterize the Canadian and Transition life zones at elevations above 6500 or 7000 feet. The dominant forest trees are Engelmann spruce, white fir, Douglas fir, yellow pine, and white pine. Other vegetation includes isolated stands of quaking aspen and a variety of high altitude grasses. In the Transition zone there are also shrubs such as Gambel oak, New Mexico locust, and deerbrier (Darrow 1944: 328-29).

Upper Sonoran (Figs. 2.5, 2.6)

Between the elevations of about 3500 and 6500 feet the Upper Sonoran life zone is characterized by two major vegetation types, Oak Woodland and Grassland, and one minor type, Chaparral. The middle and upper portions of the Upper Sonoran life zone are favored by Oak Woodland vegetation consisting of a variety of live oaks (including Emory, Mexican blue, and Arizona), and of junipers, pinyons, and Arizona cypress. Shrubs are represented by manzanita, sacahuista, fendlerbush, and others. Where tree and shrub spacing permit, bunch grasses provide ground cover (Darrow 1944: 330). Oak Woodland vegetation particularly characterizes the hills and lower mountain slopes bordering the higher valleys of Cochise County.

While Chaparral occupies steep limestone or granite slopes within the Oak Woodland area, it constitutes primarily a discontinuous position between the Oak Woodland and the Grassland vegetation types. In the first instance Chaparral consists mainly of manzanita and mountain mahogany, while in the second it is composed chiefly of sacahuista (Darrow 1944: 332-33).

Occupying the lower elevations of the Upper Sonoran life zone and the upper elevations of the Lower Sonoran zone is the Grassland vegetation type. It is characterized by short grasses such as the gramas, curly mesquite, three-awn, and dropseed, except in heavy soils along the main drainages where tall grasses prevail. The latter are represented by sacatons and tobosa (Darrow 1944: 334-37). Areas weakened by overgrazing at the upper altitudinal borders of the Grassland area are subject to encroachment of Oak Woodland and Chaparral, particularly the latter. Similar conditions along the lower altitudinal borders of the Grassland area invite encroachment of Lower Sonoran vegetational types, chiefly mesquite and creosote bush. These inroads into the Grassland area have been considerably intensified by overgrazing and by present erosion characterized by deep arroyo cutting along the drainages (Antevs 1952: 375) as well as sheet erosion of denuded grassland areas. Because of the arroyo cutting, many of the drainages no longer support tall grasses.

Fig. 2.5. Mountains and high plains. a, San Simon valley (elevation 4000 feet), looking toward Cave Creek Canyon in the Chiricahua Mountains. Foreground, shrub mesquite (*Prosopis juliflora*) growing in clusters on sandy mounds, creosote bush (*Larrea*), catclaw (*Acacia greggii*), and screw bean (*Prosopis pubeseus*); sparsely growing herbs and grasses cover the rocky surface. In immediate foreground is an early pottery site (GP Chiricahua 3:21; Fig. 6.2, Site 58). b, Right foreground, conifer zone in the Pinal Mountains (elevation 7800 feet) with quaking aspen (*Populus tremuloides*); background, dense growth of ponderosa pine (*Pinus ponderosa*) with scattered oak (*Quercus gambelli*) and maple (*Acer glabrum*). c, Open, grassy valley (elevation 6000 feet), invaded by juniper and pine, surrounded by forest of yellow pine, pinyon, and juniper (Forestdale). d, High, grass-covered plain (elevation 6000 feet), invaded by juniper, at edge of pine forest (Point of Pines). e, High, grassy plain (Empire valley, elevation 5000 feet), surrounded by mountains rising to heights of 8000 to 9000 feet. Yucca, beargrass, sotol, and other plants common to the Upper Sonoran Desert occur, along with a ground cover of grasses and herbs. Evidence of the use of mountain resources by the earlier inhabitants of the Cochise area is limited.

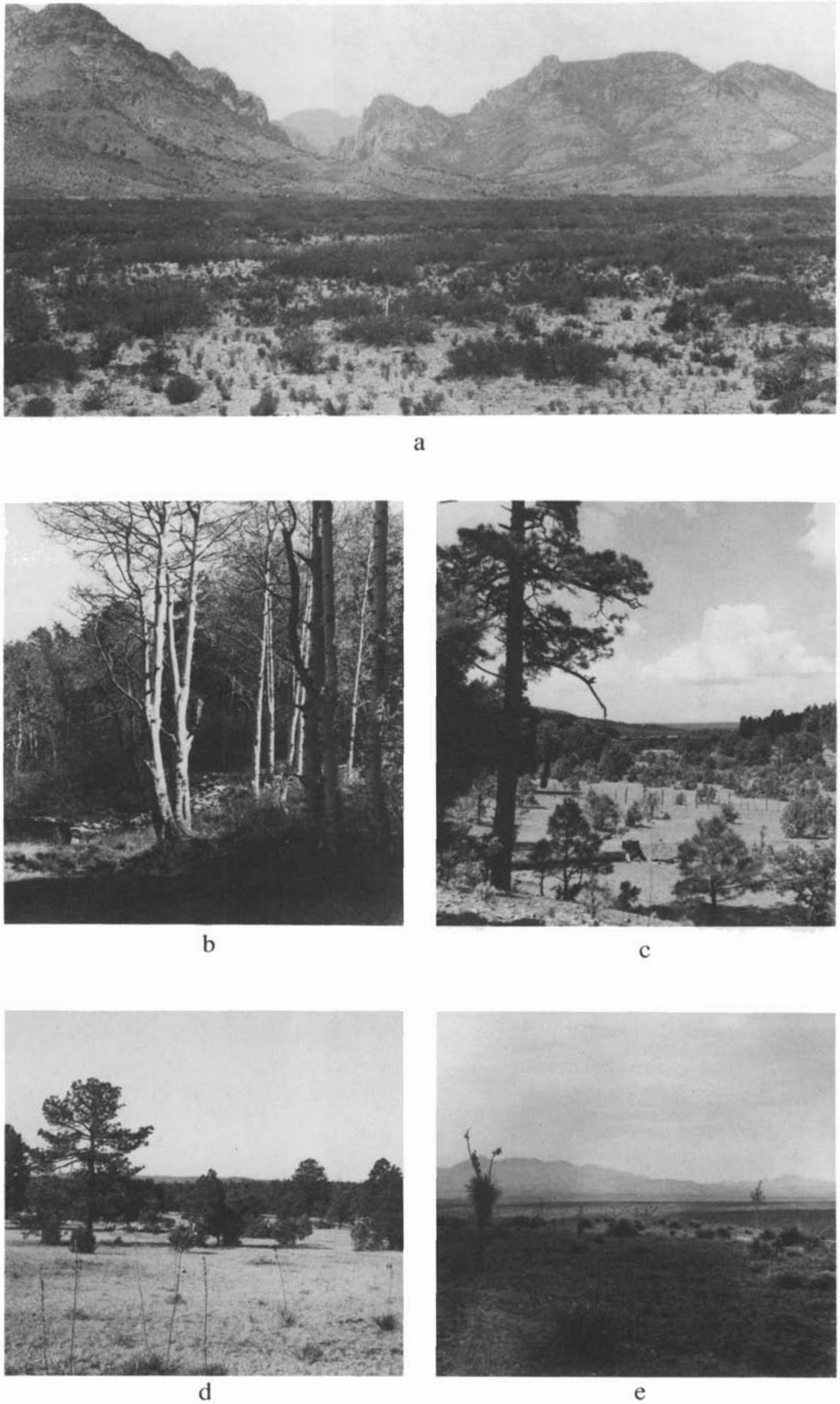

Figure 2.5

a

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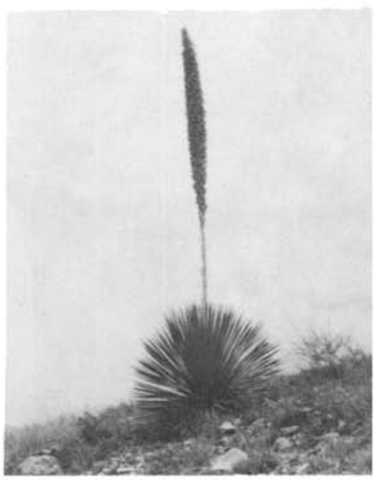

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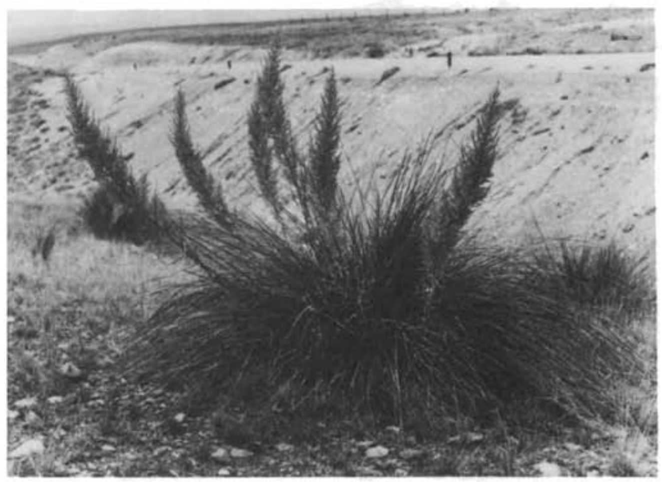

d

e

f

Figure 2.6

Lower Sonoran (Figs. 2.6, 2.7)

Extending up to 3500 or 4000 feet in elevation, the Lower Sonoran life zone is primarily characteristic of the lower portions of the major drainages in Cochise County. Three principal vegetational types are Mesquite, Cresote bush, and Desert shrub. In addition, the Grassland type discussed under the Upper Sonoran life zone extends into the lower Sonoran belt down to elevations of about 3500 feet. While the relatively pure Mesquite type is largely confined to the bottom lands of the major drainages, the compatibility of mesquite results in a number of vegetational type mixtures such as Mesquite-Grassland and Mesquite-Half-shrub (Darrow 1944: 349-51).

As a relatively pure vegetational type, Creosote bush grows on lower portions of the San Pedro and San Simon valleys. Blackbrush, acacia, and mesquite are common companions of creosote bush in these areas. By encroaching on the Grassland area up to elevations of 5000 feet, the Creosote-bush type produces a mixed Creosote-bush-Grassland vegetational type (Darrow 1944: 353-55).

Cienegas

The cienega is a feature still found in Cochise County that must have been of considerable importance to the early settlers and to prehistoric man in the Southwest (see Figs. 2.8, 2.9). A cienega is best described as a marshlike area peculiar to certain semiarid regions. Cienegas are found in rather flat valleys, or basins, where silt has accumulated providing suitable soil for lush vegetation watered by springs and seeps. Sacaton grass, in particular, is a common cienega plant; it grows to heights of 4 or 5 feet in clumps of coarse stalks and blades.

An excellent example of a cienega occurs near the head of San Simon Creek, along the Arizona-New Mexico border (see Fig. 6.2). The cienega vegetation is in marked contrast to the adjoining slopes that are covered with typical desert plants such as creosote bush, yucca, cacti, and mesquite. The San Simon Cienega, half a mile or more wide and nearly five miles in length, is heavily grassed. The meandering channel of the stream usually contains water, and is filled with cattails (*Typha*) and other water-loving plants. Cottonwood, willow, sycamore, and other trees requiring constant water are found in great numbers. The rich plant environment attracts both birds and animals. Similar cienegas are reported to have been present in former times in many Arizona river valleys. Only a few now exist, as the present dessication and accelerated erosion have destroyed a large number of them.

Fig. 2.6. Desert Grassland, to elevation of 5000 feet. a, foothills of Mule Mountain, north of Bisbee, Arizona (elevation 4500 feet), open growth of evergreen oaks (*Quercus toumeryii*) with a heavy ground cover of Tobosa grass (*Hilaria mutica*). Some species of oak and other grassland plants grow at elevations as high as 7500 feet in the Basin–and–Range region. Some species identified with the Oak-Woodland Zone also grow at lower elevations along mountain streams. b, century plant (*Agave palmerii*) in full bloom; the budding stalks are edible and the leaves are strong enough for use in house structures. c, sotol (*Daisylirion wheelerii*) on rocky grass and herb-covered slope (Empire Valley, elevation 5000 feet). d, bear-grass or Sacahuista (*Nolina micro-carpa*) on grassy plain (Empire valley). Like the yuccas and agave, sotol and bear-grass are sources of fiber and food. e, Spanish bayonet (*Yucca schottii*) in flood plain of foothills drainage. f, soap-weed, Spanish bayonet (*Yucca elata*), and creosote bush (*Larrea tridentata*) with sparsely-grassed area, cover the valley floor in the Basin-and-Range region.

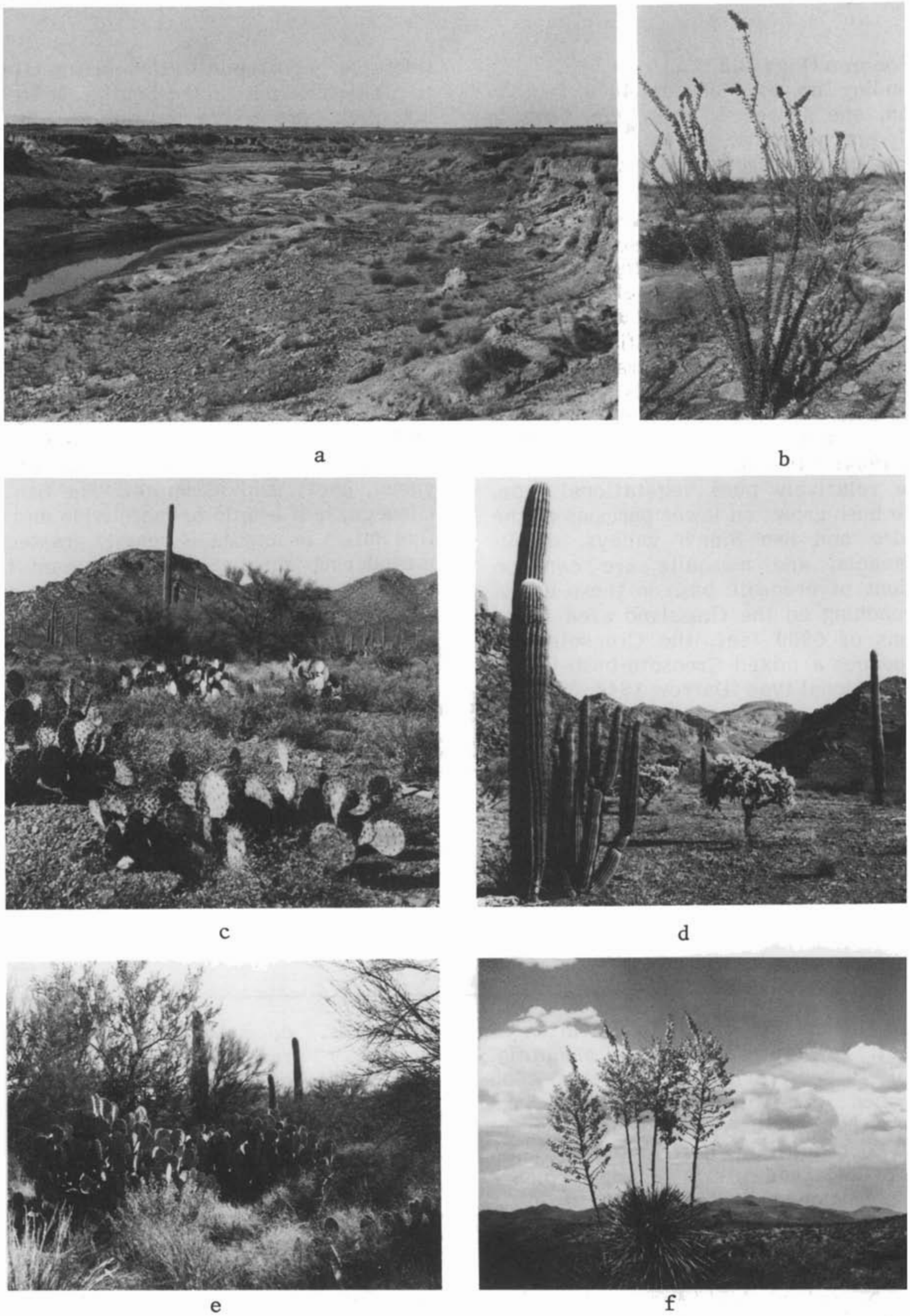

Figure 2.7

PAST ENVIRONMENT

Some idea of the natural environment of Cochise County prior to the present erosion may be envisioned from early first-hand descriptions of the country and, although details are largely lacking, from the nature of some early economic pursuits (compare Haury, Sayles, and Wasley 1959: 3-5). Unfortunately, most of the early Spanish chroniclers and historians described the area in only general terms, so that it is impossible to obtain from them specific information about a particular locality.

Two writers, however, Captain Cristóbal Martîn Bernal and Captain Juan Mateo Manje, who accompanied Father Kino in November, 1697, on a trip down the San Pedro River, down the Gila River to the Pima villages, and back up the Santa Cruz River, gave some inkling of the environment of that day. Manje describes the San Pedro River of the Sobaipuri Indians as a series of cultivated tracts in valleys irrigated by canals or ditches leading off from the river and flanked by plains with good pasture (Karns 1954: 77-83). Just below the mouth of the San Pedro, the Gila River is described as carrying "so much water that a ship could be navigated" (Karns 1954: 84).

In the 1820s and 1850s a large number of "mountain men," beaver fur trappers forced out of the north by monopolies and the dwindling supply of plews, invaded the southwest and began trapping beaver in many of its streams and rivers. One of these mountain men, Pauline Weaver, who served as a guide for Colonel Cooke on the march of the Mormon Battalion, recognized locations on the San Pedro River from his earlier trapping expeditions (Bieber and Bender 1938: 138). Another mountain man, Antoine Leroux, also one of Cooke's guides, related that he had "trapped the whole country, every river, creek and branch from the Gila to the head of the Upper Colorado" (Foreman 1941: 36). Further indirect evidence for the presence of beaver on the upper course of the San Pedro River is contained in the Spanish place-name "Las Nutrias," meaning "The Beavers" (Ruxton 1848: 233). Specific reference to beaver dams along the middle San Pedro was made by Hutton (1859: 78), while Emory (1848: 78) mentions signs of beavers at the mouth of the San Pedro.

Three-foot long "salmon trout," probably the Colorado River squawfish or Colorado salmon, were caught in the San Pedro River between Hereford and Fairbank (see Fig. 6.2) by members of Cooke's expedition in 1846 (Bieber and Bender 1938: 142-44). Fish vertebrae identified as belonging to this largest predatory minnow in North America, *Ptychocheilus lucius* Girard, were found during the excavation of Quiburi mission on the upper San Pedro River near Fairbank (Di Peso 1953: 236-37). Thus, the archaeological evidence indicates that this type of fish lived in the waters of the San Pedro River between 200 and 400 years ago, as well as in the

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Fig. 2.7. Desert Grassland, elevation below 4000 feet. a, Whitewater Draw three miles northwest of Douglas, Arizona (elevation 4000 feet). The present flood plain is entrenched within the older one shown by the low bluffs on each side of the photograph. The adjoining surfaces are covered with grasses and shrubs similar to those found within the Whitewater Draw valley, including some cacti (no giant types) and yuccas. b, ocotillo (*Fouquieria splendens*) on rocky hill top (Big Bend, Texas). c, bajada, slope from foothills to valley floors. Foreground, prickly pear (*Opuntia*) and bur-sage (*Franseria*); background, paloverde (*Cercidium microphyllum*) and ironwood (*Olneya tesota*); rear, giant saguaro cactus (*Carnegiea gigantea*) at the foot of rocky hills covered with desert shrubs. d, sparsely grassed surface; left, giant saguaro cactus (*Carnegiea gigantea*) and organ pipe cactus (*Cereus thuberi*); center, jumping cactus (*Opuntia fulgida*); right, giant cactus. e, succulent desert growth of grasses mixed with cacti and trees (paloverde and ironwood). f, yucca or Spanish bayonet (*Yucca schottii*) growing on brush-covered hills adjoining valley floors.

middle of the last century.

Passing through southeastern Arizona in September of 1851, Bartlett (1854, Vol. 1: 390, 394, 396) mentioned dining on a "plentiful supply of trout, which, though small, were a welcome addition to our bill of fare." These fish were caught in Sonoita Creek in the vicinity of Patagonia. A few days later Bartlett again dined on "a good mess of fish" caught in the Babocomari River (see Fig. 6.2) in the vicinity of the old hacienda of the same name. During the summer rainy season the Babocomari River was "about twenty feet wide, and in some places two feet deep."

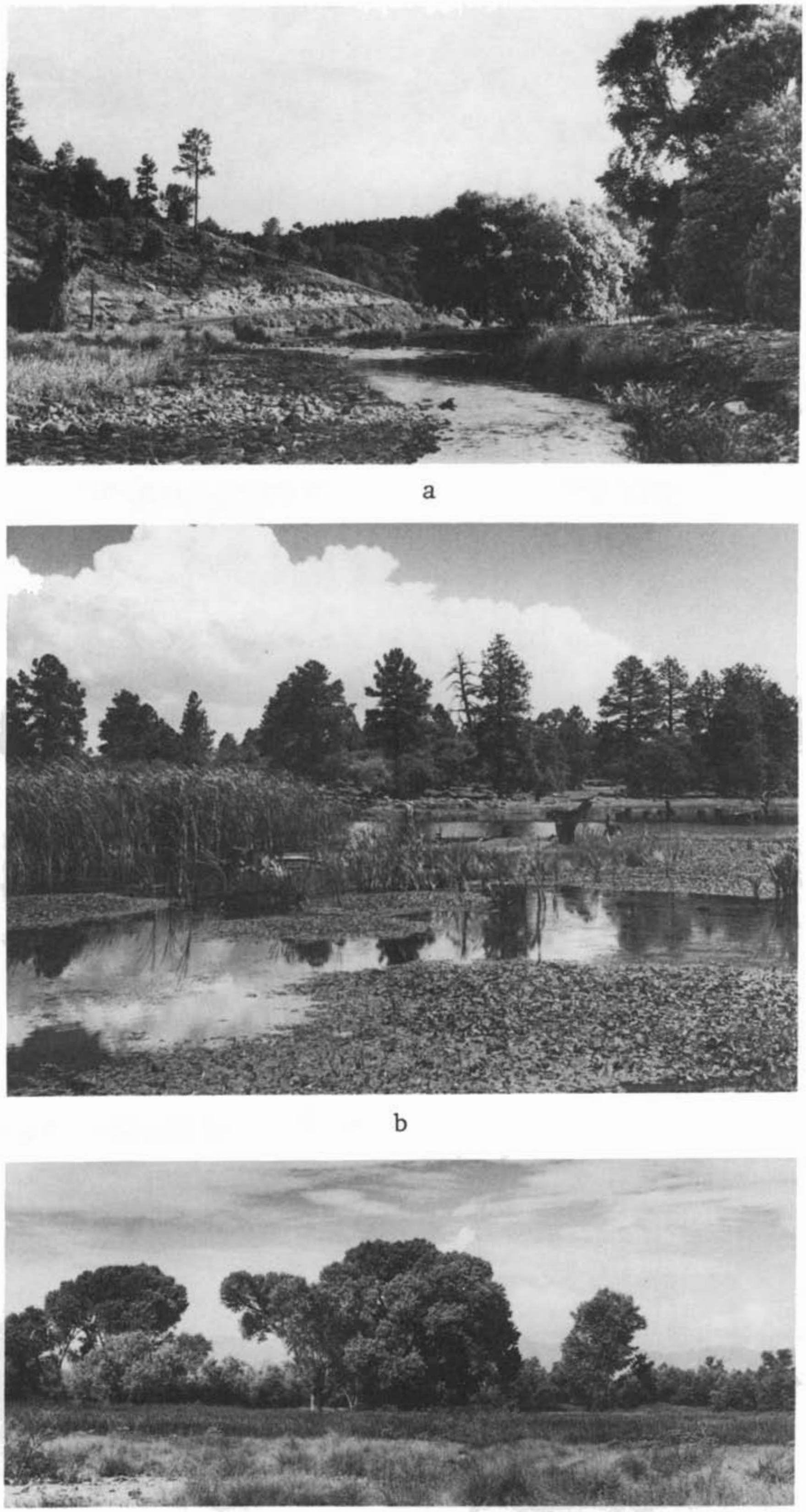
The San Pedro was certainly a perennial stream in former times, and the Babocomari may possibly have flowed year round, since it was fed by a number of springs near its source. Whitewater Draw, however, was definitely not perennial above the Agua Prieta springs (about six miles south of Douglas) in the middle of the nineteenth century. Bartlett (1854, Vol. 1: 257-60) encountered the dry bed of this stream in May, 1851. He found a cienega which was then without water, but he described Agua Prieta as "a fine spring." When Cooke crossed Whitewater Draw in December, 1846, there was water in it (Bieber and Bender 1938: 136), but his crossing may have been made below the Agua Prieta spring or after a winter rain. Dr. Parry (1854: 17), at his crossing in February, 1852, found the stream bed dry, but remarked that "extensive lagoons are said to occur in this valley a short distance south of where the road crosses."

The streams in Cochise County today do not flow continually, except in limited portions of their channels and at very shallow depths. Most of them remain entirely dry throughout much of the year. Only following floods during the summer rainy season is there sufficient water to fill deeper portions of the stream beds, and these soon become dry.

The historical sources agree that the main streams, as well as many of the minor tributaries, were lined in earlier days with groves of cottonwood, willow, ash, walnut, sycamore, and some live oak. Scrub oak occurred away from the valley bottoms, while mesquite, desert hackberry, and blackbrush or tar bush occurred in thickets on the sides of the valleys and in some of the low divides between valleys. Grasslands covered most of the valley bottoms, pediments, and high plains in Cochise County.

The major differences between the environment of the recent past and that of the present are the former presence of (1) well-timbered stream courses fed by a much larger number of springs, and (2) dense grasslands with a more favorable ratio and distribution of the mesquite-hackberry-blackbrush chaparral. The country then supported larger game animals, including populations of deer, antelope, and wild cattle, as well as wolf and bear. The need for mining timbers, railroad ties, building lumber, and firewood in the late 1800s undoubtedly played a major role in the disappearance of timber. Ash was in particular demand for wagon tongues and wheel

Fig. 2.8. Desert water. a, mountain stream (Blue River, New Mexico, elevation 6500 feet); cottonwood (*Populus*) and willow (*Salix*) along stream; yellow pine (*Pinus ponderosa*), pinyon (*Pinus edulis*), and juniper (*Juniperus* sp.) on slopes. b, mountain water tank (man-made reservoir) in meadow (elevation 6000 feet); foreground, hyacinth (*Eichornia crassipes*); left, cattail (*Typha*); background, pine (*Pinus ponderosa*) and juniper (*Juniperus*). c, desert cienega (San Simon cienega in 1950, elevation 4000 feet); foreground, cluster of Sacaton grass (*Sporobolus wrightii*); center, cattail (*Typha*); willow (*Salix*), cottonwood (*Populus fremontii*), and ash (*Fraxinus*) border pools of open water.

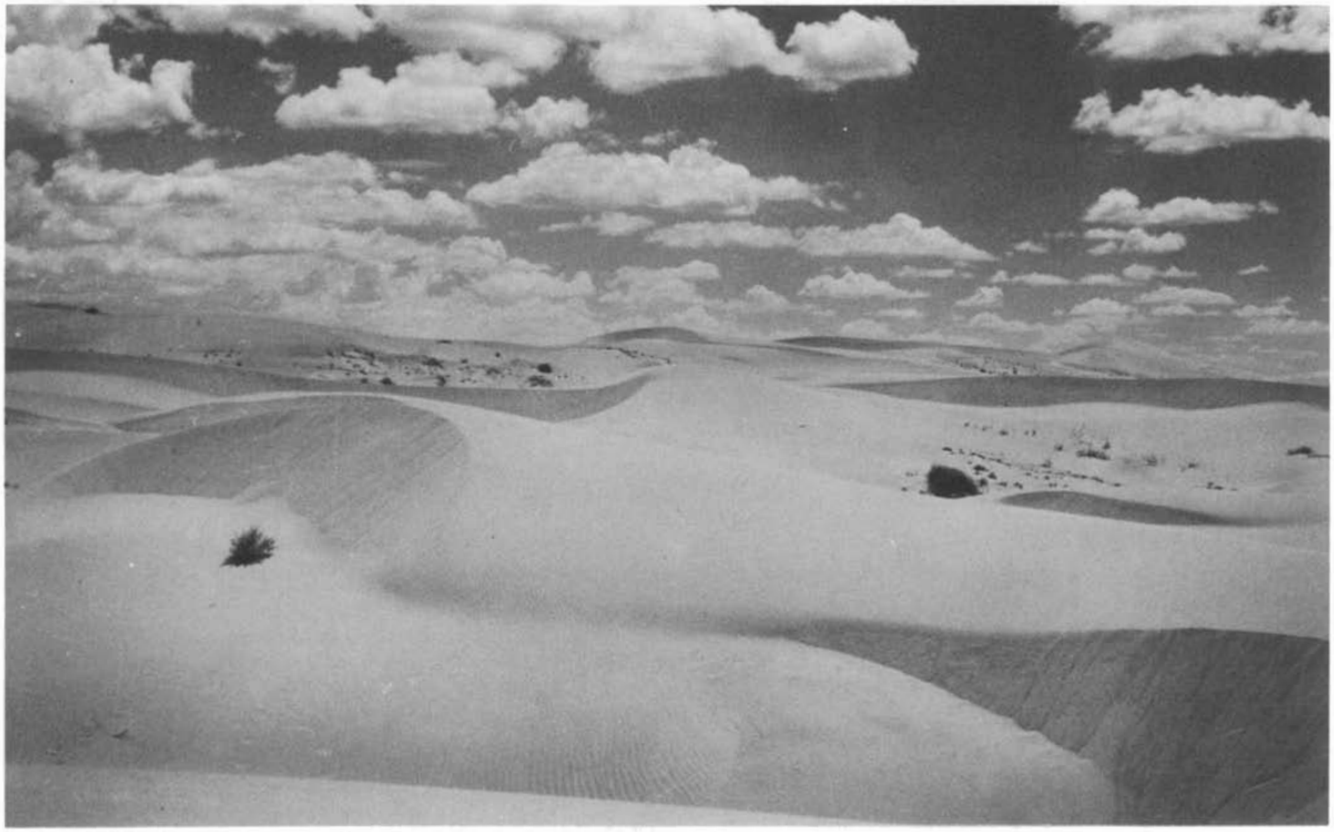


a

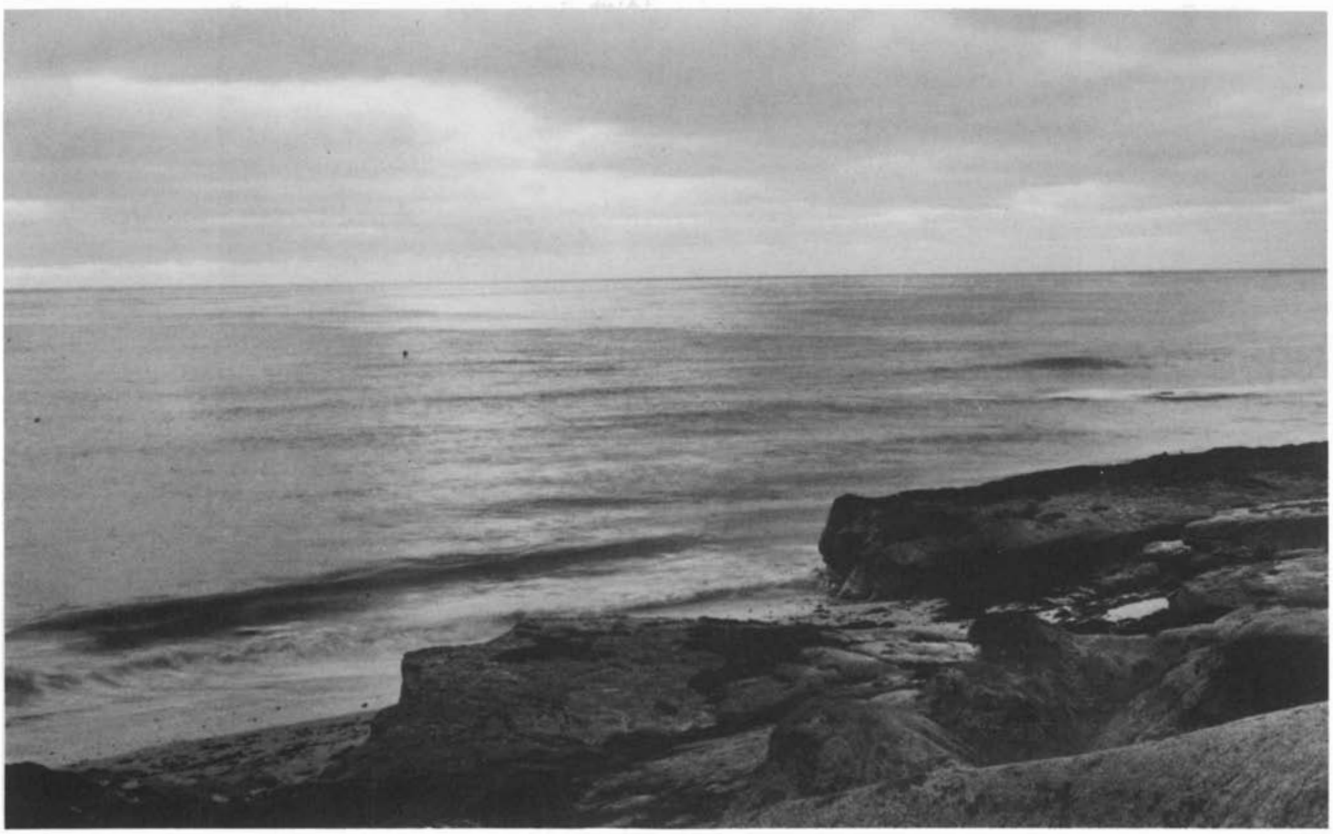
b

c

Figure 2.8



a



b

Figure 2.9

spokes (Bartlett 1854, Vol. 2: 326).

A similar historical description of the nineteenth century environment of Cochise County, published by Humphrey (1958), contains a thorough analysis of the causes for the environmental changes. He presents evidence to show that fire control, that is, eliminating brush fires or reducing them to a minimum, has contributed perhaps as much as any other factor to the encroachment of chaparral and shrubs on grassland areas, thereby removing ground cover and inviting heavy soil erosion (Humphrey 1958: 234-45).

Fig. 2.9. Desert and sea. *a*, Yuma sand dunes west of the Colorado River in the southern part of the Mohave Desert adjoining the Cochise area on the west. The dunes are shifting as there is little or no vegetation on them except in the flat areas. *b*, the Gulf of California in northern Sonora, Mexico, borders the extension of the Cochise area toward the south. The extremes in topography (ecology) represented by the arid desert and the sea contribute to the climate represented in the Cochise area with a range in elevation from sea level to 9500 feet.

3. PALEO-ECOLOGICAL EVIDENCE

Terah L. Smiley

Collecting samples of natural materials associated with cultural objects or other manifestations of human activity is now a routine part of archaeological investigations. Happily for the present-day archaeologist, the collection of such samples began several decades ago. The original investigators of the Cochise culture were pioneers in this respect. Much of the paleo-ecological resource now available is the result of their awareness of the necessity of taking such information into account in the interpretations of the cultural evidence. The faunal and floral data from those early investigations and those resulting from subsequent studies are summarized in Tables 3.1-3.3. Only those plant and animal remains that can definitely be associated geologically or archaeologically with a particular sediment containing man-made materials of a specific cultural stage are listed. Because of the need to use only precisely associated data in this basic outline, other evidences and similar materials that have been recorded from questionable Cochise sites have been intentionally omitted. Samples of flora and fauna are rare because of preservation difficulties, even though many sites have been examined or excavated.

FAUNA

At the close of the Wisconsin glaciation the animal population in the area later inhabited by the Cochise people included many of the "typical" Pleistocene forms (Table 3.1): mammoth, tapir, horse, camel, sloth, bison, and carnivores such as the dire wolf and large cat. The frequency of mammoth remains indicates that there was considerably more feed for them than now occurs in the general region. Other animal forms listed permit no specific ecological conclusions because their climatic tolerance is not known. If it were not for the presence of extinct types, the faunal evidence would show little climatic difference between the past and the present. The random discoveries of preserved remains make it almost impossible to depend on the absence of any kind of animal in drawing climatic conclusions. Man's role in the extinction of some faunal types is a point of controversy (Martin 1958). All the kinds that were present but are no longer evident, whether because of extinction or migration, were large animals. No known small animals and few, if any, intermediate size ones were eliminated. The exact time of extinction is also unknown, although certain deductions have been made (Hester 1960).

Invertebrate faunal remains consist of molluscs and diatoms (Table 3.2). Molluscs are common in many deposits, but they have not been studied in detail. These invertebrates are excellent indicators of water temperature and availability; we would learn much by an intensive study of them (Drake 1959). Several samples of sediments have been analyzed for diatoms. Deposits of the Sulphur Spring stage at the Double Adobe site (Arizona FF:10:1; GP Sonora F:10:1) yielded specimens of the genus *Epithemia*. A large population of diatoms was found in sediments of the Cazador stage, overlying the Sulphur Spring stage, at Arizona FF:10:5 (GP Pearce 8:10; Sayles and Antevs 1941: 69). Modern representatives of the types found there live mainly in still, fresh water or brackish to slightly alkaline waters, indicating a perennial stream probably deposited the sediments during the time desert conditions were starting and the small lakes or ponds were beginning to dry.

FLORA

Plant species associated with Cochise cultural remains have been identified by the study of wood and charcoal specimens and by pollen analysis (Table 3.3). Wood and charcoal probably represent artifacts or fireplace material. An intensive study of the postglacial pollen sequence in southeastern Arizona is dependent on archaeological controls. Consequently, the sediments containing the Cochise cultural materials are the primary sources of the pollen samples.

Representatives of all species found except hickory (*Carya*), elm (*Ulmus*, recently introduced as a shade tree), and linden (*Tilia*) are found in southeastern Arizona today. Ecological zonation exists in the area because of the differences in elevation between the broad desert valleys and the forested mountain tops. Failure to consider this zonation in interpretation could lead to spurious conclusions. High mountain forms might have found their way into the warmer valleys during periods of flood, or man might have brought specific plants from the mountains for tool-making and medicinal purposes. It is essential, therefore, to determine the use to which the plant may have been put before attempting any definite interpretations based on the presence of a particular form in the local environment of the site. There seems to be little difference between the actual range of species of past and present times. However, pollen analyses definitely indicate change in the dominant types present at different periods of time. Thus, the vegetation of today probably does not look like that of previous periods.

One charcoal specimen of hickory (*Carya* sp.) was found at the Double Adobe site along with the specimen of poplar (*Populus* sp.), thought to be cottonwood (Sayles and Antevs 1941: 68). Hickory requires more annual rainfall (approximately 35 inches) than is normal for the area today (approximately 15 inches). Consequently hickory is important, even though its significance is not clear at present.

An item of interest is the presence of mesquite (*Prosopis*) pollen grains in sediments representing the Cazador and later stages. Mesquite charcoal is especially prominent in Arizona EE:2:30 (San Pedro stage) and Arizona FF:10:1, Locality 2 (Cazador stage). These data suggest that mesquite may have been commonly used as firewood during all stages of the Cochise culture and probably it was growing nearby in the floodplain areas of the principal streams.

Table 3.1

Vertebrate Fauna from Cochise Culture Sites

Species	Lano Complex	Sulphur Spring	Cazador	Chiricahua	San Pedro	Early Pottery Horizon
Fish[1]		x	x			
Gopherus berlandieri[2] (Berlandier's tortoise)[3]			x	x	x	x
Chelonia sp.[1,4] (turtle)*	x	x				
Anas platyrhynchos[5] (mallard duck)		x				
Chen hyperborea[5] (snow goose)		x				
Cathartes aura[2] (turkey vulture)				x	?	x
Buteo borealis[2] (red-tailed hawk)				x	x	x
Anas carolinensis[5] (green-winged teal)		x				
Geococcyx californianus[2] (roadrunner)				x	?	x
Bubo virginianus[2] (horned owl)				x	x	x
Tyto alba[2] (barn owl)				x	?	x
Corvus corax[2] (raven)				x	?	x
Corvus cryptoleucus[5] (white-necked raven)		x				
Nothrotherium shastense[4] (ground sloth)*	x	x				
Ursus americanus[6] (black bear)				x	?	x
Taxidea taxus[4] (Berlandier's badger)	x	x		x	x	x
Bassariscus astutus[6] (cacomistle)					x	x
Canis lupus[6] (wolf)				x	?	x
Canis dirus[4] (dire wolf)*	x	x				
Canis[1] *latrans*[4] (coyote)	x	x		x	x	x
Canis familiaris[6] (dog)				x	x	x
Urocyon cinereoargenteus[6] (gray fox)				x	x	x
Vulpes macrotis[4] (kit fox)	x	?		x	x	x
Felis atrox[4] (jaguar)*	x	x				
Lynx rufus[6] (wildcat)				x	x	x
Neotoma sp.?[6] (wood rat)				x	x	x
Citellus lateralis[4] (golden-mantled squirrel)*	x	x				
Spermophilus variegatus[6] (rock squirrel)				x	x	x
Cynomys ludovicianus[4] (prairie dog)	x	x		x	x	x
Erethizon dorsatum[6] (porcupine)				x	?	x
Lepus alleni[6] (antelope jackrabbit)					x	x
Lepus[1] *californicus*[4] (black-tailed jackrabbit)	x	x		x	x	x
Sylvilagus auduboni (Audubon's cottontail)[6]			x	x	x	x
Pecari sp[4] (peccary)	x	x		?	?	x
Antilocapra[1] *americana*[6] (pronghorn antelope)		x		x	x	x
Tetrameryx cf. *T. conklines*[4] (four-pronged antelope)*	x	x				
Ovis canadensis[6] (bighorn sheep)				x	x	x

Table 3.1

(Continued)

Species	Lano Complex	Sulphur Spring	Cazador	Chiricahua	San Pedro	Early Pottery Horizon
Bison sp.[1,6] (bison)*	x	x				
Odocoileus virginianus couesi[6] (Sonora deer)					x	x
Odocoileus[1,4] *hemionus*? (mule deer)[5]		x	x	x	x	x
Odocoileus virginianus[7] (white-tailed deer)					x	?
Cervus canadensis[3] (elk)					x	?
Camelops sp.[1] (camel)*	x	x				
Tapirus sp.[4] (tapir)*	x	x				
Equus[1] cf. *E. occidentalis*[4] (horse)*	x	x				
Mammuthus sp.[1] (mammoth)*	x	x				

* Extinct
1. Sayles and Antevs 1941: 64.
2. Haury 1950: 152-53.
3. John F. Lance, Department of Geology, University of Arizona, Tucson.
4. Haury 1950: 128-40, 154.
5. See Chapter 4, Sulphur Spring Stage.
6. Haury 1950: 151, 154.
7. Eddy 1958.

Table 3.2

Invertebrate Fauna from Cochise Culture Sites

Species	Lano Complex	Sulphur Spring	Cazador	Chiricahua	San Pedro	Early Pottery Horizon
Molluscs						
Cionella sp.[1]					x	
Gastrocopta sp.[1]					x	
Gyraulus parvus[2]				x	x	
Helisoma trivolvis[2]		x	?	?	x	
Lymnaea caperata[2]					x	
Lymnaea obrussa[2]					x	
Lymnaea palustris nuttaliana[2]					x	
Olivella pedroana[2,3]		x				
Physa virgata[2]		x				
Pisidium sp.[1]					x	
Pupillida[1]					x	
Sphaerium aureum[2]		x	x	?	x	
Succinea avara[2]		x				
Succinea grosverori[2]					x	
Succineid snail shells[1]					x	
Uniomeris sp.?[2]		x	x	x	x	
Diatoms[4]						
Amphora ovalis v. *pediculus*			x			
Anomoeoneis sphaerophera			x			
Cymbella mexicana			x			
Cystopleura turgida			x			
Cystopleura turgida v. *granulata*			x			
Cystopleura zebra porcellus			x			
Cystopleura zebra v. *probiscidea*			x			
Cystopleura zebra v. *saxonica*			x			
Denticula elegans v. *Kittoniana*			x			
Epithemia		x				
Eunotia pectinalis v. *ventralis*			x			
Navicula semota			x			
Neidium amphigomphus			x			
Nitzschia amphibia			x			
Pinnularia viridis			x			
Rhopalodia gibba			x			
Stauroneis phoenicenteron			x			
Surirella utahensis			x			

1. Drake 1959.
2. Sayles and Antevs 1941: 66-67.
3. Marine species from either the Gulf of California or Pacific coast of California.
4. Sayles and Antevs 1941: 69-70.

Table 3.3

Flora from Cochise Culture Sites

Species or Type	Lano Complex	Sulphur Spring	Cazador*	Chiricahua	San Pedro	Early Pottery Horizon
Wood and Charcoal						
Carya sp.[1] (hickory)		x				
Fraxinus sp.?[2,3] (ash)			x	x	x	x
Pinus sp.?[1] (pine)	x	x	?	?	?	x
Populus sp.?[1] (cottonwood)		x	x	x	x	x
Prosopis sp.[3] (mesquite)			x	?	x	x
Quercus (many forms)[2,3] (oak)	x	x	x	?	?	x
Pollen types[4]						
Celtis			x	x	x	x
Chenopodiaceae plus *Amaranthus*			x	x	x	x
Compositae			x	x	x	x
Cyperaceae					x	x
Ephedra				x	x	x
Gramineae			x	x	x	x
Juglans				x	x	x
Malvaceae				x	x	x
Pinus			x	x	x	x
Prosopis			x	x	x	x
Quercus			x	x	x	x
Salix				x	x	x
Typha						x
Zea					x	x

* The samples identified as Cazador stage came from Locality 2, Fig. 7.1., and other locations along Whitewater Draw that are stratigraphically later than the Sulphur Spring stage.

1. Sayles and Antevs 1941: 68.
2. Forest Products Laboratory, U.S. Department of Agriculture, Madison, Wisconsin.
3. T. L. Smiley, Geochronology Laboratories, University of Arizona, Tucson.
4. Paul S. Martin, Geochronology Laboratories, University of Arizona, Tucson; from research on the postglacial pollen sequence in the Southwest supported by the National Science Foundation.

4. GEOLOGICAL DATING

Ernst Antevs

Since the first study of the environmental background and age of the Cochise culture (Sayles and Antevs 1941: 31-56), our knowledge has notably advanced. The climatic significance of geological processes and deposits are more fully understood. The climatic history has been complemented. A comparatively dry phase during the late part of the Provo Pluvial seems to be revealed in a pollen profile from west-central New Mexico (Clisby and Sears 1956). In 1953 Sayles defined a new cultural stage, the Cazador. It is intermediate between the Sulphur Spring and Chiricahua stages, and dates from the final pluvial phase that postdated the dry interval of the Datil drought. Sites have yielded new artifacts and important new stratigraphic data. Some have shown that the Chiricahua stage persisted into the transition to the Medithermal, thus confining the succeeding San Pedro stage to the Medithermal.

FORMATION OF SIGNIFICANT GEOLOGICAL BEDS

Whitewater Draw, an ephemeral stream near Douglas in southeastern Arizona, rises in the Chiricahua and Swisshelm mountains, and after reaching the central parts of the 20-mile wide Sulphur Spring valley, flows in a general southerly direction into Sonora, Mexico. From a little north and downstream of Double Adobe, the Whitewater occupies a definite stream valley that varies from about one-fourth mile to nearly one mile wide. The stream valley is bordered by distinct, in places gravelly, bluffs that are some 50 to 150 feet wide and 10 to 15 feet deep. The stream valley, or arroyo, began forming in 1885 (Fig. 4.1).

Prior to 1885, the Whitewater, also then ephemeral, lacked a channel. It was a draw--a shallow, hardly noticeable depression that was mostly grass-covered and in places expanded to mud flats and temporary pools (Meinzer and Kelton 1913: 11, 28). It is still such a draw in the reach above the arroyo. The pre-1885 deposit was yellow, faintly laminated, top silt that accumulated in the stream valley and on the flood plain to the north in a belt perhaps a mile wide.

The conditions before 1885, however, were not natural. Domestic horses and cattle were first brought to the general region by the Coronado expedition in 1540. During the Spanish and Mexican occupation, especially during the first quarter of the 1800s, there were huge herds of cattle in southeastern

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Fig. 4.1. Gravel barrier in Whitewater Draw. a, flood plain of Whitewater Draw about three miles northwest of Douglas, Arizona, looking east toward Swisshelm Mountain. Foreground, Cochise artifacts occur in the "desert pavement;" background, knee high tobosa grass (*Hilaria mutica*) covers the flat surfaces to the slope. b, arroyo of Whitewater Draw, showing break in gravel barrier. c, gravel, containing bones of mammoth and horse, on bedrock clay. d, arroyo bank (upstream) north of barrier; laminated clay and silt on bedrock, calichified clay overlain by massive calichified silt; cienega silt at surface. e, massive calichified silt on gravel, resting on bedrock clay. At higher level where man stands, Chiricahua stage artifacts occur in charco clay overlain by massive silt. f, massive cienega silt (right), with erosion channel containing San Pedro stage artifacts, rests on erosion surface of massive calichified silt.

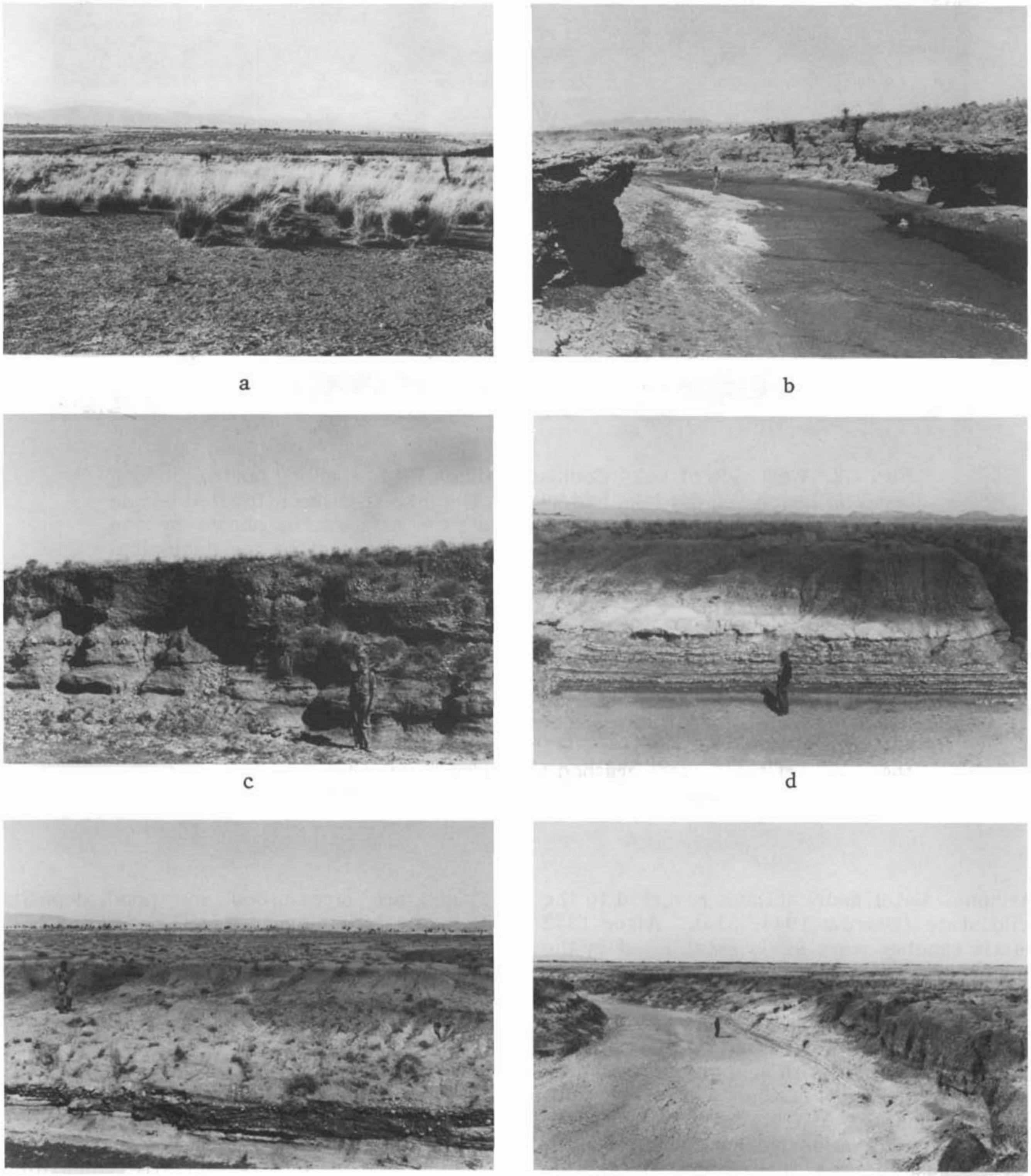


Figure 4.1

Fig. 4.2. West side of Lake Cochise (Willcox Playa) looking north, showing break in beach and dry lake bed, right. The lake area has attracted people from their earliest appearance in southern Arizona, as shown by the artifacts they left behind, and it is a significant part of the geological record (Fig. 6.3). This section of the beach is now a part of Highway 666 from west of Willcox to Douglas. The beach provided a desirable camping area, with slopes both toward the lake and inland forming fresh water lagoons (some fed by springs). Hearths occur on both slopes and in the beach materials. During the building of the highway west of Willcox, handstone and milling stones were observed at the screening plant where beach materials were being processed for use in constructing the road; fine materials were used for road topping and coarse materials, including the stone artifacts, were crushed for making concrete.

Arizona. Later many animals reverted to the wild state (Darrow 1944: 313). After 1872 cattle ranches were again established in the Sulphur Spring valley (Meinzer and Kelton 1913: 13). Therefore, the conditions in the valley before 1885 were not typical of a semiarid climate, but rather of those on the borders of a region with arid climate.

During ages of distinctly moister (subhumid) climate, the Whitewater ran throughout the year, carried relatively little detritus because of the then ample vegetative cover, and entrenched itself (Antevs 1955a: 318). Recognizable sediments from such stages are stream-bed and pond deposits. High waters must have deposited fine sediments on the flood plain, but these deposits cannot now be identified even if they were preserved. A substantial stream flow was possible when early Cochise man camped at Double Adobe and other places (Fig. 4.2).

Since overgrazing has essentially the same effect as an intense drought, the modern artificial arroyo cutting that began in 1885 illustrates events that are typical of a time when the climate has changed to arid. Arroyos form quickly under such conditions.

The Whitewater arroyo was cut from the Mexican boundary to a point some six miles north of Double Adobe, a distance of fully 20 miles, between 1885 and 1910 (Meinzer and Kelton 1913: 28).

Floods do not normally overflow the arroyo banks, but rather enlarge the trenches; they also gradually shift the channels. The deep entrenchment of the flumes and the drought-reduced plant cover promote rapid sheet erosion of the valley floors.

Since the distinct pluvial conditions ended some 9000 years ago, there have been at least four old arroyo erosions that have cut up the central parts of the flood plain and the stream valley, and have carried away most of the pluvial and early postpluvial beds. Furthermore, most remnants of older beds are now covered. The only portions observable are those that are crossed at an angle by the modern arroyo and thus appear in the arroyo walls. Most of the sediments are not indicative of a specific age, but rather of special conditions of formation. Mammals, if represented, only indicate pluvial or postpluvial antiquity. Consequently, sufficient data to facilitate reconstruction of conditions and events and to enable dating are not often at hand.

The activities of the Whitewater during the last pluvial and the postpluvial have thus been confined to the narrow stream valley and to the lowest strip of the basin floor north of Double Adobe, perhaps a mile wide. Here there have been at least four arroyo erosions and two regular stream erosions. Between the degradations there have been brief times of filling and long ages of soil formation. The soils, especially, have been washed away. Two of the types of sediments found in the archaeological site sections are forming in arroyos at present, namely residual gravel and charco clay. During arroyo cutting coarse gravel and cobbles may be left practically in place while finer debris is flushed away. More often, however, the coarse fractions are transported a short stretch and dumped where the current slackens, especially on the inside of arroyo bends. Heavy mammal bones and heavy artifacts such as milling stones and handstones deposited on such banks often can be traced to sites from 50 to a few hundred feet upstream. Redeposited bones might lead to the false conclusion that the bed is older than it actually is, or to the erroneous assumption that an extinct animal survived longer than it did. However, since extinction of the pluvial-age mammals is believed to have preceded the first arroyo erosion, no such mistakes are made here. On the other hand, artifacts in arroyo gravel, if redeposited, may be older than the geological occurrence indicates.

Charco clay is deposited in depressions in the arroyo floor that are perhaps 20 to 50 feet in extent and 5 feet deep (Antevs 1952: 381). To be of archaeological interest the depression itself, or an underlying basin, must be fairly impervious, so that water is retained for some time after an arroyo runs, making it an inviting camping site for early man as well as a waterhole for wildlife. Charco clays, deposited from muddy water, have an uneven base and are small in extent and thickness. Since artifacts and animal bones in the clay may have been thrown in rather than brought there from another site by the stream current, and since charcos existed while arroyos were maintained, that is during dry ages, these deposits constitute primary and datable archaeological sites.

The deposits in the San Simon cienega are useful for an understanding of the massive, gray, gray-brown, and brown clays and silts. This cienega or wet meadow is located on the Arizona-New Mexico border just north of U.S. Highway 30, some 60 miles northeast of Douglas. It is five miles long and one-half mile wide. The southern part is still wet and covered by a luxuriant growth of grasses, but the northern part has been drained and eroded into a badland by the modern headward erosion of the arroyo cutting of San Simon Creek. A concrete dam, built at the northern end of the cienega to stop erosion, was completed in February, 1942.

Some typical sections measured at different times and places in the arroyo walls in the northern, drained part of the cienega, Arizona CC:16:3 (GP San Simon 9:6), are presented in Figure 4.4 (see Fig. 4.3 for symbol designations). Section A shows a thin brown clay (c) not observed in the other sections and greater division of the dark clays, perhaps because they were more moist when observed in 1936. Sections B and C are

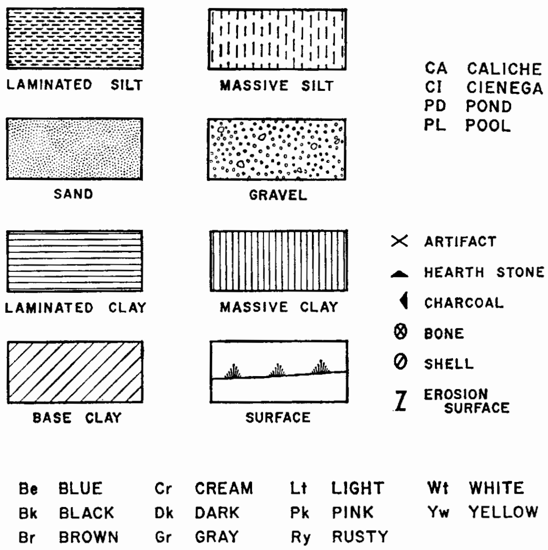


Fig. 4.3. Explanation of symbols used in the geological sections (Figs. 4.4, 4.6, 4.7-4.14, 10.3).

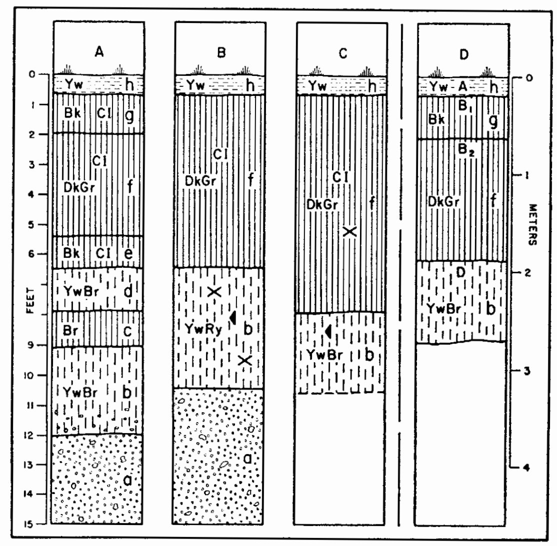


Fig. 4.4. Sections at the northern and dissected end of the San Simon cienega (Fig. 6.2, Site 55, Arizona CC:16:3; GP San Simon 9:6). Section A shows greatest division of dark clays and thin brown clay (c) not observed in the other sections; Section B, typical dry exposure, Chiricahua stage artifacts found in bed b; Section C, typical dry exposure; Section D, interpretation of the section as a soil; horizon D is the substratum (Carpenter and Bransford 1924: 616).

characteristic of dry exposures. A typical series of beds consists of the following (metric measurements are given in the figures): gravel (a) at the base, 4 to 5 feet of yellow-rusty or yellow-brown massive clay-silt (b), 6 feet of dark gray massive clay (f), 6 to 12 inches of yellow silts at the top. In places the dark gray clay (f) contains white nodules or concretions of carbonates. In the late 1940s Emil W. Haury and party found distinctive Chiricahua artifacts in the yellow-brown clay (b) at Section B. Section C produced a large mortar and charcoal in 1950. Section D is a summary of the interpretation of the section as a soil by Carpenter and Bransford (1924: 616).

The gravel (a, Fig. 4.4) at the bottom of the existing exposures is residual and derives from the Altithermal Long Drought. The overlying clay-silt (b) began depositing when the climate changed from arid to semiarid, the transition to the Medithermal (Antevs 1955a: 318). The yellow-rusty to yellow-brown colors of the next beds (b-d) suggest good to fair drainage and aeration. When these clay-silts had accumulated to form an impervious floor, the wet cienega developed. Then the dark gray to black clays (e-g) were formed from the clay, silt, and soil that were carried in by the wind and washed into the basin by runoff after rains. These sediments were sorted by the dense grass cover that trapped coarse fractions near the border of the cienega and permitted only fine clay to reach the central part of the valley. This accumulation went on through the greater part of the Medithermal. It proceeded parallel with soil forming processes that added color and other features to the raw sediments. The dark colors of the clays may be largely due to plentiful organic matter and to poor drainage and aeration.

The clays exposed beneath the top silt on the Whitewater and San Pedro arroyos seem to be essentially like those below the San Simon cienega, except that they are more oxidized. The top clays at Double Adobe (see Fig. 4.6) are a well-developed soil, as shown in a study by Joseph B. Hammon and Robert G. Hardgrave (Sayles and Antevs 1941: 36). They found that the A horizon or topsoil was absent. The B_1 horizon or upper subsoil is a dark brown clay (e) that is stiff, highly colloidal, and massive with columnar structure. A mottled, brownish gray to light gray, massive or faintly laminated clay (d) is the B_2 horizon or lower subsoil. The B_1 horizon (bed e) developed mainly through hydrolization, or change of primary minerals to colloids. The dark color is mostly due to calcium humate or fixed organic matter. The organic colloids leached down from the surface. The B_2 horizon (bed d) developed by hydrolization, downward leaching of calcium and other soluble salts, and upward transportation of calcium by the ground water. The light color and mottling are the result of fluctuations of the water table and consequent alternate oxidation and reduction. These interpretations are from Hammon and Hardgrave. Clays such as these are called "cienega clays" or "cienega soils" in this study.

The normal top deposit on the flood plains of the Whitewater and other streams in southeastern Arizona is a cream, yellow, or brown, faintly laminated silt that in places is sandy (Sayles and Antevs 1941: 43-44). This silt is separated sporadically from the underlying cienega clay by a distinct erosion surface. In most places it is one foot thick, but in erosion channels it may reach ten feet in thickness. In the Sulphur Spring valley the silt contains the bones of domestic horse and cow, and at several places is underlain by potsherds, the youngest of which date about A.D. 1200-1300. Thus, the silt, where datable, postdates the dry age of the late 1300s. The silt suggests that during the runoff after rains the mud fractions of coarse sand and gravel were trapped in the vegetation, while those of fine clay were largely carried away by the stream, mainly leaving only silt to settle in the center of the valley. The faint lamination could be the result of the deposition of a little clay as the flood subsided. Why the silt differs so markedly from the underlying beds is not known.

An important factor in the interpretation of past climate is the fact that silts, silt-clays, and clays may exhibit a range in structure from distinct laminations to faint laminations or a nearly homogeneous deposit.

The clearest lamination is formed by alternating laminae of silt and clay. Such lamination is present in the east portion of the Double Adobe exposure (see Fig. 4.6, bed c^1) and at Arizona FF:10:5 (GP Pearce 8:10, see Fig. 4.10, bed g). A lamina-couplet resembles a varve, but is probably not an annual deposit. The settling must have taken place in a permanent water body, either a natural pool or a pond dammed by man or beaver. Perhaps each couplet represents one large flood, with the silt settling during the flood and the clay after the flood subsides. The important point is that these silt-clays indicate a comparatively moist climate.

Moderate or fair lamination may occur in beds that consist predominantly of clay or silt. Inasmuch as the original lamination may become much less distinct through weathering and soil formation, it is possible that some of these deposits also formed in permanent ponds or pools. However, moderate to fair lamination may form on mud flats temporarily covered by a sheet of water after heavy rains.

Faint lamination, such as occurs in the yellow top silt, may also form on occasionally flooded mud flats and perhaps in wet meadows by the settling of some clay as the flood diminished. Whether present massive silts and clays such as the cienega clays in the San Simon cienega and at Double Adobe were originally massive or laminated is not known. Most clays forming in dense grass cover probably are massive.

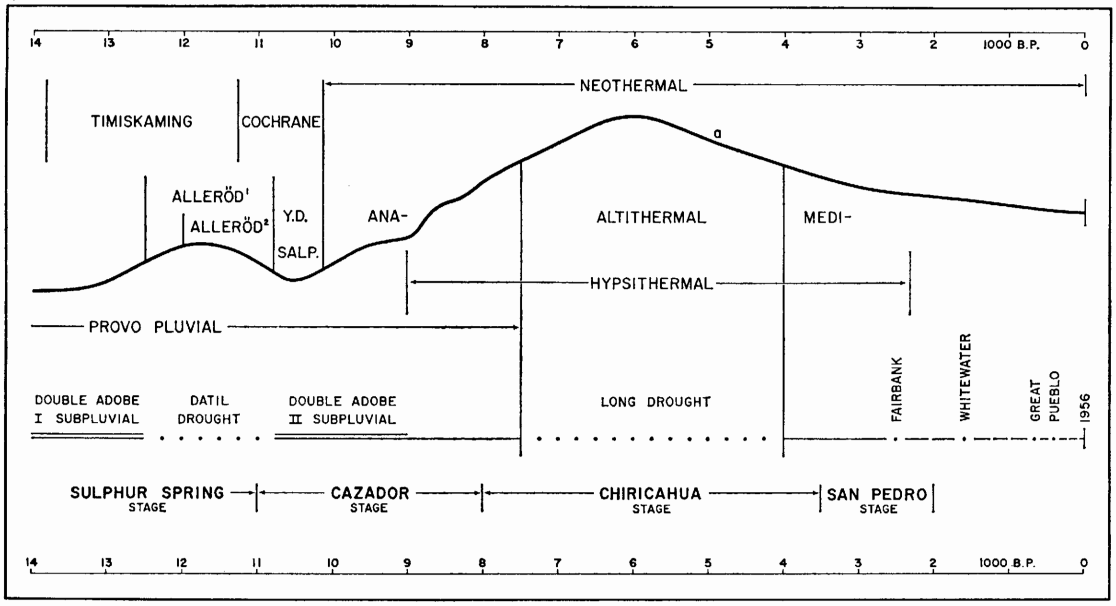


Fig. 4.5. Graph of the past 13,000 years showing temperature and moisture variations in the Southwest, chronological and climatic periods, and dating of the stages of the Cochise culture. Line a, temperature curve by Magnus Fries, based on history of vegetation of southern Sweden; Alleröd[1], duration of the interval as dated by varves and pollen; Alleröd[2], as dated by radiocarbon in Denmark; Y.D., Younger Dryas; Salp., Salpausselka; subpluvial double lines indicate subhumid climate; single line, semiarid climate; dots, arid climate and droughts.

CLIMATIC HISTORY

The climatic history of the Southwest during the last 20,000 years has been previously discussed at some length (Antevs 1955a, 1955b); the present outline is a brief summary (see Addendum).

Two climatic time divisions, one based on temperature and the other on moisture, are needed for correlation and dating in the arid and semiarid West. The former division is the major one; it is based on long-continued temperature conditions and changes and it is necessary for telecorrelation. The latter division is regional; it is founded on the moisture conditions and changes because they control the geological processes that make possible the regional correlations (Antevs 1955a: 317). The temperature graph compiled by Magnus Fries (1951) for southern Sweden during the last 13,000 years is correlated with Southwestern chronological and climatic periods in Figure 4.5.

During late stages of the last, or Provo, pluvial there were some possible, but poorly documented, moisture fluctuations in the Southwest (Antevs 1955a: 327). One of these now seems proven. A pollen diagram of the sedimentary column from the San Augustin Plains in west central New Mexico (Clisby and Sears 1956) contains in the 12 to 14-foot level an abrupt and marked maximum of semidesert shrub and grass pollens, indicating distinctly drier climate than do the pollens in levels below and just above. This dry interval was also comparatively warm, for that same horizon shows an equally prominent minimum, or virtual absence of subalpine spruce pollen.

This relatively warm and dry interval may have prevailed sometime between 10,000 and 15,000 years ago. This dating is based on the radiocarbon age of 19,700 ± 1600 years for the 19-foot level (Magnolia Petroleum Company). It may correlate with the comparatively warm Timiskaming in Canada and Alleröd in northern Europe, both recorded by rapid ice retreat and relatively warm pollen floras. The Alleröd has been dated by varves and plant pollens at roughly 10,800-12,500 B.P. (before present; Fig. 4.5) and by radiocarbon at 10,800-12,000 B.P. (Iversen 1953: 11). The temperature increase in New Mexico may also have been the same as that indicated by foraminiferal records and by oxygen isotopic analyses of pelagic foraminifers in deep-sea sediments in the Atlantic and the Caribbean, an increase dated by radiocarbon at about 13,000 B.P. (Ericson and others 1956: 387). The comparatively warm and dry interval, therefore, probably began approximately 12,500 years ago. It terminated some 10,800 years ago with the inception of the Younger Dryas and correlative climatic spans (Fig. 4.5).

The slightly xerothermic interval indicated at the 12 to 14-foot level in the pollen profile from the San Augustin Plains may have prevailed roughly from 10,800 to 12,500 B.P. The pollen evidence suggests that it was cooler than at present, but possibly equally dry. At Double Adobe the change of climate from subhumid to semiarid is probably represented by a clay bed (see Fig. 4.6, bed d). There is no evidence of arroyo erosion at Double Adobe at this time; therefore, the climate did not turn arid, but remained moderately dry. Since this semiarid state prevailed for a long time, as seen from the contemporary cultural changes, it may be represented mainly by soil formation, though no soil has been observed. It has been named the Datil Drought or the Datil Interval (Antevs 1959). It is a fair assumption that this drought reduced the vegetation and thereby contributed to the extinction of the mammoth in the Southwest by about 11,500 years ago.

In the eastern part of the arroyo wall at Double Adobe stream-deposited gravel and sand that rest on an old substratum contain Sulphur Spring artifacts (see Figs. 4.6, bed b; 7.1, Locality 4). The overlying, distinctly laminated silt-clay (Fig. 4.6, bed c^1) contained a mammoth jaw in situ. These two beds indicate a permanent stream and a subhumid climate. They derive from a time when the mammoth still ranged the region and predate 12,500 B.P. This sub-age is named Double Adobe I Subpluvial (Fig. 4.5).

Near the west end of the same long exposure at Double Adobe there are similar deposits of gravel and sand, but these contain Cazador artifacts (see Figs. 4.8, beds $b^{1,2}$; 7.1, Locality 2). The sand is stratified by laminae of silt and overlain by a massive pond clay (Fig. 4.6, bed c). These beds also record a stream with a permanent flow and a subhumid climate. The position and altitude of these beds is similar to that of partly different stream and pond deposits at the east end of the exposure. Therefore, the moist age began by a lowering of the stream bed. The probable course of this later stream is shown in Figure 7.1A, b. This relatively moist sub-age, recorded by retrenchment of the stream and by the artifact-bearing sand and gravel beds (see Fig. 4.8, beds $b^{1,2}$) is named Double Adobe II Subpluvial (Fig. 4.5). Between these two subpluvials there was a semiarid interval that, to judge from the contemporaneous cultural change, was of long duration. This interval was the Datil Drought.

The deposition of beds d^1-d^3 (see Fig. 4.8) on pond clay (bed c), indicates a change of climate from subhumid to semiarid. This period was the gradual Anathermal drying that culminated in the Long Drought of the Altithermal.

The Altithermal is the distinctly warmer age that prevailed from several to a few thousand years ago. In the West, where it was also drier, the Altithermal is called the Long Drought. It is characterized by arroyo and wind erosion, accumulation of caliche, dessication of lakes, extinction of glaciers, and, in south central Oregon, by frequency maxima of grasses, chenopods, and composites. Arroyos are vertical-walled channels of ephemeral streams cut by flash floods resulting from rapid and unobstructed runoff that is a consequence of severe reduction or destruction of the plant and soil mantle. The principal destructive agent in the past was drought. In the Southwest the Altithermal coincided with extensive arroyo cutting and deposition of residual gravel and charco clay in the arroyo floors. The caliche (calcium carbonate) occurs as a soft accumulation, a hard cement, or hard nodules. There is no known evidence in the West of major moisture fluctuations during the Long Drought.

The succeeding Medithermal is the relatively cool age of the past few thousand years. In the West this age was also comparatively moist. It is recorded by arroyo filling, stabilization of dunes, development of wet meadows or cienegas, rebirth of lakes and glaciers, and decrease in representation of xerothermic plants. Because it is desirable to coordinate whenever possible the time divisions based on temperature and moisture, and because moist conditions returned about 4000 years ago, as dated by the salt content of Abert, Summer, and Owens lakes in the late 1800s, the boundary between the Altithermal and the Medithermal has been established at about 2000 B.C. (Fig. 4.5). This time-divisional boundary is important in the Southwest. The time unit defined by Deevey and Flint (1957), "Hypsithermal Interval," is impractical for present purposes in the West. The term is derived and redefined from A. Chiarugi's "Ipsotermico" and is based on temperature alone. It is a collective term for Danish pollen zones V-VIII, or the Boreal, Atlantic, and Sub-Boreal Scandinavian climatic periods, comprising approximately the time span from 7000 to 600 B.C.

During the Medithermal in the Southwest, an essentially stable water supply, richer vegetation, and more game induced man to settle permanently in such places as Bat Cave in west central New Mexico, places he had visited only occasionally during the Altithermal. Moisture seems to have been greatest during the first part of the Medithermal, about 2000-500 B.C., and to have been generally decreasing since then. Besides this change, there have been dry periods, at least three of which were sufficiently severe to cause arroyo cutting: the Fairbank Drought about 500 B.C., the Whitewater Drought about A.D. 330, and the Great Drought of A.D. 1276-1299 (Antevs 1955a: 329-30). Another dry span, A.D. 1573-1593, named the Pueblo Drought because it is well indicated by small tree growth in the Pueblo country, has not been found recorded by arroyo erosion. The intense modern drought would have started natural arroyos perhaps by 1956, at least in southern Arizona (Antevs 1959).

GEOLOGICAL DATING OF THE COCHISE CULTURE

Sulphur Spring Stage

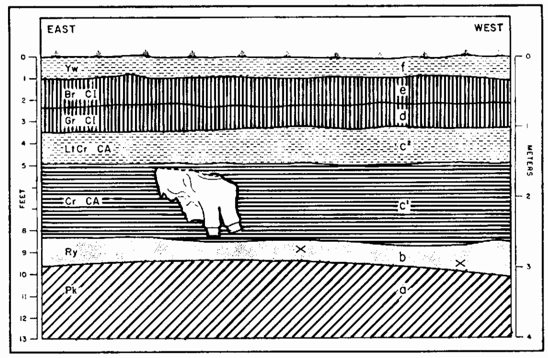
The Sulphur Spring stage embraces an assemblage of artifacts that includes numerous grinding stones, percussion-flaked cutting and scraping tools, and hammerstones. The artifacts occur in association with the bones of extinct animals.

The type site for the Sulphur Spring stage is within the Double Adobe area (Arizona FF:10:1, GP Sonora F:10:1) 12 miles northwest of Douglas, Arizona (Figs. 6.2, Site 38; 7.1, Localities 3, 4, 5). Before erosion and excavations destroyed it, the site was exposed 800 feet southwest of the Double Adobe schoolhouse and 300 feet northwest of the highway bridge. Located in the south wall of the Whitewater arroyo for a distance of about 500 feet, the site probably commenced fully 100 feet east of the old, washed-out bridge and extended to the west of it for about 200 feet.

The artifacts occur in fine gravel and sand, a stream-bed deposit (Fig. 4.6, bed b), resting on the eroded surface of an old pink calichified clay (Fig. 4.6, bed a). The artifacts must have come from a nearby campsite, for with them there were hearthstones and charcoal (Sayles and Antevs 1941: 41, 64). The charcoal has been identified as hickory (*Carya*) and poplar (*Populus*, probably cottonwood; L. H. Daugherty in Sayles and Antevs 1941: 47, 68), ash (*Fraxinus*), and oak (*Quercus*, T. L. Smiley, this volume). There were also bones of horse (*Equus*), and dire wolf (*Aenocyon*), both extinct, and of bison, pronghorn antelope, and coyote (Chester Stock in Sayles and Antevs 1941: 47, 64).

The gravel and sand deposit containing the Sulphur Spring artifacts is directly overlain by bed c^1 (Fig. 4.6), three feet or more of distinct alternating laminae of silt and clay, formed in an enduring pond, dammed presumably by man or beaver. In 1926 Byron Cummings and his students (ill., p. x; Tanner 1954: 12-14) removed an upper jaw of a mammoth, with teeth and tusks in their sockets, from this laminated deposit 35 feet west of the old bridge (Fig. 7.1, Locality 4). In

Fig. 4.6. Idealized section of the Sulphur Spring stage exposure at the Double Adobe site (Arizona FF:10:1; GP Sonora F:10:1; Fig. 6.2, Site 38). Section is based mainly on photographs taken by Emil W. Haury in 1926 when Byron Cummings excavated a mammoth jaw found in situ 35 feet west of the old highway bridge (Fig. 7.1, Loc. 4).



1936-1938, mammoth ribs were exposed in the arroyo wall 25 feet west of the jaw site. A fragment of a mammoth leg bone was found near the skull by Walter Neal of Frontier, Arizona.

Photographs taken by Emil W. Haury in 1926 show that the top of the jaw was somewhat below the top of the pond bed (Fig. 4.6). The laminated sediment of silt and clay in which the jaw is imbedded excludes the possibility of a current capable of transporting the heavy jaw to the site. The jaw was in situ. The mammoth fell and died at the edge of the pond, for the tusks faced north, and just south of the jaw site the old substratum rises above the level of the pond deposits. The jaw was well preserved and must have been covered soon after the animal died. The overlying deposit consists of laminated silt-clay (bed c^1, Fig 4.6) and almost white silt (bed c^2) that was perhaps originally thicker than its present representation. The pond sediments are heavily impregnated with soft caliche and interlaminated with hard flat concretions. The overlying massive gray clay (bed d) is also rather strongly calichified. A slight erosion of bed d observed nearby in 1939 is probably of Altithermal age. The dark brown cienega clay (bed e) may be of Medithermal age. These two beds (d, e) are the B_2 and B_1 horizons of a well-developed soil (Hammon and Hardgrave in Sayles and Antevs 1941: 36). The top bed (f) is a yellow or cream-colored faintly laminated silt containing potsherds that indicate it postdates the drought and arroyo cutting of the late 1200s.

The heavy accumulation of caliche in the pond deposit (beds c^1, c^2) must have occurred during the Long Drought. Thus, the pond deposit itself is pre-Altithermal. The dire wolf, mammoth, and horse indicate a respectable age for the Sulphur Spring stage. The hickory, which requires a much moister climate than now prevails in southeastern Arizona, and the distinctly laminated pond sediment show that the climate was comparatively moist and that Whitewater Draw was then a permanent stream (Sayles and Antevs 1941: 33-34, 47). The Sulphur Spring stage is of pluvial age.

A more detailed dating may be achieved by reference to the mammoth, its moisture requirements, and a moderately dry interval during the late pluvial. This reasoning was employed in the dating of the mammoth hunts at the Naco and Lehner sites (Antevs 1959). It is assumed that the mammoth required a denser and more luxurious vegetation than now grows in the Southwest and, therefore, a moister climate than now prevails in the area. Consequently, the mammoth became extinct in the Southwest during the first late pluvial or postpluvial drought that approached the intensity of the modern one. The comparatively dry interval named the Datil Drought may have prevailed roughly from 12,500 to 10,800 years ago and may have caused the extinction of the mammoth in the Southwest by about 11,500 years ago. It may be concluded, therefore, that the Sulphur Spring artifacts occurring in a moist-climate bed beneath a mammoth jaw in situ at Double Adobe derive from the Double Adobe I Subpluvial (Fig. 4.5) and that they are more than 12,500 years old.

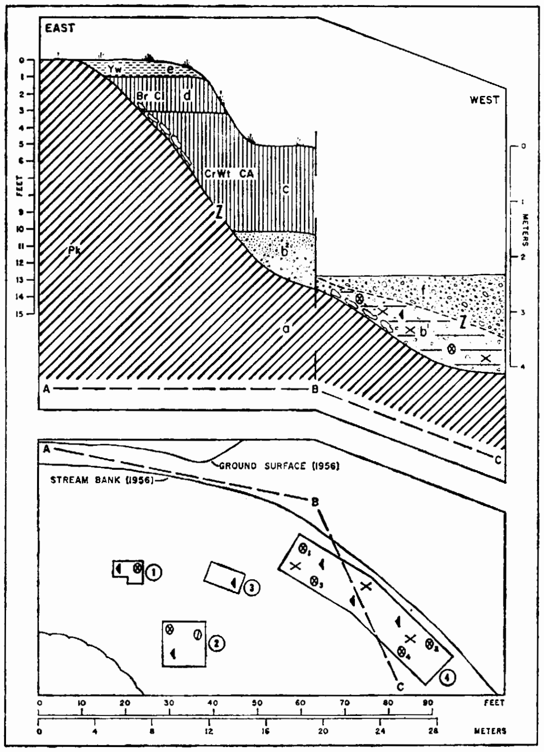


Fig. 4.7. Section of a Sulphur Spring stage exposure 0.35 mile west of Double Adobe (Fig. 7.1, Loc. 1). The site was revealed by pits in the arroyo floor. Bed b^1, consisting of a few feet of laminated sand, contained hearthstones, a few Sulphur Spring artifacts, and several fossils. Test Pits 1-3 were dug in 1956; Test Pit 4 in 1938. The fossils in bed b^1 include mammoth, dire wolf, camel, snow goose (*Chen hyperborea*), mallard duck (*Anas platyrhynchos*), green-winged teal (*Anas carolinensis*), white-necked raven (*Corvus cryptoleucus*), *Uniomeris* shells, and charcoal of western yellow pine. (Mammals identified by Chester Stock and John F. Lance; birds by Hildegarde Howard; charcoal by U.S.D.A. Forest Products Laboratory.)

Another Sulphur Spring stage site, designated Arizona FF:10:1, is located 0.35 mile west of the Double Adobe schoolhouse (Figs. 4.7; 7.1, Locality 1). Here the artifacts occur in a sand bed containing remains of mammoth, dire wolf, camel, water birds, *Uniomeris*, and western yellow pine. An overlying silty clay, containing a camel bone, was heavily calichified during the Altithermal. The artifacts are of pluvial age but cannot be further dated as the mammoth remains could have been redeposited.

No radiocarbon dates have been recovered from any samples identified with sediments in which Sulphur Spring artifacts are associated with fossil bones. The only published dates earlier than 9000 years ago that may relate to the Sulphur Spring stage by climatic and cultural events range in age from 9000 to 12,000 years ago.

Cazador Stage

The Cazador stage is characterized by the presence of milling stones, small handstones, chipped stone tools comparable to those in the Sulphur Spring stage, and the first appearance of pressure-flaked projectile points in the Cochise culture. The principal site is the west end of the long, 500-foot exposure at Double Adobe (Arizona F:10:1; Fig. 6.2, Site 33) in the arroyo wall from 350 to 425 feet west of the old bridge (Fig. 7.1, Locality 2). Projectile points were found by Sayles in May, 1953, and the site was excavated in 1953-1955. The artifacts occur mainly in rusty gravel (bed b^1, Fig. 4.8) that rests directly on top of the eroded surface of old, pink, calichified clay, but some are found in the overlying coarse, rusty sand (bed b^2, Fig. 4.8). This sand is stratified with laminae of silt 0.5 inch thick spaced 5 to 6 inches apart. The lamination suggests a permanent stream. The silt may have settled at seasons of small and gentle flow.

Thus, these artifacts occur in a position similar to that of the Sulphur Spring stage artifacts in the east portion of the same arroyo bluff (Fig. 7.1, Localities 3, 4, 5). However, the overlying beds (c, d, Fig. 4.8) are different. Bed c is a bluish, practically massive clay, one foot thick. The uniform thickness of the clay, and its occurrence directly on top of sand and gravel that do not lie in a small closed basin in impervious beds, show that the clay is not a dry-climate charco deposit. Like the distinctly laminated silt-clay in the eastern end of the bluff, it

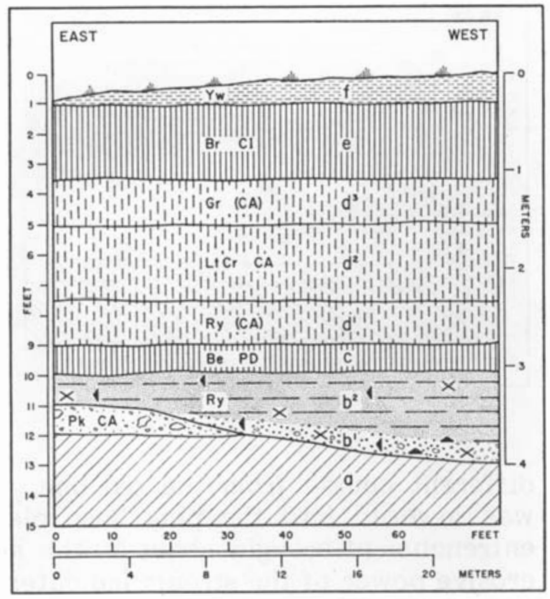


Fig. 4.8. Profile of the Cazador stage exposure at the Double Adobe site (Fig. 7.1, Loc. 2). The exposure extends from 350 to 425 feet west of the old bridge. Artifacts were found in beds b^1 and b^2, gravel and sand. (Long dashed lines indicate laminated sand.)

must have settled in a pond formed by damming of the stream. Three beds of massive silt (d$^{1-3}$, Fig. 4.8) overlie the pond clay; the middle bed d^2 in particular is almost white from caliche. Inasmuch as the calichification is Altithermal in age, the silts themselves are from the earlier transition from subhumid to semiarid conditions. These interpretations support the view that the Cazador artifacts derive from the pluvial. No bones of extinct mammals have been found with these artifacts. The overlying dark brown cienega clay and yellow-cream silt (beds e, f, Fig. 4.8) are the same as the upper beds in the east portion of the exposure (beds e, f, Fig. 4.6).

Cazador stage artifacts have been found from 350 to 425 feet west of the old highway bridge (Fig. 7.1, Locality 2) and Sulphur Spring stage tools from 100 feet east to 200 feet west of the same bridge (Fig. 7.1, Localities 3, 4, 5). Both the Cazador and Sulphur Spring stage artifacts are found in sand and gravel lying directly on the bedrock clay. The Cazador stage, however, is stratigraphically later than the Sulphur Spring stage (see Chapter 8).

The prehistoric people camped along a permanent stream. The artifacts and the charcoal from their fires were incorporated in the gravel and sand of the stream bed. However, the overlying pond deposits, a massive blue clay at the Cazador site (bed c, Fig. 4.8) and a laminated cream silt-clay at the Sulphur Spring station (bed c^1, Fig. 4.6) are distinctly different and could not have accumulated in the same pond. The Cazador site is separated from the Sulphur Spring site by a broad and gradual boundary zone extending from about 200 to 350 feet west of the old bridge. There is no sharp or definite line of demarcation between them, such as occurs between beds separated by arroyo cutting. This circumstance provides additional evidence that the Cazador stage artifacts and the overlying clay were not deposited in a dry-climate arroyo.

The conditions we observed suggest the following sequence of events. The preservation of the mammoth jaw in the Sulphur Spring beds (Fig. 4.6) could only have been brought about by rapid burial under a few feet of sediments. Therefore, either bed c^2 accumulated beyond its preserved surface and was later reduced by sheet erosion just before clay bed d was deposited, or bed d was laid down shortly after the burial of the mammoth jaw. The filling of the old stream channel, whose probable course is shown in Figure 7.1A, a, suggests that the climate changed from dry subhumid to semiarid (Antevs 1955a: 318). This event took place during the transition to the Datil Drought as explained in the preceding section.

During the moderate drought itself there may have been mainly soil formation. Later, however, the stream began again to incise its bed. The new channel (Fig. 7.1 B) followed a

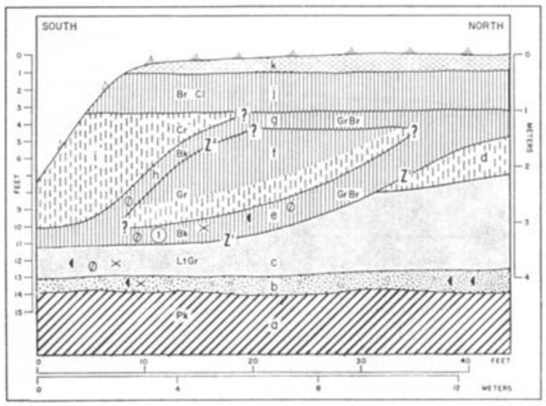


Fig. 4.9. Section of GP Pearce 8:21 (Fig. 6.2, Site 32). Sulphur Spring stage artifacts have been found in beds b and c; Cazador stage artifacts, in bed e. Encircled number 1 marks the site of the diatom sample. The profiles shown in this figure and in Figure 4.10 are based on excavations made in 1937-1938 (Sayles and Antevs 1941), and confirmed by subsequent observations.

different course from the old one. It, too, was lowered into the pink base clay. The entrenchment brought about by the increased erosive power of the stream indicates a swing of the climate back to subhumid. This change, following the moderate Datil Drought, introduced the Double Adobe II Subpluvial that began about 10,800 years ago (Fig. 4.5). While the stream at Double Adobe was permanent, Cochise men of the Cazador stage camped along its bank, possibly 9000 or more years ago.

Following the definition of the Cazador stage, the data from all sites previously identified with the Sulphur Spring stage was re-examined. Two of these sites overlain by later stages were re-investigated, resulting in the identification of the Cazador stage directly superimposed on the Sulphur Spring stage. GP Pearce 8:21 is located 3.5 miles north and 1.25 miles west of Double Adobe (Fig. 6.2, Site 32). Sulphur Spring stage artifacts occur in rusty gravel resting on the old pink clay and in the next overlying light gray sand that ranges from coarse to silty (beds b, c, Fig. 4.9). Charcoal is found with the artifacts, and numerous shells of a large freshwater mussel (*Uniomeris*?) and a small clam (*Sphaerium aureum* Prime) occur in the sand (H. G. Richards in Sayles and Antevs 1941: 67). The people camped on a perennial stream.

Probably much later, erosion took place (Z^1, Fig. 4.9). Then a black to gray-brown massive clay was deposited. In this bed (e, Fig. 4.9) were found shells of large mussel and small clam, a well-developed diatom flora of 17 species (Ruth Patrick in Sayles and Antevs 1941: 69-70), charcoal, and artifacts. The latter include a leaf-shaped point (Sayles and Antevs 1941, Pl. 11b) that may be either Cazador or Chiricahua stage. However, since the diatoms and molluscs show that the clay was deposited in a permanent pool or pond, the artifacts are of pluvial age and represent the Cazador stage. After some time a brownish massive silt grading into clay settled in the pond (bed f, Fig. 4.9). Large mussels, small clams, and small snails were still present.

The two lower artifact-bearing beds (b, c) at GP Pearce 8:21 (Fig. 4.9) represent the Double Adobe I Subpluvial (Sulphur Spring stage), and bed d, the transition to the Datil Drought. Erosion Z^1 and beds e and f record the Double Adobe II Subpluvial. Bed g is a gray-brown massive clay, probably part of a soil; bed h is a black to brown massive clay, a pond or pool deposit. The relationships of bed h to the clays in Beds e and g could not be made out in the exposures in 1938, 1940, or 1950, because the beds are so alike that they merge at the junctions. This problem is of little importance, however, for the history of the section after deposition of bed f has no bearing on the age of the lower beds and their artifacts.

Arizona FF:10:5 (GP Pearce 8:10; Fig. 6.2, Site 33) is located 2.6 miles north and 1.75 miles west of Double Adobe in the east-side arroyo wall (Sayles and Antevs 1941: 48). This prehistoric camp was used under changing climatic conditions, for the artifacts occur in beds ranging in texture from gravel to clay (a, b, e, f, Fig. 4.10). The lack of uniformity of the beds may be a consequence of both uneven deposition and later stream erosion. Bed e, a dark gray-

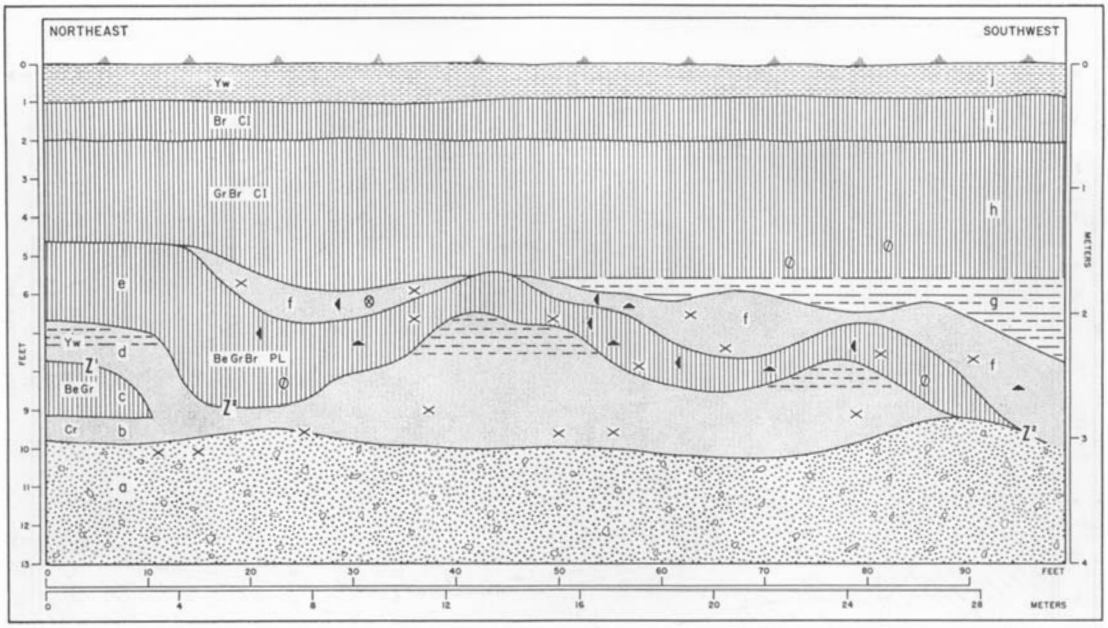


Fig. 4.10. Profile of Arizona FF:10:5 (GP Pearce 8:10; Fig. 6.2, Site 33). Beds a and b represent the Sulphur Spring stage, and beds e and f the Cazador stage. (See Fig. 4.9.)

brown or bluish massive clay, may have been formed in a dammed pond, for the underlying beds are sandy silt and sand that would not hold water in small pools. Moreover, the presence in the clay of numerous shells of a small freshwater clam and a freshwater snail (*Sphaerium aureum* Prime and *Physa virgata* Gould; H. C. Richards in Sayles and Antevs 1941: 66-67), as well as fish vertebrae, shows that there was a permanent stream at the site. The stream remained perennial for some time, as shown by the partly overlying bed g that extends for fully 50 feet southward. Bed g is a yellow sediment consisting of alternating laminae of silt and clay that indicate deposition in a permanent pond. The conditions of formation of beds e and g show that the artifacts are of pluvial age. A radiocarbon date of 6210 ± 450 years ago (C-511; Libby 1955: 113) obtained on charcoal from the base of bed b (Fig. 4.10) cannot represent the actual age of the bed, for it assigns a deposit laid down in a permanent stream to the time of the culmination of the Long Drought.

Although the site was not completely excavated, collections and observations made by Arizona State Museum personnel (first by E. W. Haury and later by E. B. Sayles) indicate that tools from the upper beds e and f represent the Cazador stage and from the lower beds a and b the Sulphur Spring stage.

Chiricahua Stage

The artifact assemblage of the Chiricahua stage includes some types comparable to those in earlier stages, as well as some first appearing in the Chiricahua stage. Chiricahua differs from its predecessor, the Cazador stage, by a greater frequency and variety of flaked stone implements. The Chiricahua stage is the first postpluvial period of the Cochise culture as now defined, and artifacts are associated with modern mammals.

The geological occurrence of Chiricahua artifacts is especially well shown in the arroyo of Wet Leggett (33° 40' N. Lat.; 108° 45' W. Long.; Figs. 6.3, Site 35; 9.5), west of Reserve in west central New Mexico (Martin, Rinaldo, and Antevs 1949: 35, 49, 55-57, 61, 70). The artifacts were found in gravel left in the arroyo after the fine debris had been flushed out; they also occurred in overlying silty arroyo fill. There is evidence in this valley for only one prominent arroyo erosion

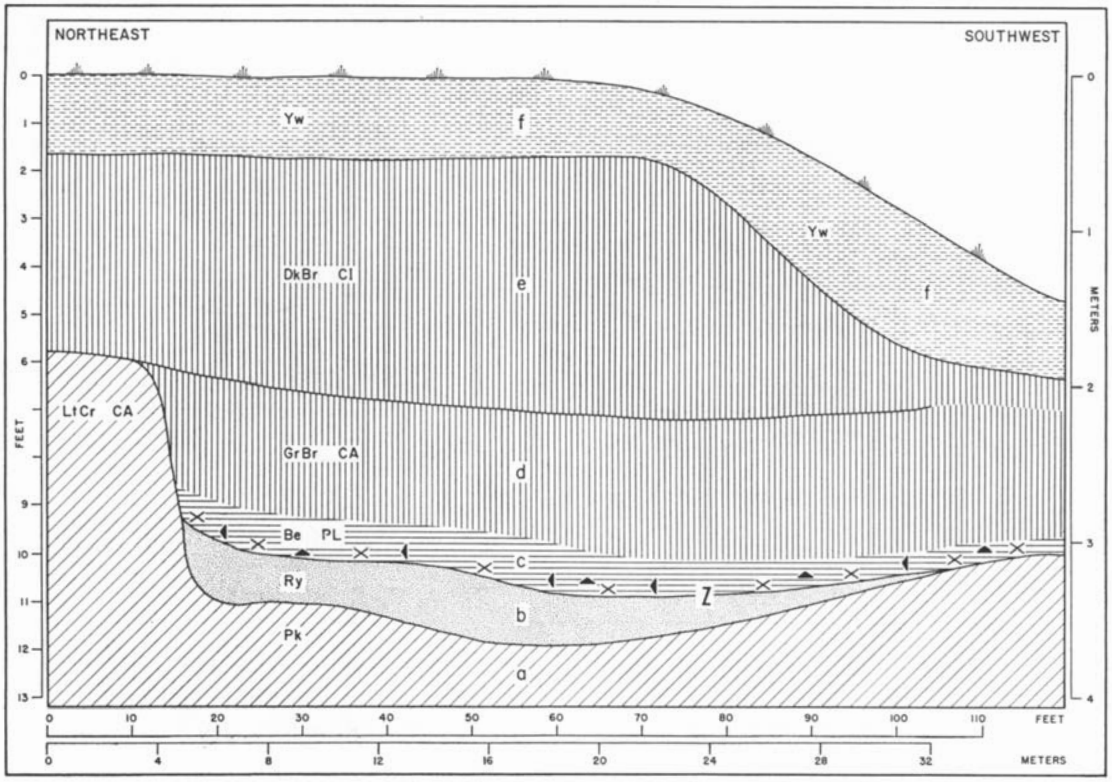


Fig. 4.11. Profile of Arizona FF:10:7 (GP Sonora F:10:30; Fig. 6.2, Site 36). Chiricahua stage artifacts were found in charco clay c.

and that apparently took place during the Long Drought. Therefore, these artifacts derive from the Altithermal and from the subsequent transition to the relatively moister Medithermal (Martin, Rinaldo, and Antevs 1949: 49, 57).

The most important occurrences of artifacts were in charco clay, that is, in a clay deposited in a depression in the arroyo floor from muddy water left after arroyo runs. Apparently the prehistoric people camped by charcos.

Another charco site is Arizona FF:10:7 (GP Sonora F:10:30; Fig. 6.2, Site 36), located one mile north and 0.6 mile west of Double Adobe, in the east-side arroyo wall. The section is shown in Figure 4.11. Bed c, which rests on an uneven surface, is a blue pool or charco clay. The lower portion of this bed contains Chiricahua stage artifacts, broken hearthstones, and charcoal, identified as *Populus* by T. L. Smiley. Bed d is a gray-brown, silty clay with caliche nodules. Bed e appears to be comparable to bed f, or beds f and g, in the San Simon cienega profile (Fig. 4.4). Thus, the artifacts and remains of hearths in charco clay c at Arizona FF:10:7 (Fig. 4.11) may derive from the Altithermal.

Another Chiricahua stage site, GP Sonora F:10:26, is 4.5 miles northwest of Douglas and 0.4 mile south of an old bridge across Whitewater Draw, in the west-side arroyo wall (Figs. 4.12; 6.2, Site 42). Its profile is variable, but that shown in Figure 4.12 is representative. The artifacts occur sparingly in gravel (bed c) and in great numbers in the blue-gray massive clay (bed d). Although no cross section of an old arroyo was observed, the clay of bed d probably is a charco clay. The silty clay in bed b appears to be practically impervious. Beds c and e are residual arroyo gravels.

Chiricahua stage artifacts also occur beneath the northern part of the San Simon cienega in a massive clay-silt deriving from the transition to the Medithermal (Arizona

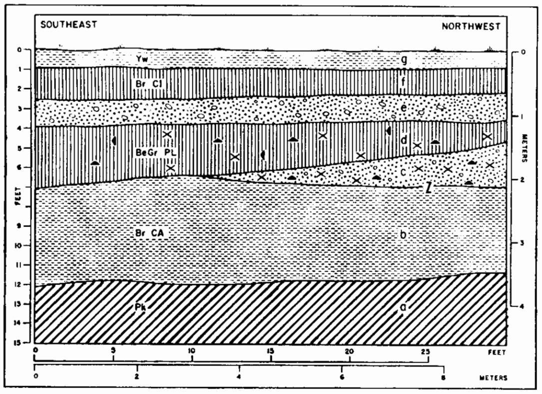


Fig. 4.12 Section of GP Sonora F:10:26 (Fig. 6.2, Site 42). Chiricahua stage artifacts occurred in arroyo gravel (c) and charco clay (d).

CC:16:3; GP San Simon 9:6; Fig. 4.4 B, b). A large number of Chiricahua grinding tools and many chipped implements were found in and mostly beneath peat at GP Chiricahua 3:16 near Portal, Arizona (Figs. 6.2, Site 61; 9.2).

The Chiricahua stage lasted from late Anathermal to early Medithermal, perhaps from 8000 to 3500 years ago (6000 to 1500 B.C.; Fig. 4.5). Two radiocarbon dates that bear on this cultural stage fall in the later portion of this time span: 4006 ± 270 B.P. (C--515; Libby 1955: 113) obtained on charcoal from the charco clay at Arizona FF:10:4 (GP Sonora F:10:31; Fig. 6.2, Site 35; Sayles and Antevs 1941, Fig. 16); 4508 ± 680 B.P. (C-556; Libby 1955: 113) based on charcoal from the silty arroyo fill on the Wet Leggett. Comparative stratigraphic position indicates that the former sample, dated at 4006 years ago, must be the older of the two. It may well date much more than 4000 years ago. The Wet Leggett date of 4508 B.P. may be correct, but probably is too old.

San Pedro Stage

The assemblage of artifacts for the San Pedro stage includes some types comparable to those in the Chiricahua stage and pressure-flaked projectile points; percussion-flaked and pressure-flaked scrapers, axes, and knives; deep-basin milling stones; large handstones; mortars; and pestles. The cultural features that set this stage apart from the earlier stages, however, are houses and storage pits.

On the Wet Leggett in west central New Mexico (Fig. 6.3, Site 35), it became evident that Chiricahua artifacts occurred not only in the deposits on the floors of Altithermal arroyos, but also in the silty arroyo fill representing the transition to the relatively moister Medithermal (Martin, Rinaldo, and Antevs 1949: 46-47, 49, 55, 61, 70). I therefore concluded (Wormington 1949: 90) that the arroyos in which the San Pedro sites occur must represent a hitherto unrecognized sharp drought, perhaps dating about 1000 B.C. Later, this drought, recorded at the Fairbank site (Arizona EE:8:1; GP Benson 5:10; Fig. 6.2, Site 5) and named the Fairbank Drought (Sayles and Antevs 1941: 21-23; Antevs 1955a: 330), was radiocarbon-dated at 513 B.C. (C-519; Libby 1955: 113). This date is acceptable.

A particularly instructive site is Arizona FF:6:2 (GP Pearce 8:8; Figs. 4.13; 6.2, Site 30), 4.5 miles north and 1.5 miles west of Double Adobe (Sayles and Antevs 1941, Fig. 18). San Pedro stage artifacts were collected from an early gravel (bed d, Fig. 4.13) and a plainware potsherd was found in a later gravel (bed f, Fig. 4.13). The section shows three erosions: Z^1, probably caused by the Fairbank Drought of about 500 B.C.; Z^2, brought about by the Whitewater Drought of perhaps A.D. 330; and Z^3, induced by the Great Drought of A.D. 1276-1299 (Antevs 1955a: 329-30).

Another site, GP Sonora F:10:41 (Figs. 4.14; 6.2, Site 41), is located 6.5 miles northwest of Douglas or 5.5 miles southeast of Double Adobe, in the east-side arroyo wall. An erosion trench (Z^1), 7 feet deep and 30 feet wide, cut in a brown, faintly laminated clay (bed a, Fig. 4.14), was later filled by current-bedded fine sand and silt (bed b^1).

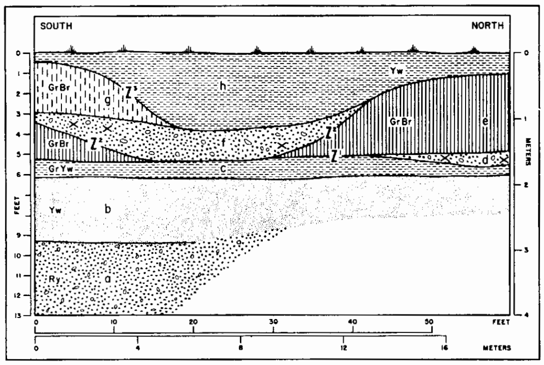


Fig. 4.13. Profile of GP Pearce 8:8 (Arizona FF:6:2; Fig. 6.2, Site 30). This exceptional section shows three erosions: Fairbank, Whitewater, and Great Pueblo (Sayles and Antevs 1941, Fig. 18). San Pedro stage artifacts were found in bed d; a plainware sherd was in bed f.

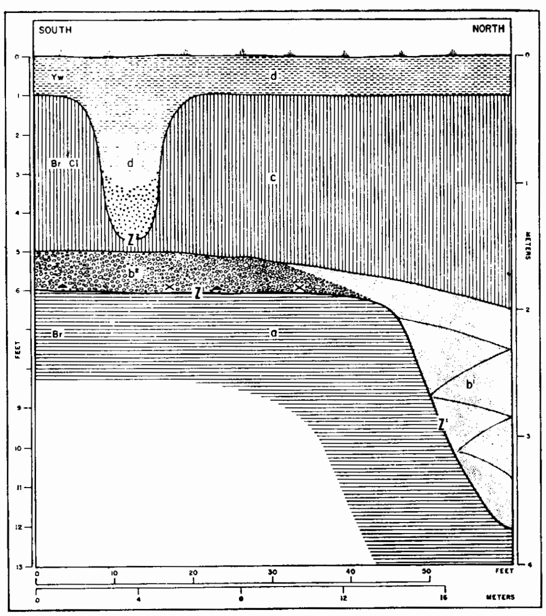


Fig. 4.14. Section at GP Sonora F:10:41 (Fig. 6.2, Site 41). San Pedro stage artifacts were found in gravel b^2.

The brown clay south of this channel cut was overlain by coarse gravel (bed b^2), 8 inches thick. A milling stone and handstone of the San Pedro stage were found in this gravel. The gravel and arroyo fill were covered by 4 to 6 feet of brown massive cienega clay that is somewhat pebbly in parts (bed c). This clay, in turn, was channeled by an erosion trench 4 feet deep and 12 feet wide (Fig. 4.14, Z^2) that was filled with some gravel and sand, but mostly with a distinctive cream silt (bed d). It is similar to the silt in bed h at Arizona FF:6:2 that was deposited between A.D. 1300 and 1885. Therefore, erosion Z^1 and Bed b^2 are moderately old and the erosion may have been caused by the Fairbank Drought. The artifacts probably date from about 500 B.C.

SUMMARY

The temperature rise that began some 12,500 years ago, according to geological and biotic data in northern Europe, Canada, and the Atlantic, seems to be recorded in the pollen graph obtained in west central New Mexico (Clisby and Sears 1956), where this comparatively warm period was also moderately dry. This probably semiarid breach in the Provo Pluvial, named the Datil Drought, is thought to have exterminated the mammoth in the Southwest. It was succeeded by a renewal of cool and moist climatic conditions.

At Double Adobe in southeastern Arizona the transition to the Datil Drought, the drought itself, and the subsequent return of moist climate are represented by silt deposition, probable soil formation, and stream entrenchment. These events and processes intervene between two separate pond sediments. Sulphur Spring stage artifacts occur at Double Adobe in pluvial pond deposits below a mammoth jaw found in situ. They predate the Datil Drought and were made during the Double Adobe I Subpluvial (Fig. 4.5). Cazador stage artifacts, on the other hand, are found in pluvial deposits formed in ponds *after* the Datil Drought and date from the Double Adobe II Subpluvial. Thus, the Sulphur Spring stage artifacts at Double Adobe, Localities 3, 4, and 5, could be as much as 12,500 years old; the Cazador stage artifacts in the western part of the same exposure, Locality 2, could be no more than about 9000 years old.

Chiricahua stage artifacts occur both in Altithermal arroyo-floor deposits and in silty arroyo fill that accumulated during the transition to the less arid Medithermal. The time boundaries of the stage have been placed at 8000 and 3500 B.P. (6000-1500 B.C.). Datable San Pedro stage artifacts are mainly present in camps maintained during a dry Medithemal interval, the Fairbank Drought, radiocarbon-dated at 500 B.C. At about the time of Christ the introduction of pottery initiated a new cultural stage. The San Pedro stage has been assigned the time span from 1500 B.C. to the beginning of the Christian era (see Figs. 4.5 and 6.1).

Summarized below are the principal environmental conditions for the four cultural stages.

Sulphur Spring stage. The temperature was lower and the rainfall heavier than at present. Vegetation was ample. Whitewater Draw was a perennial stream, and Cochise people camped on its banks, using ash, oak, hickory, yellow pine, and cottonwood as fuel. Pleistocene mammals, including the mammoth, ranged the valley. However, the climate turned warmer and drier during the semiarid Datil Drought, and vegetation became relatively scarce, causing extinction of the mammoth in the Southwest.

Cazador stage. The climate was again comparatively cool and moist, and the vegetation ample. The Whitewater flowed throughout the year and Cochise people camped along its side. In time, however, the temperature rose and the precipitation decreased, gradually introducing the very warm and dry Long Drought or Altithermal. The resulting reduction of forage and water caused the extinction of those Pleistocene mammals that had managed to survive the modern Datil Drought.

Chiricahua stage. The climate was distinctly warmer and drier than at present. Vegetation was much reduced, and, as a consequence, occasional heavy rains tore up the valley floors and cut arroyos. The mammals of the period were all of modern species. Chiricahua people camped on gravel banks and by charco pools in the arroyos. Dry conditions endured for a long time, but finally the rainfall increased, the arroyos filled with silt, and the vegetation grew denser.

San Pedro stage. The climate was at first semiarid or possibly dry subhumid, and vegetation was adequate. Then a sharp drought set in, the Fairbank Drought, soon followed by a return of the semiarid climate. Most of the San Pedro camps found were maintained during the Fairbank Drought.

ADDENDUM

(E. B. Sayles)

The geologic-climatic reconstruction presented here and elsewhere (Antevs 1955a, 1955b) has been challenged by the ecologist, Paul Schultz Martin, who has presented an essentially contrary climatic history on the basis of pollen studies in southern Arizona (Martin, Schoenwetter, and Arms 1961). The main points of contradiction and the problems raised are discussed in an article in *American Antiquity* (Antevs 1962). Martin (1963a) has presented additional comments in the same journal and the University of Arizona Press has published a revised edition of the Martin-Schoenwetter-Arms study (Martin 1963b). On the whole, however, Martin and his associates have not presented sufficient evidence to cause any major changes in the reconstruction set forth in this chapter.

5. RADIOCARBON DATING

William W. Wasley and E. B. Sayles

The original dating of the Cochise culture was based on the climatic sequence related to geological sediments representing the past 10,000 years or more, following the peak of the pluvial of 20,000 years ago. Archaeological contexts of the sediments representative of climatic changes were designated as cultural stages; the early stages took place before the introduction and development of agriculture, pottery, and town life that evolved during the past 2000 years or more in the greater Southwest (Sayles and Antevs 1941: 33-55, Fig. 19).

Since publication of *The Cochise Culture* by Sayles and Antevs in 1941, the large amount of archaeological research carried on in the Southwest, particularly at Ventana Cave (Haury 1950), and in the Cochise area proper has contributed much toward a fuller definition of the Cochise culture. Additional studies over a wide area have demonstrated the significance of these early stages of Southwestern prehistory. While the geological age of the basic sequence, determined from the initial research on the Cochise culture, remains firm, the context of the stages has been clarified by additional work and by the definition of early hunting in the Llano complex. The geological age of the Cochise culture has been refined by radiocarbon dating, a technique developed since the first discoveries of the Cochise culture were made beginning in 1926.

Radiocarbon dates bearing on the Cochise culture range from 12,000 years ago to the historic period. The earliest dates from samples associated with Cochise remains are identified with the Cazador stage, ranging from 8000 to 9000 years ago. The earlier Sulphur Spring stage has no associated datable radiocarbon, but dates related to it by climatic and cultural events indicate that it may be several thousand years older than any date presently associated directly with the Cochise culture. These dates are shown in Tables 5.1-5.4, along with the related and inferred dates. The B.P. dates, derived from a 1950 base, have been listed as suggested in the editorial statement by Flint and Deevey (1962).

SULPHUR SPRING STAGE
(Table 5.1)

No radiocarbon dates have been derived from samples associated with sediments in which Sulphur Spring stage artifacts have been identified with extinct fauna. The dates heretofore published identified all samples originating from the Double Adobe area (Arizona FF:10:1; GP Sonora F:10:1) with the Sulphur Spring stage, regardless of the specific locations from which they came and their identity with other stages (see Fig. 7.1).

One published date, C-511, 6210 ± 450 B.P. (Libby 1955: 113; first published in 1951, *Science* 13: 116) is inconsistent with the archaeological and geological record; Libby identified it as from a Sulphur Spring site, overlain by a Cazador site (Fig. 4.10, Arizona FF:10:5, GP Pearce 8:10).

Three radiocarbon dates, C-216, A-67, A-67 bis, previously published as associated with the Sulphur Spring stage, came from samples subsequently identified with later geological strata and with the Cazador stage; they are listed in Table 5.2.

Radiocarbon dates that have some bearing on the probable age of the Sulphur Spring stage are those identified with the hunting complexes found within the Cochise area. For example, at Ventana Cave (Haury 1950: 62-67) handpicked charcoal (A-203) from Bed 5-B, volcanic ash, representing the earliest occupation level with Pleistocene megafauna (Damon and Long 1962: 246), yielded a date of 11,300 ± 1200 B.P. The wide range given indicates that the earliest occupation of the site may have occurred between 9,000 and 12,000 years ago. Additional information concerning the age of the early sediments in Ventana Cave is reported by Colbert (1973: 25-33). The jaw bone of a horse was excavated by Julian Hayden in November, 1969, from the volcanic ash layer (the earliest archaeological association) lying above the conglomerate that formed the floor of the cave; the lower conglomerate contained the bones of fossil fauna: "a bone chip sample from the conglomerate yielded a C-14 date of 12,300±300 B.P. (G-X-1896), which is stratigraphically consistent with the age from the volcanic debris" (Haury and Hayden 1975).

The association of artifacts with extinct fauna at Ventana Cave and in Sulphur Spring stage deposits indicates contemporaneity within the same geological period. There are also analogies between the early tool assemblages at Ventana Cave and those of the Cochise culture, and further relationships occur in the following Chiricahua and San Pedro stages.

Geological relationships with early hunting complexes found within the Cochise area proper also include the Llano complex in the San Pedro valley. Radiocarbon dates from the Lehner site (Arizona EE:12:1) are compatible, but the much later date at the Naco site (Arizona FF:9:1) is inconsistent and may be due to variants in the dating methods.

CAZADOR STAGE
(Table 5.2)

Dates from the type site, Locality 2, Double Adobe area (Arizona FF:10:1; GP Sonora F:10:1) range from 7030±260 B.P. to 9350±160 B.P. from three samples, with varying dates derived from different processing. Inferred dates from Double Adobe I (Arizona FF:10:1; GP Sonora F:10:1) are from four samples with varying dates resulting from different processing, ranging from 8000±140 B.P. to 8960±100 B.P. A single sample from the Murray Springs area with varying dates of 8250±200 B.P. (A-69) and 8270±260 B.P. (A-69 bis), is within the range of Cazador dates, but has no associated archaeological remains. A range of 8000 to 9000 B.P. seems consistent with the geological-archaeological records of the Cazador stage.

CHIRICAHUA STAGE
(Table 5.3)

Only two sites within the Cochise area proper have provided radiocarbon samples from Chiricahua stage deposits; the dates range from 7000 to 4000 years ago and there is a wide variance in dates with both geological and archaeological associations from the Wet Leggett site, Pine Lawn, New Mexico. Geological correlation is also established with the dates from Murray Spring in the San Pedro Valley (Arizona EE:8:13), with superimposed dates of 4120 and 5280 years ago. Older dates came from Bat Cave in New Mexico—5605 overlying 5931 years ago, both correlated with the Chiricahua stage. An earlier date of 6880 years ago from Grants, New Mexico, is associated with a variant Pinto-Gypsum-Chiricahua assemblage.

Other dates related by geology and archaeology from the Cienega site, Point of Pines (Arizona W:10:112), show a younger range from 4000 years ago to shortly before the time of Christ. The younger dates are also represented in other nonceramic contexts that have been correlated with the Cochise culture. Tularosa Cave, New Mexico, dates from 2300 to 2080 years ago. O Block Cave, similar in archaeological context to Tularosa Cave, is comparable to the Chiricahua stage and has a date of 2780 years ago. Santa Ana, New Mexico, provided a series of dates ranging from 3330 to 2600 years ago.

The scattered clustering of dates associated with the Chiricahua stage may be a result of the re-occurring erosion cycles that took place during that period, 8000 to 4000 years ago. Within the Cochise area proper, the desert grassland, the archaeological evidence records only the presence of small groups, with no long permanent occupation such as occurred later in the San Pedro stage.

In the mountainous areas of Arizona and New Mexico, where cultural assemblages have been assigned to the Chiricahua stage, the radiocarbon dates have been uniformly more recent. These dates are considered consistent with those in the desert grasslands on the basis that in these mountain areas, specifically the Point of Pines region in Arizona and the Pine Lawn Valley in New Mexico, the Chiricahua stage of cultural development persisted longer than in southeastern Arizona, and may represent the transition to the San Pedro stage.

SAN PEDRO STAGE
(Table 5.4)

Radiocarbon dates associated and related with the San Pedro stage range from about 3500 years ago to the beginning of the Christian era.

Related dates from the Matty Canyon-Cienega Creek area (Arizona EE:2:30, 35) furnish a long series from 1350 B.C. (A-86-Average) to A.D. 100 (Sh-5358). The latter date is younger than the clustering of dates but is consistent with other later dates such as those from the Point of Pines area (Arizona W:10:112) with a range of 1430 B.C. to well within the Christian era. However, the latest dates from the Point of Pines area are inconsistent--they fall well within the time period of the Hohokam culture that was nearing its peak at that time.

Some of the later dates identified with the Chiricahua stage and in associations related to that stage, may actually represent the transition to the San Pedro stage that had taken place within the Cochise area proper (the desert grasslands). The specific stage identity with the late stages of the Cochise sequence is less significant than the fact that the cultural contexts during this time period are comparable, with regional variations.

Table 5.1

Radiocarbon Dates for the Sulphur Spring Stage

Sample Number	B.P. Date (B.C. Date)	Site	Remarks
Associated dates			
None			
C-511	*6210 ± 450 (4260 B.C.)	Inconsistent with geological record	Charcoal; reported by Libby (1955: 113) as Sulphur Spring date.
Related dates		Llano	
A-33	*7133 ± 350 (5183 B.C.)	Lehner Site, Arizona EE:12:1	Carbonaceous material from black swamp soil overlying hearths, bone bed, and artifacts (Wise and Shutler 1958: 73). Inconsistent with range of Llano dates.
A-33 bis	10,410 ± 190 (8460 B.C.)	Lehner Site, Arizona EE:12:1	Same sample as A-33 but date derived by CO_2 method (Damon and Long 1962: 243).
A-40a	*12,000 ± 450 (10,050 B.C.)	Lehner Site, Arizona EE:12:1	Charcoal and sand collected from Hearth 2, Sample 4 (Wise and Shutler 1958: 73).
A-40b	*10,900 ± 450 (8950 B.C.)		
A-378	*10,940 ± 100 (8990 B.C.)	Lehner Site, Arizona EE:12:1	Fragmented charcoal handpicked from levels i and j just west of the westernmost limit of excavation (Haury, Sayles, and Wasley 1959: 6, 12). Date not previously published.
M-811	11,290 ± 500 (9340 B.C.)	Lehner Site, Arizona EE:12:1	Charcoal from Hearth 2 (Crane and Griffin 1959: 190; Haury, Sayles, and Wasley 1959: 24-25).
K-554	11,170 ± 140 (9220 B.C.)	Lehner Site, Arizona EE:12:1	Charcoal from Hearth 2 (Tauber 1960: 23, computed from a 1950 base; Haury, Sayles, and Wasley 1959: 24-25).
A-42	11,240 ± 190 (9290 B.C.)	Lehner Site, Arizona EE:12:1	Same sample as K-554 (Damon and Long 1962: 243).

Table 5.1 - continued

A-9, 10	*9250 ± 300 (7300 B.C.)	Naco Site, Arizona FF:9:1	Fragmented charcoal in clay matrix surrounding mammoth bones. Combined samples (Wise and Shutler 1958: 73; Haury, Antevs, and Lance 1953). Inconsistent with range of Llano dates.
		Ventana Cave	
A-203	11,300 ± 1200 (9350 B.C.)	Ventana Cave, Arizona Z:12:5	Handpicked charcoal from matrix of Bed 5-B, lower member, volcanic debris layer (Haury 1950: 62-67), the earliest occupation level, and the youngest level containing Pleistocene megafauna (Damon and Long 1962: 246).
G-X-1896	12,300 ± 300 (10,350 B.C.)	Ventana Cave, Arizona Z:12:5	Colbert (1973: 25-33), bone chips from earliest geological level, containing Pleistocene megafauna.

*Dates obtained by the solid carbon, or black carbon, method.

Table 5.2

Radiocarbon Dates for the Cazador Stage

Sample Number	B.P. Date (B.C. Date)	Site	Remarks
Associated dates			
A-184C	8240 ± 960 (6290 B.C.)	Double Adobe Site, Arizona FF:10:1 (Fig. 7.1, Loc. 2)	Charcoal handpicked from sand. A-184E is the soil fraction with organic content minus the handpicked charcoal.
A-184E	7030 ± 260 (5080 B.C.)		
C-216	*7756 ± 370 (5806 B.C.)	Double Adobe Site, Arizona FF:10:1 (Fig. 7.1, Loc. 2)	Collected prior to excavation of site. Charcoal-bearing dirt. Reported by Libby (1955: 112-13) as Sulphur Spring stage.

Table 5.2 - continued

A-67	*8200 ± 260 (6250 B.C.)	Double Adobe Site, Arizona FF:10:1 (Fig. 7.1, Loc. 2)	Same area as above; collected before excavation of Loc. 2 (Wise and Shutler 1958: 73).
A-67 bis	9350 ± 160 (7400 B.C.)	Double Adobe Site, Arizona FF:10:1 (Fig. 7.1, Loc. 2)	Same sample as above but derived by CO_2 method (Damon and Long 1962: 244).
Inferred dates			
A-69	*8250 ± 200 (6300 B.C.)	Murray Springs, Arizona EE:8:13	Heavily carbonaceous earth, overlying clay containing mammoth bones and underlying silt containing Cochise artifacts. The carbonaceous earth is from a local pond deposit similar to that overlying the bone bed at the Lehner site (Haury, Sayles, and Wasley 1959: 12, 25).
A-69 bis	8270 ± 260 (6320 B.C.)	Murray Springs, Arizona EE:8:13	Same sample as A-69 but date derived by CO_2 method (Damon and Long 1962: 245).
A-189	8960 ± 100 (7010 B.C.) 8680 ± 100 (6730 B.C.)	Double Adobe area, Arizona FF:10:1, +Double Adobe I (North wall)	Charcoal from horizon equated with Martin's Pollen Zone IV (Martin, Schoenwetter, and Arms 1961: 56a; Damon, Long and Sigalove 1963). The younger date was derived from the total soil with some disseminated charcoal.
A-190	7910 ± 200 (5960 B.C.)	Double Adobe area, Arizona FF:10:1, +Double Adobe I (South wall)	Carbonaceous earth sample from Martin's Pollen Zone IV (Martin, Schoenwetter, and Arms 1961: 56a; Damon, Long, and Sigalove 1963).
A-191	8000 ± 60 (6050 B.C.)	Double Adobe area, Arizona FF:10:1, +Double Adobe I (North wall)	Carbonaceous earth representing the base of Martin's Pollen Zone IV (Martin, Schoenwetter, and Arms 1961: 56a; Damon, Long, and Sigalove 1963).

Table 5.2 - continued

A-188C	8270 ± 250 (6320 B.C.)	Double Adobe area, Arizona FF:10:1,	Charcoal handpicked from soil matrix, and equated with Martin's Pollen Zone IV (Martin, Schoenwetter, and Arms 1961: 56a; Damon and Long 1962: 244). A-188E is the total soil with visible but minute specks of charcoal.
A-188E	8260 ± 160 (6310 B.C.)	+Double Adobe I (North wall)	

*Dates obtained by the solid carbon, or black carbon, method.
+Double Adobe I, see Chapter 12.

Table 5.3

Radiocarbon Dates for the Chiricahua Stage

Sample Number	B.P. Date (B.C. Date)	Site	Remarks
Associated dates			
C-515	*4006 ± 270 (2056 B.C.)	Cochise site No. 12, Whitewater Draw, Arizona, GP Sonora F:10:31	Charcoal from Chiricahua artifact zone (Libby 1955: 113; Sayles and Antevs 1941: 52).
A-192A	7560 ± 260 (5610 B.C.)	Whitewater Draw, Arizona, GP Sonora F:10:31,	A-192A is the carbonate fraction and A-192B is the total soil organic fraction of a sample taken from the blue pond clay of the Chiricahua artifact zone (Damon and Long 1962: 244; Martin, Schoenwetter, and Arms 1961: 61-62).
A-192B	4960 ± 300 (3010 B.C.)	Double Adobe III	
A-68+	*2850 ± 200 (900 B.C.)	San Pedro River, Arizona EE:12:2	Charcoal "with artifacts tentatively identified with Chiricahua stage" (Wise and Shutler 1958: 74). Same sample as above but date derived by CO_2 method (Damon and Long 1962: 245).
A-68 bis+	1800 ± 140 (A.D. 150)		

Table 5.3 - continued

A-70	*7000 ± 265 (5050 B.C.)	San Simon Creek, Arizona CC:12:4	Carbonaceous material; probably Chiricahua stage (Wise and Shutler 1958: 74).
A-70 bis	6920 ± 160 (4970 B.C.)	San Simon Creek, Arizona CC:12:4	Same sample as above but date derived by CO_2 method (Damon and Long 1962: 245).
Related dates			
A-186	4120 ± 490 (2170 B.C.)	Murray Springs, Arizona EE:8:13	Earth with some disseminated charcoal. Sample taken 210 cm below surface (Damon, Long, and Sigalove 1963; Martin, Schoenwetter, and Arms 1961: 61-62).
A-187	5280 ± 330 (3330 B.C.)	Murray Springs, Arizona EE:8:13	Earth with low organic content. Sample taken 270 cm below surface (Damon, Long, and Sigalove 1963; Martin, Schoenwetter and Arms 1961: 61-62).
A-19	*4310 ± 160 (2360 B.C.)	Cienega site, Arizona W:10:112	Pine and oak charcoal from hearth in Bed D-1 associated with Chiricahua stage cultural material (Wise and Shutler 1958: 73; Haury 1957: 22-24).
M-541	2530 ± 250 (580 B.C.)	Cienega site, Arizona W:10:112	Same sample as above but date derived by CO_2 method (Crane and Griffin 1958a: 1102).
A-21, 22	*3980 ± 160 (2030 B.C.)	Cienega site, Arizona W:10:112	Combined samples of highly fragmented charcoal from matrix of Bed D-1 (Wise and Shutler 1958: 73; Haury 1957: 22-24).
M-540	2400 ± 200 (450 B.C.)	Cienega site, Arizona W:10:112	Same sample as above but date derived by CO_2 method (Crane and Griffin 1958a: 1102).
L-432	2200 ± 200 (250 B.C.)	Cienega site, Arizona W:10:112	Sample sample as above; date derived by a third laboratory (Olson and Broecker 1959: 26-27).
M-461	2600 ± 250 (650 B.C.)	Cienega site, Arizona W:10:112	Scattered fragments of charcoal from Bed D-1 adjacent to samples A-21, A-22, associated with Chiricahua stage cultural material (Crane and Griffin 1958a: 1102; Haury 1957: 22-24).

Table 5.3 - continued

A-29	*4400 ± 150 (2050 B.C.)	Cienega site, Arizona W:10:112	Scattered charcoal fragments in Bed D-1 (Wise and Shutler 1958: 73; Haury 1957: 22-24).
A-29 bis	2430 ± 150 (480 B.C.)	Cienega site, Arizona W:10:112	Same sample as above but date derived by CO_2 method (Damon and Long 1962: 243).
A-27	*3070 ± 150 (1120 B.C.)	Cienega site, Arizona W:10:112	Charred, water-logged pine branch from Pit 6 that cut through Beds D-1 and D-2. A-27 bis is a recombustion of the solid carbon sample (Haury 1957: 23; Wise and Shutler 1958: 73; Damon and Long 1962: 242).
A-27 bis	3190 ± 150 (1240 B.C.)		
C-612	*2300 ± 200 (350 B.C.)	Tularosa Cave, New Mexico	Corn and vegetal material from Square 2R2, Level 13; preceramic and associated with Chiricahua type implements (Libby 1955: 112).
C-534	*2233 ± 200 (283 B.C.)	Tularosa Cave, New Mexico	Corn cobs from the lowest occupational level, Square 2R2, Level 14 (Libby 1955: 112).
C-585	*2112 ± 230 (162 B.C.) *2177 ± 225 (227 B.C.) Av. *2145 ± 160 (195 B.C.)	Tularosa Cave, New Mexico	Corn cobs and tree bark, Square 2R2, Level 10, Pine Lawn Phase (Libby 1955: 112).
M-715	2080 ± 200 (130 B.C.)	Tularosa Cave, New Mexico	Wood and plant materials from lowest occupation level, designated Tularosa I (Crane and Griffin 1960: 41).
M-717	2780 ± 200 (830 B.C.)	O Block Cave, New Mexico	Charcoal from lowest occupation level that represents same preceramic Cochise culture as in Tularosa I (Crane and Griffin 1960: 42; Martin, Rinaldo, and Bluhn 1954: 23).
C-556	*4508 ± 680 (2558 B.C.)	Antevs I, Wet Leggett Arroyo, New Mexico	Charcoal from "beds which may be either Chiricahua or San Pedro phases" (Libby 1955: 113; Martin, Rinaldo, and Antevs 1949: 58).

Table 5.3 - continued

M-250	2500 ± 350 (550 B.C.)	Santa Ana, New Mexico	Charcoal from a surface hearth in the same site as M-248. Most of the lithic material came from this hearth (Crane 1956: 670; Agogino and Hibben 1958: 424).
M-253	2600 ± 300 (650 B.C.)	Santa Ana, New Mexico	Charcoal from a large surface hearth within 125 yards of M-250 (Crane 1956: 670; Agogino and Hibben 1958: 424).
M-248	3100 ± 500 (1150 B.C.)	Santa Ana, New Mexico	Charcoal from a deeply buried site with an artifact assemblage similar to the Chiricahua-San Pedro stages of the Cochise culture (Crane 1956: 670; Agogino and Hibben 1958: 423-24).
M-249	3330 ± 300 (1380 B.C.)	Santa Ana, New Mexico	Charcoal from a stone-lined hearth 16 feet below the present surface, 150 yards south from sample M-248 (Crane and Griffin 1958a: 1102; Agogino and Hibben 1958: 423).
M-254	2900 ± 250 (950 B.C.)	Santa Ana, New Mexico	Charcoal from a hearth 19 feet below the present surface, in the same arroyo as samples M-248 and M-249 (Crane and Griffin 1958a: 1102; Agogino and Hibben 1958: 423).
M-346	6880 ± 400 (4930 B.C.)	Grants, New Mexico	Charcoal from a hearth in the old dune level at Grants 1, a San Jose site. Culture is a variant of Pinto-Gypsum-Chiricahua (Crane and Griffin 1958b: 1120; Hester and Agogino 1958: 187).
C-571	*5605 ± 290 (3655 B.C.)	Bat Cave, New Mexico	Charcoal from Area III, Section Ic, Front, 48 to 60 inch depth (Libby 1955: 112). "Chiricahua phase tools...occur with the earliest maize in the cave" (Dick 1954: 140).
C-573	*5931 ± 310 (3981 B.C.)	Bat Cave, New Mexico	Charcoal from Area III, Section Ic, Front, 60 to 66 inch depth (Libby 1955: 112). A "hearth in the buff sand, immediately below the midden bed and earliest maize" (Dick 1954: 140).

*Dates obtained by the solid carbon, or black carbon, method.

+The dates of this site (A-68, A-68 bis) are inconsistent with range of Chiricahua dates; more likely the site represents the San Pedro stage.

Table 5.4

Radiocarbon Dates for the San Pedro Stage

Sample Number	B.P. Date (B.C. Date)	Site	Remarks
Associated dates			
C-518	*1762 ± 430 (A.D. 188)	Sulphur Spring Valley, GP Pearce 8:9	Charcoal associated with San Pedro stage artifacts in Bed C (Libby 1955: 113; Sayles and Antevs 1941: 53, Fig. 17).
C-519	*2463 ± 310 (513 B.C.)	San Pedro Valley, GP Benson 5:10	Charcoal associated with San Pedro stage artifacts and features (Libby 1955: 113; Sayles and Antevs 1941: 22-23).
A-193	3860 ± 200 (1810 B.C.)	GP Pearce 8:11, Double Adobe IV	Reversed stratigraphy of A-194.
A-194	2860 ± 440 (910 B.C.)	GP Pearce 8:11, Double Adobe IV	Organic alluvium taken from 135-145 cm below bottom of "pit house" (Damon, Long, and Sigalove 1963).
Related dates			
A-51 A-51 bis	*3380 ± 200 (1430 B.C.) 3190 ± 160 (1240 B.C.)	Cienega site, Arizona W:10:112	Wet, rotten wood, presumably deposited during formation of Bed C-3. A-51 bis is a recombustion of the solid carbon material (Wise and Shutler 1958: 73; Damon and Long 1962: 242).
A-49 A-53	*2610 ± 200 (660 B.C.) *2030 ± 200 (130 B.C.)	Cienega site, Arizona W:10:112	Wet, rotten wood from Bed C-3. A-53 is a re-run of A-49 (Wise and Shutler 1958: 73).
A-25 bis A-258	2700 ± 160 (750 B.C.) 2440 ± 160 (490 B.C.)	Cienega site, Arizona W:10:112	Wood from Pit 1, Bed D-1. Wood was red and appeared to have been partly replaced by silica and limonite. A-25 bis is a recombustion of solid carbon. A-258 is the original sample prepared for the CO_2 method (Damon and Long 1962: 242-43).

Table 5.4 - continued

A-26	*3280 ± 200 (1330 B.C.)	Cienega site, Arizona W:10:112	Carbonaceous material directly above bones in Cremation 36, considered intrusive into Bed D during Bed C-3 times. A-26 bis is recombustion of the A-26 material, while A-26B was treated from an unused portion of the original sample (Wise and Shutler 1958: 73; Damon and Long 1962: 242).
A-26 bis	2490 ± 170 (540 B.C.)		
A-26B	2900 ± 150 (950 B.C.)		
A-50	*3250 ± 200 (1300 B.C.)	Cienega site, Arizona W:10:112	Wet, charred wood from Pit 8, which is intrusive into the lower part of Bed C-3. Sample A-52 is a re-run of A-50 (Wise and Shutler 1958: 73).
A-52	*3025 ± 200 (1075 B.C.)		
A-48	*2150 ± 200 (200 B.C.)	Cienega site, Arizona W:10:112	Charcoal from Cremation 42 in Pit 7, Bed C-3 (Wise and Shutler 1958: 73; Haury 1957: 23).
A-28	*2515 ± 200 (565 B.C.)	Cienega site, Arizona W:10:112	Finely divided carbonaceous material associated with cremations in Pit 3, Bed C-2. The second date is a recombustion of the solid carbon from which the first date was derived (Wise and Shutler 1958: 73; Damon and Long 1962: 241-42).
A-28	1900 ± 160 (A.D. 50)		
A-20, A-23	2100 ± 150 (150 B.C.)	Cienega site, Arizona W:10:112	Charcoal from Pit 3, Bed C-2, two samples combined (Damon and Long 1962: 242).
M-462	1140 ± 300 (A.D. 810)	Cienega site, Arizona W:10:112	Fragmented solid charcoal from matrix of Pit 3, Bed C-2, distributed between cremations. Small sample, probably inadequate (Haury 1957: 22-23; Crane and Griffin 1958a: 1102; Damon and Long 1962: 242).
Sh-5664a+	1940 ± 170 (A.D. 10)	Matty Canyon, Arizona Section MC-5	Cienega; decayed plant material from Unit 3, M_1 marker bed, upper cienega stratum (Eddy and Cooley 1964).
Sh-5664b	1760 ± 190 (A.D. 190)		
Sh-5664 Av.	1860 ± 130 (A.D. 90)		

Table 5.4 - continued

A-88A	*2980 ± 300 (1030 B.C.)	Matty Canyon, Arizona Section MC-5	Same type of material from same locus as sample Sh-5664 (Shutler and Damon 1959: 61; Eddy and Cooley 1964).
A-88B	*2740 ± 250 (790 B.C.)		
A-88 Av.	*2860 ± 210 (910 B.C.)		
A-88 bis	2010 ± 150 (60 B.C.)	Matty Canyon, Arizona Section MC-5	A recombustion of the solid carbon sample A-88 (Damon and Long 1962: 245).
Sh-5665+	2470 ± 200 (520 B.C.)	Matty Canyon, Arizona Section MC-5	Cienega material from Unit 3, M_2 marker bed, lower cienega stratum (Eddy and Cooley 1964).
A-92	2220 ± 150 (270 B.C.)	Matty Canyon, Arizona Section MC-5	Same type of material from same locus as sample Sh-5665 (Damon and Long 1962: 245; Eddy and Cooley 1964).
A-196	2190 ± 100 (240 B.C.)	Matty Canyon, Arizona Section MC-5	Cienega material collected from the 3E-3F boundary, representing the top of the lower cienega stratum, M_2 marker bed (Damon, Long, and Sigalove 1963; Eddy 1958: 143).
A-74	*1950 ± 250 (A.D. 1)	Matty Canyon, Arizona EE:2:30	Charcoal from Test 1, Pit 1, a San Pedro stage cooking pit (Wise and Shutler 1958: 74; Eddy 1958: 92).
A-85	*2550 ± 300 (600 B.C.)	Matty Canyon, Arizona EE:2:30	Charcoal from Test 3, Pit 11, a San Pedro stage cooking pit (Shutler and Damon 1959: 60; Eddy 1958: 92).
A-86A	*3080 ± 300 (1130 B.C.)	Matty Canyon, Arizona EE:2:30	Charcoal from Test 3, Pit 14, a San Pedro stage cooking pit (Shutler and Damon 1959: 61; Eddy 1958: 92).
A-86B	*3660 ± 300 (1710 B.C.)		
A-86C	*3180 ± 300 (1215 B.C.)		
A-86 Av.	*3300 ± 230 (1350 B.C.)		

Table 5.4 - continued

A-87	*2610 ± 250 (660 B.C.)	Cienega Creek, Arizona EE:2:35	Charcoal from Lense 4, probably a San Pedro stage cooking pit (Shutler and Damon 1959: 61; Eddy 1958: 92-93).
A-89A	*3180 ± 300 (1230 B.C.)	Cienega Creek, Arizona EE:2:35	Charred wood from Lense 4 (Shutler and Damon 1959: 61; Eddy 1958: 92-93).
A-89B	*2620 ± 200 (670 B.C.)		
A-89C	*2520 ± 300 (570 B.C.)		
A-89 Av.	*2770 ± 170 (820 B.C.)		
Sh-5356+	2800 ± 190 (850 B.C.)	Cienega Creek, Arizona EE:2:35	Occupational charcoal from cooking Pit 3, above the falls (Eddy and Cooley 1964).
Sh-5358+	1850 ± 150 (A.D. 100)	Matty Canyon, Arizona Section MC-5	Occupational charcoal from Unit 3, M_1 marker bed (Eddy and Cooley 1964).
Sh-5359+	2150 ± 140 (200 B.C.)	Matty Canyon, Arizona Section MC-5	Occupational charcoal from Unit 3, M_2 marker bed, about 50 cm below sample Sh-5358 (Eddy and Cooley 1964).
A-227A	2140 ± 60 (190 B.C.)	Cienega Creek, Arizona	Carbonaceous earth, taken 375 feet upstream from Section MC-6. A-227B is the NaOH soluble fraction (Damon, Long, and Sigalove 1963; Eddy and Cooley 1964).
A-227B	1790 ± 400 (A.D. 160)		

*Dates obtained by the solid carbon, or black carbon, method.
+Shell Oil Company dates published with the permission of the Shell Development Company (a division of Shell Oil Company, Exploration and Production Research Division, Houston, Texas).

6. ARCHAEOLOGICAL ANALYSIS

E. B. Sayles

The reconstruction of the Cochise culture in terms of four sequent stages (Fig. 6.1) is based on an analysis of more than 100 sites in the southern part of the Southwest (Figs. 6.2, 6.3; Tables 6.1-6.3). Approximately 70 of these sites are in the area of Cochise County, Arizona, where the culture was first identified and defined (Fig. 6.2, Table 6.1).

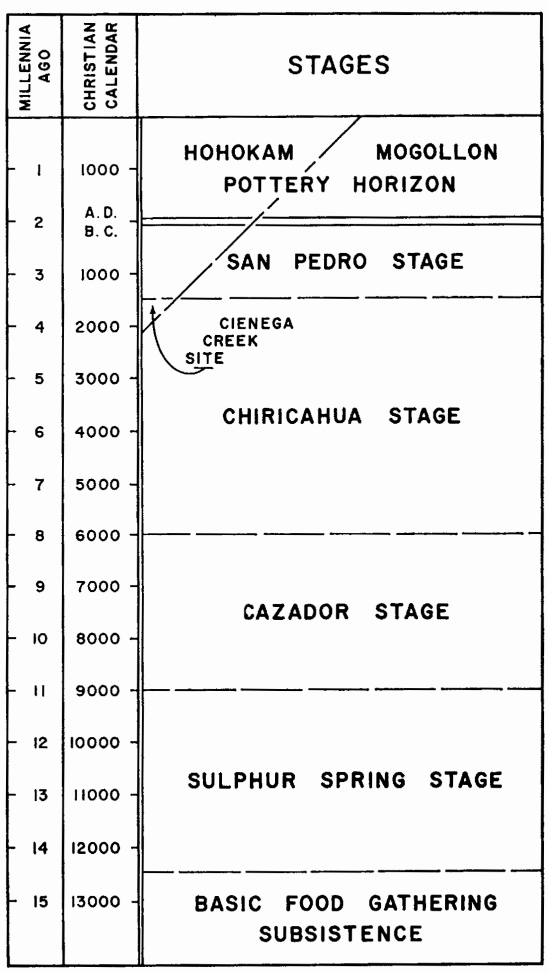


Fig. 6.1. Simplified archaeological sequence of the Cochise culture. (Dating based on Antevs; placement of Cienega site at Point of Pines based on Haury 1957.)

Although data from all of these sites have contributed to the current understanding of the Cochise culture, the artifact types and assemblages on which the culture is based were first established through a study of only those sites in which both archaeological and geological context were clearly demonstrated (Table 6.4). Furthermore, each stage is keyed to a type site that exhibits the best clustering of the available archaeological, geological, and other evidence. The type sites (Table 6.3) provide the fullest documentation for the assemblage of traits in each stage. Traits from other sites are compared with those from the type sites. This procedure is especially important in the study of sites lacking well defined archaeological and geological contexts. Thus, each stage is first established in terms of data from the type site and then amplified only to the extent that additional data are available from sites that can be correlated with the type site. The stage is based not only on archaeological content, but also on associated nonartifactual material in the assemblage and the geological context in which the assemblage occurs.

The type concept is fundamental to the method employed in the study and interpretation of the approximately 4000 stone artifacts from the four type sites and those closely correlated with them (Tables 6.4, 6.5). These artifacts were classified in terms of material, size, shape, method of manufacture, wear and other evidence of use, and frequency. Forty types were established on the basis of the clustering of similarities (see Figs. 6.6-6.19). All comparisons were made directly between individual specimens, but the interpretations are based on types abstracted from all well documented artifacts following the procedure of Haury (1950: 172-73).

Approximately 4000 additional tools from many other sites (Figs. 6.2, 6.3) were subjected to the same kind of analysis. These artifacts were not used in the establishment of the definition of the Cochise assemblage or the individual stages. However, their presence confirms the validity of the archaeological reconstruction. In addition, they bolster the type definitions by swelling the sample and expanding the typological range.

Many of the artifacts that may be identified typologically as Cochise tools were collected as "surface" finds throughout the region. They occur adjacent to the stream courses in the San Simon, Sulphur Spring, and San Pedro valleys, along the beaches of ancient lakes, on the outwash slopes of the valley margins, and elsewhere. They are commonly found as single specimens without associations. Occasionally they occur in some concentration with hearths. Some are found imbedded in the rocky surface of "desert pavement." Both flaked and ground stone artifacts are included in such finds, but the latter are usually represented by such small fragments that their original form can only be surmised on the basis of small patches that retain some of the smooth surface of the artifact.

These surface finds are not included in the tabular analyses because they cannot be identified with a specific Cochise stage or assemblage. However, their presence further demonstrates the widespread occurrence of the Cochise culture. Many kinds of artifacts of earlier stages persist into later stages in only slightly modified form. It is the presence of these persisting and only slightly changing forms that helps to demonstrate the continuity from stage to stage in the Cochise culture. At the same time, however, the persistence factor prevents the identification by stage of the scattered surface finds of many artifacts. The influence of this factor in the tabular analyses of documented artifacts is balanced by an emphasis on the appearance of new traits.

The 40 artifact types are grouped into eight categories based on method of manufacture and inferred function in order to examine the changes in the subsistence activities of the Cochise people through time (Table 6.5; Figs. 6.4, 6.5). Five categories represent inferred gathering activities and three categories represent inferred hunting activities. Milling or grinding stones and associated flake tools are indicative of gathering activities in which there is an emphasis on both the collecting and the processing of plant food. Flake tools comparable to those of the big-game hunting complex are the basis for inferring hunting activities.

The methods used to determine the function represented by an artifact are based on those used by Woodbury (1954) and Thompson (1958). These methods involve a detailed study of the inherent characteristics of the archaeological specimens combined with a careful dependence on ethnographic analogy. In addition, comparison of the Cochise assemblage with the artifact complex of the big-game hunting cultures makes possible an analysis of the Cochise culture in terms of the balance between gathering and hunting activities (Figs. 6.4, 6.5).

The function assigned to an artifact is the one for which the form was originally fashioned, but it is entirely possible, indeed probable, that the artifact may have served more than a single purpose. A Clovis point could have been as useful as a primary flake for cutting the stalk from the rhizome of a tule plant, but it was probably made for use as a projectile weapon. Likewise, milling stones may have been used in dispatching trapped animals, but it is doubtful that they were manufactured for that purpose. The milling stones may have been used for breaking animal bones or grinding pigments, but it is inferred that they were made primarily for use in processing plant foods, just as the projectile points are inferred to have been made for killing game, even though they could have served some other food-getting purpose.

Although the nearly 4000 artifacts have been carefully tabulated according to type and function, no effort has been made to use these data in a quantitative manner. Neither the actual counts nor the frequencies have been subjected to statistical analysis; rather they provide a concrete basis for broad inferences about the ways in which prehistoric tool forms reflect the relative dependence of the Cochise people on hunting and gathering activities.

The 3969 artifacts from the 22 sites and localities with full documentation are divided into 40 artifact types. These types are grouped under functional categories in which five type groups represent inferred gathering

Table 6.1

List of Archaeological Sites Shown in Figure 6.2
Cochise County

Fig. 6.2	Site Designation	Fig. 6.2	Site Designation
1	Arizona EE:4:1[1]	34	GP Pearce 8:17
2	GP Benson 5:18[2]	35	Arizona FF:10:4 (GP Sonora F:10:31)
3	GP Benson 5:17	36	Arizona FF:10:7 (GP Sonora F:10:30)
4	Arizona EE:8:5, 7 (GP Benson 5:16)	37	GP Sonora F:10:23
5	Arizona EE:8:1 (GP Benson 5:10), Fairbank site	38	Arizona FF:10:1 (GP Sonora F:10:1) Double Adobe area
6	AF Arizona EE:7:2[3]	39	GP Sonora F:10:17
7	AF Arizona EE:7:9	40	GP Sonora F:10:40
8	GP Benson 8:2, 3, 4	41	GP Sonora F:10:41
9	Arizona: EE:8:12	42	GP Sonora F:10:26
10	Arizona EE:8:13	43	GP Arizona L:14:2
11	Arizona EE:12:2	44	GP San Simon 2:1
12	Arizona BB:16:1	45	GP San Simon 2:2
13	GP Arizona L:13:9	46	GP San Simon 2:4
14	GP Arizona L:13:4, 5, 6, 7	47	Arizona CC:12:2
15	Arizona CC:13:3 (GP Arizona L:13:10)	48	Arizona CC:12:1, 3 (GP San Simon 2:3)
16	GP Arizona L:13:11	49	GP San Simon 5:3
17	GP Arizona L:13:8	50	GP San Simon 5:4
18	GP Arizona L:13:4	51	GP San Simon 5:5
19	GP Arizona L:10:2, San Simon Village	52	GP San Simon 5:6, 7
20	Arizona CC:13:6	53	GP San Simon 9:1, 2
21	GP Arizona L:14:5	54	GP San Simon 9:3
22	GP Arizona L:13:12	55	Arizona CC:16:3 (GP San Simon 9:6)
23	GP Arizona L:13:13	56	GP Chiricahua 3:27
24	Arizona CC:13:1 (GP Arizona L:13:15)	57	GP Chiricahua 3:22
25	GP Arizona L:13:14	58	GP Chiricahua 3:21, Cave Creek Village
26	GP Pearce 5:3	59	GP Chiricahua 3:23
27	GP Pearce 5:7	60	GP Chiricahua 3:24
28	Arizona FF:5:3	61	GP Chiricahua 3:16, Cave Creek midden
29	Arizona FF:5:4	62	GP Chiricahua 3:8
30	Arizona FF:6:2 (GP Pearce 8:4, 8, 9)	63	GP Chiricahua 3:19
31	GP Pearce 8:3	64	Arizona FF:8:2
32	GP Pearce 8:21	65	Arizona FF:8:3
33	Arizona FF:10:5 (GP Pearce 8:10)		

1. Arizona State Museum Survey (Wasley 1957); see Fig. 6.3.
2. GP, Gila Pueblo Survey; see Fig. 6.3.
3. AF, Amerind Foundation Survey.

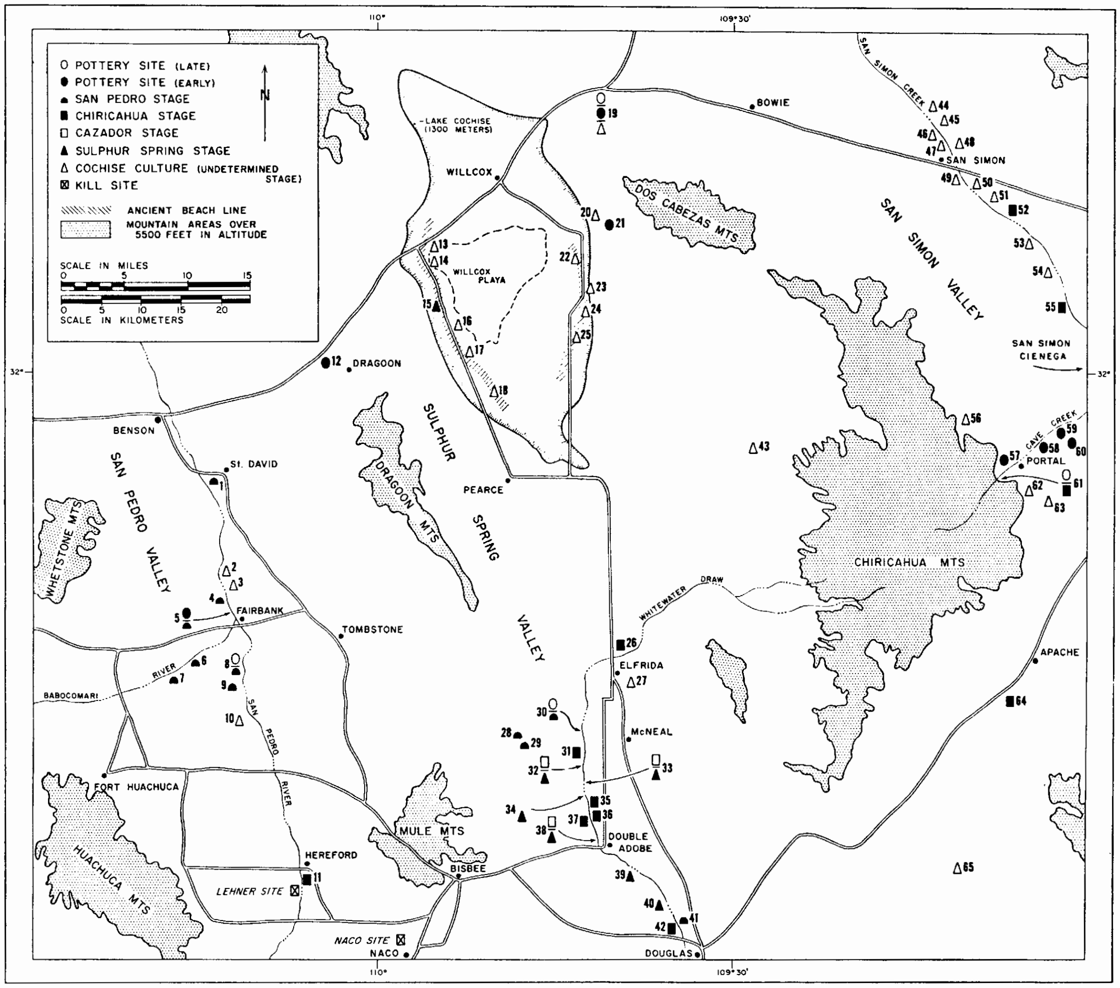


Fig. 6.2. Map of Cochise County showing archaeological sites related to the Cochise culture. See Table 6.1 for list of sites. An additional 29 sites along Whitewater Draw from Elfrida to the Mexican International Border also contain evidence of man in association with various geological strata. They are not shown on the map because they have not been identified with the Cochise culture by both geological and archaeological criteria, but they emphasize the clustering of sites along this stretch of Whitewater Draw.

Table 6.2

List of Archaeological Sites shown in Figure 6.3
Cochise Culture Area

Fig. 6.3	Site Designation	Fig. 6.3	Site Designation
1	Arizona O:5:2	22	Arizona CC:7:2
2	GP Arizona J:12:8		(GP Arizona L:7:5)
3	Arizona AA:12:41	23	GP New Mexico P:13:1, 2, 3
4	Arizona BB:9:35	24	GP Chihauhua A:2:5
5	Arizona BB:13:6	25	GP Chihuahua A:9:5, 9, 12
6	Arizona AA:13:11	26	GP Survey of Chihuahua
7	Arizona BB:14:12	27	GP Survey of Chihuahua
8	Arizona AA:16:5	28	GP Survey of Chihuahua
9	GP Sonora D:2:1	29	Sonora F:10:3
10	GP Sonora D:3:1		(GP Sonora H:7:1)
11	Arizona DD:13:12		La Playa site
	(GP Sonora D:3:2)	30	Peralta complex sites
12	GP Sonora D:3:3	31	Sonoran sites
13	Arizona DD:8:8	32	Coastal Sonoran sites
14	Arizona DD:14:1	33	Flattop site
15	Arizona EE:2:10, 12, 30, 35	34	Concho complex sites
16	GP Sonora E:9:6	35	Wet Leggett site and
17	GP Sonora E:9:7		Tularosa Cave
18	Arizona EE:10:1	36	Bat Cave
19	Arizona EE:10:21	37	Atrisco and San Jose sites
20	GP Arizona K:8:1	38	Big Bend sites
21	GP Arizona L:2:10	39	Southeastern Chihuahua sites

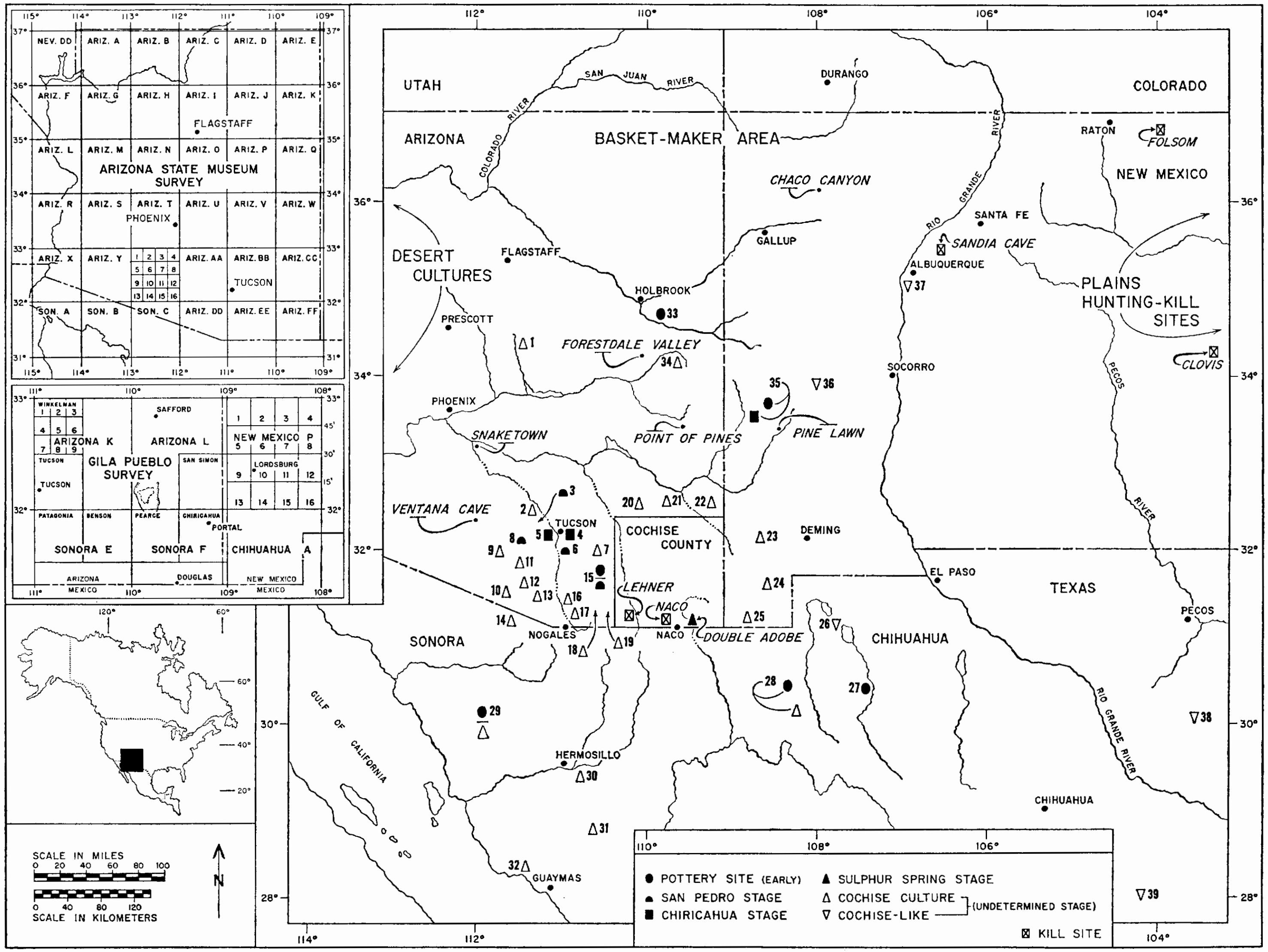


Fig. 6.3. Map of the Southwest showing archaeological sites containing Cochise cultural remains. See Table 6.2 for list of sites. Some sites and regions are identified on the map by name. Inset compares Gila Pueblo (GP) and Arizona State Museum site survey systems.

Table 6.3

List of Archaeological Sites by Stage

Stage[1] Site Designation	Map Reference Fig. No.	Map Reference Site No.
Sulphur Spring Stage		
Arizona CC:13:3 (GP Arizona L:13:10)	6.2	15
Arizona FF:10:1 (GP Sonora F:10:1), Double Adobe site[2]	6.2	33
	7.1	Loc. 1,3,4,5
Arizona FF:10:5 (GP Pearce 8:10), overlain by Cazador stage	6.2	33
GP Pearce 8:17	6.2	34
GP Pearce 8:21, overlain by Cazador stage	6.2	32
GP Sonora F:10:17	6.2	39
GP Sonora F:10:40	6.2	40
Cazador Stage[3]		
Arizona FF:10:1 (GP Sonora F:10:1), Double Adobe site[2]	6.2	33
(Loc. 2)	7.1	Loc. 2
Arizona FF:10:5 (GP Pearce 8:10), overlies Sulphur Spring stage	6.2	33
GP Pearce 8:21, overlies Sulphur Spring stage	6.2	32
Chiricahua Stage		
Arizona BB:9:35	6.3	4
Arizona BB:13:6	6.3	5
Arizona CC:16:3 (GP San Simon 9:6)	6.2	55
Arizona BB:12:2	6.2	11
Arizona FF:8:2	6.2	64
Arizona FF:10:4 (GP Sonora F:10:31)	6.2	35
Arizona FF:10:7 (GP Sonora F:10:30)	6.2	36
Arizona Z:12:5, Ventana Cave	6.3	
GP Chiricahua 3:16, Cave Creek midden[2]	6.2	61
GP Pearce 5:3	6.2	26
GP Pearce 8:3	6.2	31
GP San Simon 5:6, 7	6.2	52
GP Sonora F:10:23	6.2	37
GP Sonora F:10:26	6.2	42
Wet Leggett site	6.2	35
San Pedro Stage		
AF Arizona EE:7:2	6.2	6
AF Arizona EE:7:9	6.2	7
Arizona AA:12:41	6.2	3
Arizona AA:16:5	6.2	8
Arizona EE:2:12, 30, 35	6.3	15
Arizona EE:4:1	6.2	1
Arizona EE:8:1 (GP Benson 5:10), Fairbank site[2]	6.2	5
Arizona EE:8:5, 7 (GP Benson 5:16)	6.2	4
Arizona EE:8:12	6.2	9

Table 6.3
(continued)

		Map Reference	
Stage[1]	Site Designation	Fig. No.	Site No.
	Arizona FF:5:3	6.2	28
	Arizona FF:5:4	6.2	29
	Arizona FF:6:2 (GP Pearce 8:4, 8, 9)	6.2	30
	Arizona Z:12:5, Ventana Cave	6.3	
	GP Benson 8:2, 3, 4	6.2	8
	GP Sonora F:10:41	6.2	41
Early Pottery Horizon			
	Arizona BB:16:1	6.2	12
	Arizona EE:2:10	6.3	15
	Arizona EE:8:1 (GP Benson 5:10), Fairbank site	6.2	5
	GP Arizona L:10:2, San Simon village (Early to Late Pottery)	6.2	19
	GP Arizona L:14:5	6.2	21
	GP Chiricahua 3:21, Cave Creek Village[2]	6.2	58
	GP Chiricahua 3:22	6.2	57
	GP Chiricahua 3:23	6.2	59
	GP Chiricahua 3:24	6.2	60
	GP Survey of Chihuahua	6.3	27, 28
	Tularosa Cave	6.3	35

1. Late pottery sites, sites of undetermined stage, and Cochise-like sites not listed.
2. Type sites.
3. Kill sites.

Table 6.4

List of Archaeological Sites Used for Analysis of Artifact Types Shown in Table 6.5

Map Reference			
Fig. No.	Site No.	Site	Stage
6.2	5	Arizona EE:8:1 (GP Benson 5:10)	San Pedro
6.2	19	GP Arizona L:10:2	Early and Late Pottery
6.2	28	Arizona FF:5:3	San Pedro
6.2	29	Arizona FF:5:4	San Pedro
6.2	30	Arizona FF:6:2 (GP Pearce 8:4, 8, 9)	San Pedro
6.2	32	GP Pearce 8:21	Sulphur Spring, Cazador
6.2	33	Arizona FF:10:5 (GP Pearce 8:10)	Sulphur Spring, Cazador
6.2	34	GP Pearce 8:17	Sulphur Spring
6.2	35	Arizona FF:10:4 (GP Sonora F:10:31)	Chiricahua
6.2	36	Arizona FF:10:7 (GP Sonora F:10:30)	Chiricahua
6.2	38	Arizona FF:10:1 (GP Sonora F:10:1) (Fig. 7.1, Localities 1, 3, 4, 5)	Sulphur Spring
6.2	38	Arizona FF:10:1 (GP Sonora F:10:1) (Fig. 7.1, Locality 2)	Cazador
6.2	41	GP Sonora F:10:41	San Pedro
6.2	42	GP Sonora F:10:26	Chiricahua
6.2	58	GP Chiricahua 3:21	Early and Late Pottery
6.2	61	GP Chiricahua 3:16	Chiricahua
6.3	Ventana Cave	Arizona Z:12:5	Chiricahua, San Pedro
6.3	3	Arizona AA:12:41	San Pedro
6.3	15	Arizona EE:2:30	San Pedro

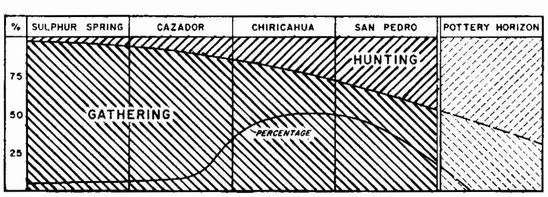


Fig. 6.4. Frequency diagram of artifacts classified according to their inferred use in gathering and hunting activities. The percentage curve indicates the number of artifacts in each stage relative to the total classified. For example, the interpretation that the Sulphur Spring stage is characterized by 98 percent gathering activities and 2 percent hunting activities is based on only 5 percent of the total artifacts classified for all stages. (Compare Figure 6.5 and Tables 6.4, 6.5.)

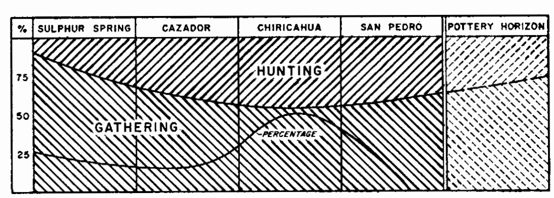


Fig. 6.5. Frequency diagram of 40 artifact types representing hunting or gathering activities. The percentage curve provides an indication of the number of new types introduced in each stage. Seven of the nine types present in the Sulphur Spring stage represent gathering activities; only two types represent hunting activities. (Compare Figure 6.4 and Tables 6.4, 6.5.)

Table 6.5

Comparison of 40 types of artifacts (from sites listed in Table 6.4) according to their inferred use in hunting and gathering activities. Compare Figures 6.4-6.19.

Stage	Inferred Gathering Tools							Inferred Hunting Tools						
	Nether milling stone	Handstone	Core	Flake	Other	Total	%	Flake	Biface	Other	Total	%	Total	%
San Pedro														
No. of artifacts	87	108	367	471	43	1076	*66*	159	368	23	550	*34*	1626	*41*
No. of types	5	5	5	3	2	20	*59*	4	7	3	14	*41*	34	
New types			1		2	3	*60*		2		2	*40*	5	
Chiricahua														
No. of artifacts	220	414	338	511		1483	*78*	181	210	17	408	*22*	1891	*48*
No. of types	5	5	4	5		19	*55*	6	6	3	15	*45*	34	
New types	4	3	2	2		11	*55*	3	3	3	9	*45*	20	
Cazador														
No. of artifacts	43	134	13	19		209	*88*	17	12		29	*12*	238	*6*
No. of types	1	2	2	4		9	*60*	3	3		6	*40*	15	
New types		1		1		2	*33*	1	3		4	*67*	6	
Sulphur Spring														
No. of artifacts	66	108	16	19		209	*98*	5			5	*2*	214	*5*
No. of types	1	1	2	3		7	*77*	2			2	*23*	9	
Total number of artifacts	416	764	734	1020	43	2977	*75*	362	590	40	992	*25*	3969	
Total number of types	5	5	5	5	2	22	*55*	7	7	4	18	*45*	40	

activities and three, inferred hunting activities. The artifacts from each stage are classified according to the scheme with special attention to the introduction of new types (Table 6.5). These broad interpretations of the relative importance of hunting and gathering in the several stages of the Cochise culture are therefore based on information of varying quality (Figs. 6.4, 6.5). The data for the two early stages are inadequate, and the Chiricahua stage is best represented. The San Pedro curves are also probably reasonably accurate because of the continuity of artifact types into the Early Pottery horizon. The frequency curves in both figures are carried into the ceramic period as a result of the analysis of 156 artifacts (not including potsherds) from Early Pottery sites excavated in Cochise County (Fig. 6.2, Sites 12, 57-60). These artifacts include 25 types, 15 of them similar to Cochise types. A similar degree of continuity of Cochise types into early Mogollon sites is documented by Wheat (1955).

Brief descriptions, illustrations, frequency diagrams, synoptic sequences, and summary comparisons of the major artifact types are presented in this chapter. More detailed information on the artifact assemblages for each stage is provided in the following chapters. Each type is illustrated and its frequency is plotted for each of the four Cochise stages and the Early Pottery horizon (Figs. 6.6-6.19); frequency diagrams show the total number of artifacts for each type.

GRINDING TOOLS

Grinding tools are the most characteristic artifacts of the Cochise culture. Nether milling stones and functionally related handstones are the major forms, but mortar-basins and pestles also occur. These types constitute about 30 percent of the artifacts examined in this study.

The handstone and nether stone are actually two parts of a single artifact, but they are treated separately for analytical purposes. The handstone is an implement small enough to be held in one hand while crushing, cracking, grinding, pulverizing, or otherwise processing plant foods and other materials on the upper surface of the larger and stationary nether milling stone. The several types of handstones and nether stones are differentiated largely on the basis of shape, grinding or working surface, and wear pattern. The Cochise grinding tools differ from the metates and manos of the later pottery horizons. The later metate is a nether stone with a prepared troughlike surface on which the mano, a muller usually held by both hands, is moved back and forth. This specialized tool was developed to grind the maize produced by the farming economy typical of Southwestern prehistory from about the time of Christ. In this study the term "metate and mano" is used only to describe this formally prepared and specialized type of grinding equipment, while the simpler grinding tools of the Cochise and related cultures are called milling stones or grinding stones.

Nether Stones

There are five types of nether grinding stones: slab, basin or shallow basin, basin-mortar or deep basin, pebble mortar, and lapstone or proto-palette (Figs. 6.6, 6.7).

Slab nether stone

The earliest type of nether stone is little more than a relatively thin, unmodified, naturally flat stone with small pits and irregular wear depressions on the upper surface (Fig. 6.6a). The pits may be the accidental product of the pounding and crushing action of the handstone or the purposeful pecking of the surface to roughen it for more efficiency in grinding as is done by present-day users of stone grinding tools. The irregular surface depressions result from the rubbing or grinding action of the handstone on the nether stone. Although these shallow depressions are present on slab milling stones in the Sulphur Spring and Cazador stages, they are most common on those of the Chiricahua stage.

The milling stones are inferred to have been used primarily for the processing of food, but it is very likely that they were used for grinding other materials as well, especially pigments. In the Sulphur Spring and Cazador stages the slab type of nether stone probably served all grinding needs, because it was the only form of milling stone in use. In the Chiricahua stage, when more

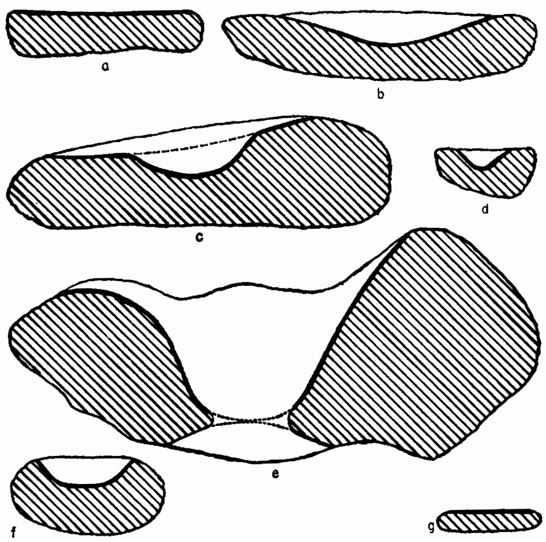


Fig. 6.6. Nether milling stones: a, slab; b, basin; c, e, basin-mortar; d, f, pebble; g, lapstone. Heavy line indicates grinding surface. Scale, about 1/6. See Figure 6.7 for tool frequencies by stage.

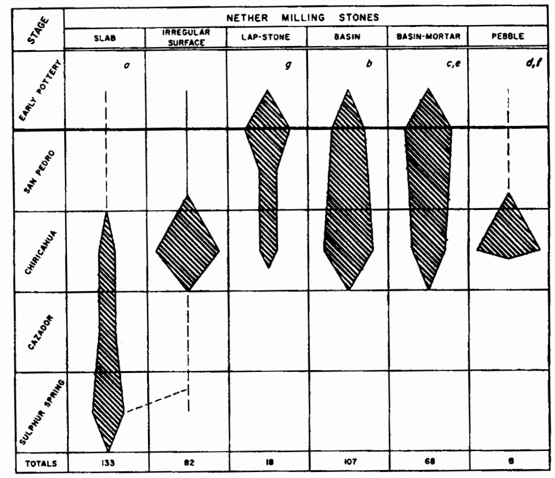


Fig. 6.7. Frequencies of nether milling stones. Italicized letters refer to artifacts in Figure 6.6 that illustrate various types.

specialized tool forms began to appear, the lapstone may have been used for the pigment-grinding function.

Lapstone

Thin flat slabs small enough to be held in the hand are called proto-palettes or lapstones (Fig. 6.6g). They are comparable to, and probably typologically ancestral to, the more carefully made paint palettes of the ceramic periods. The lapstone first appears in Chiricahua stage contexts and becomes increasingly popular through time, possibly in part, at least, at the expense of the slab type of nether stone. Also the decrease in popularity of the slab type in later times is related to the introduction of the basin types of nether milling stones (Fig. 6.7).

Basin nether stone

The comparatively small nether stone with a shallow oval-shaped basin (Fig. 6.6b) appears at the beginning of the Chiricahua stage. At first the shallow basin was produced by the rubbing and grinding motion of the handstone on the nether stone as indicated by the nature of the matching handstone. The basin nether is typologically derived from the slab type with irregular wear depressions on the working surface. In later times the nether stone was larger and thicker and the basin was often partially shaped prior to use.

Basin-mortar

Although the deep-basin nether stones (Fig. 6.6c, e) are found in Chiricahua stage contexts, they are more typical of the San Pedro stage, when the matching convex handstone also makes its appearance. The deep-basin types are made from unusually large and thick boulders, probably in order to obtain satisfactory depth in the oval-shaped grinding basins. Some of these larger nether stones weigh more than 100 pounds. The heavier specimens are found in sites of the San Pedro stage and the Early Pottery horizon. Their presence may indicate a greater permanence and stability of the later Cochise sites. The size and weight of the deep-basin nether stones suggests that they were not intended to be carried from place to place as the smaller and lighter nether stones of earlier times may have been.

Both deep and shallow basins exhibit surface pitting similar to that on the slab nether stone. The pitting occurs in the basin itself and on adjoining surface areas, but there is no evidence of efforts to modify the exterior shape of these nether stones. Some of the shallow-basin artifacts have grinding basins on opposite surfaces. The restrictions of the pitting to the basin area suggests that the pecking was used to "sharpen" the grinding surface.

Some of the deep-basin stones seem to have served also as mortars. A deeper, secondary, circular-shaped basin was made in the center of the normal oval-shaped grinding surface (Fig. 6.6c). The circular basin is usually deeper than it is wide. The mortar basin occurs, probably as early as the Chiricahua stage, alone in boulders, and in pebble mortars as well as in the more common basin-mortar combination. The combination form is characteristic of the San Pedro stage and continues, often with much larger basins, into the Early Pottery horizon. It is inferred that a handstone was used for grinding in a semirotary fashion in the shallow basin part of the combination nether stone and that a handstone, or possibly a pestle, was used for pounding and crushing in the deeper mortar portion.

An opening was purposefully made in the bottom of some large San Pedro stage basin-mortars or deep basin nether stones (Fig. 6.6e). The edges of the hole are carefully rounded and finished in contrast to the thin and jagged edges of the holes in worn examples. These holes were made in the bottoms of these nether stones long before the bottom had worn through and before the useful life of the tool had been exhausted. Thus, the holes are purposeful openings and not the result of excessive wear. The large nether stone with a prepared hole in the bottom suggests that some kind of hopper-mortar was intended. The Californian hopper-mortar with a bottomless basket fastened with an adhesive such as asphalt to the rim of a stone mortar (Kroeber 1925: 411-14) presents an obvious analogy. However, although the Cochise type may have been used in a fashion similar to that of some Californian stone mortars, a basket or other receptacle must have been placed below the hole in the bottom. Its use with a gyratory, long wooden pestle has been postulated by Hayden (1969: 154-61). The type with the hole in the bottom occurs in the San Pedro stage and the Early Pottery horizon.

There is a slight possibility that the opening in the hopper-mortar type was made in order that the heavy stone could be transported more easily, perhaps slung on a pole between two carriers. However, the type is characteristic of those periods when dwelling sites were becoming more permanent and stable. It is more likely, therefore, that the hole played a definite role in the grinding process.

Pebble mortar

A circular basin also occurred on stones of double-fist or cobble size beginning in the Chiricahua stage (Fig. 6.6d, f). The exterior of the pebble mortar was left unfinished. This form was probably the prototype of the stone vessel with relatively thin walls and exterior shaping that appeared during the Early Pottery horizon.

Handstones

This category includes both handstones and pestles, the two major classes of implements used with the various nether grinding stones. There are five types: unmodified handstone, modified handstone, convex handstone, proto-pestle, and cylindrical pestle (Figs. 6.8, 6.9).

Unmodified handstone

The earliest type of handstone, like the earliest type of nether stone, is an essentially unmodified natural stone, usually quartzite. Its only identifying characteristics are the result of use; most obvious is the flatness of the ground or worn surface (Fig. 6.8a). Both flat surfaces of this type of handstone may exhibit wear. In addition, there is frequently a pitting of the grinding surface similar to that on the surface of the slab nether stone. The edges are not shaped, but are frequently pecked, probably from use as a crushing or pounding tool.

Modified handstone

In contrast with the unmodified handstone, the edges of modified handstones (Fig. 6.8b-f) are pecked and shaped (Fig. 6.8b) to produce symmetrical forms, usually oval or rounded rectangular (see Fig. 6.20). The grinding facets occur on the two opposed flat surfaces or sides of the handstone, producing

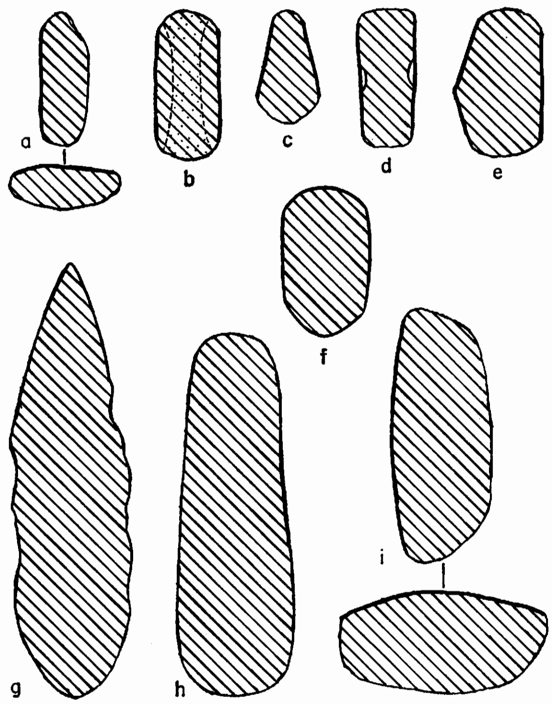


Fig. 6.8. Handstones and pestles: a, unmodified handstone; b–f, modified handstones; g, proto-pestle; h, cylindrical pestle; i, convex handstone. Heavy line indicates grinding surface. Scale, about 1/5. See Figure 6.9 for frequencies by stage.

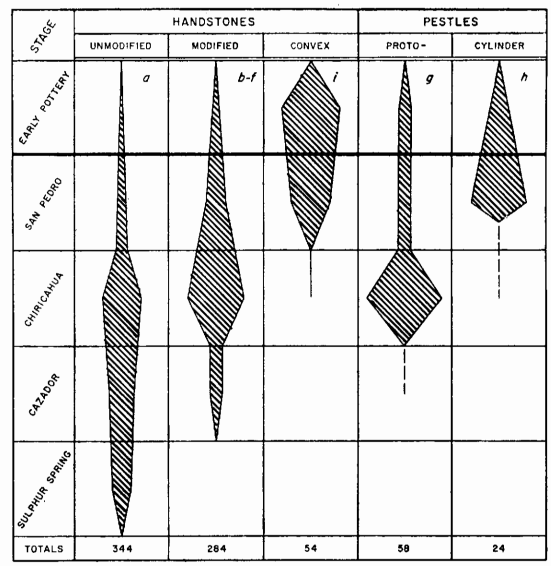


Fig. 6.9. Frequencies of handstones and pestles. Italicized letters refer to artifacts in Figure 6.8 that illustrate various types.

varied cross sections. Common among these are wedge-shaped forms (Fig. 6.8c) and one with a double-faceted surface (Fig. 6.8e). The grinding faces often have small pits, single, opposed, or multiple, as if arranged for convenient finger grips when the tool was used for crushing, cracking, or pounding (Fig. 6.8d). Occasionally there is evidence of a grinding surface on the longer edges as well as on the flat sides, producing what is sometimes called a cylindrical grinding surface (Fig. 6.8f). The modified types were most common during the Chiricahua stage (Fig. 6.9).

Convex handstone

Convex handstones are present in the Chiricahua stage, but are most charcteristic of the San Pedro stage when deep-basin nether stones were popular. They increase in popularity into the Early Pottery horizon at the same time that all other types of handstones decrease in frequency (Fig. 6.9). The convex handstone is shaped and unifacial, and the single grinding surface is convex on both axes, often markedly so (Fig. 6.8i). Some of the later convex handstones are so large as to be unwieldy when held in one hand. Thus, they match the larger size of the later deep-basin nether stones.

Proto-pestle

This form is little more than a shaped handstone, or an unmodified cobble, with one end extended, heavily battered, or otherwise exhibiting evidence of use as a crushing or pounding tool.

The artifact illustrated in Figure 6.8g, though classed as a proto-pestle because of gross form, is perhaps better interpreted functionally as a digging tool. The ends are pointed or beveled, rather than flattened. Moreover, they are polished and slightly striated, suggesting use in the ground as a digging tool rather than in a mortar as a crushing implement. This interpretation is based in part on analogy with similar forms from the Early Pottery horizon identified by Wheat (1955: Fig. 8v, w) as digging stones.

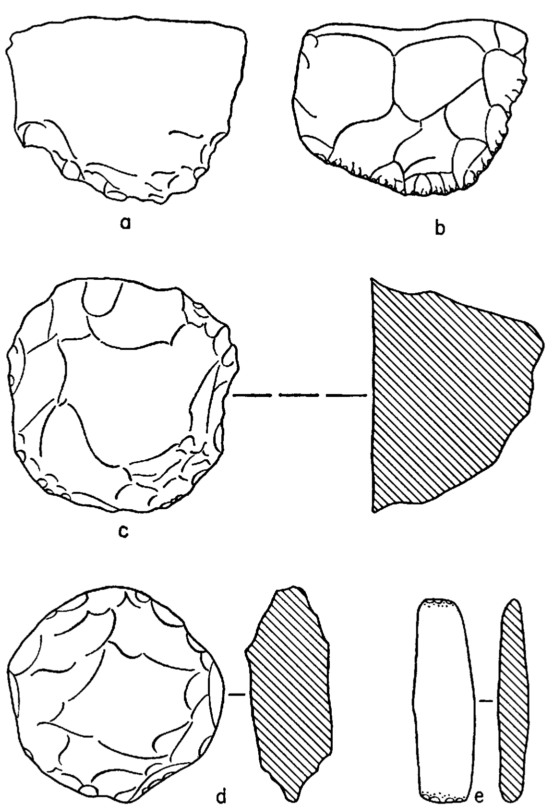


Fig. 6.10. Core tools: a, sinuous-edged chopper; b, straight-edged chopper; c, chopper plane; d, hammerstone; e, pebble hammerstone. Scale, about 1/3. See Figure 6.11 for frequencies by stage.

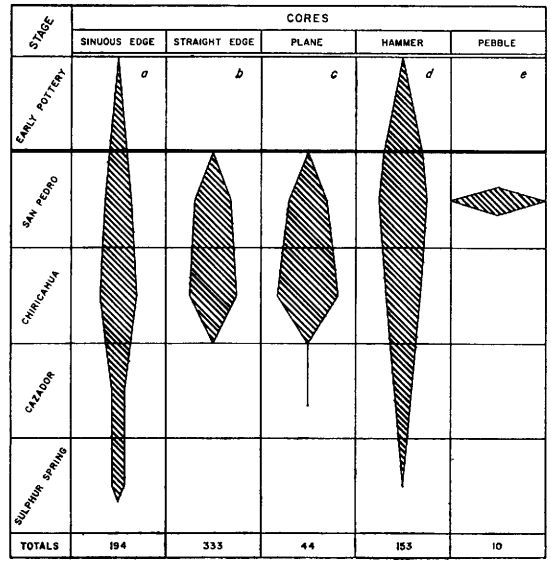


Fig. 6.11. Frequencies of core tools. Italicized letters refer to artifacts in Figure 6.10 that illustrate various types.

Cylindrical pestle

This crushing tool is most common in San Pedro stage contexts where it can be correlated with deep-basin mortars and the more developed pebble mortars. The pestle is a basically cylindrical stone, often little modified, with flattened or rounded ends that are pitted and battered from use (Fig. 6.8h).

CHIPPED STONE TOOLS

Chipped-stone artifacts made from both cores and flakes constitute 70 percent of the sample studied. However, in general, the grinding tool types are more sensitive as stage diagnostics than are the various chipped tool types.

Core Tools

Large, heavy, often crude, mostly percussion-flaked implements made from cobbles or cores (see Fig. 6.21), or sometimes from thick flakes, account for 18 percent of the total artifact collection. There are three types of chopper or cutting tools and two of hammering implements: sinuous-edged chopper, straight-edged chopper, plane chopper; cobble hammerstone and pebble hammerstone (Figs. 6.10, 6.11).

Sinuous-edged chopper

This form is usually made from a prepared turtle-back core (see Fig. 6.21). Several coarse flakes were removed from a natural or prepared flat surface to produce a sinuous cutting edge on a plano-convex tool (Fig. 6.10a). The same kind of tool results from the removal of several thick flakes along one edge of a naturally plano-convex cobble. In either form, the edge opposite the cutting edge was left unmodified, probably to serve as a hand grip. The sinuous-edged chopper is the only chopping tool in the Sulphur Spring stage; it persists through all Cochise stages into the Early Pottery horizon (Fig. 6.11).

Straight-edged chopper

Similar to the sinuous-edged chopper, the edge of this form was straightened by the removal of additional smaller flakes (Fig. 6.10b). The resulting efficient cutting edge was frequently retouched. The straight-edged chopper is restricted to the Chiricahua and San Pedro stages.

Plane

The plano-convex shape of the plane is accentuated by the shaping of the convex surface to produce a high-domed upper surface that may have been intended for holding the tool comfortably in the hand (Fig. 6.10c). The edge was chipped around the entire perimeter producing a more symmetrical form than is typical of other chopper types. The plane seems to be limited to the Chiricahua and San Pedro stages (Fig. 6.11). The high-domed scraper (see Figs. 6.14d, e; 6.21) is essentially the same form as the plane except much smaller.

Hammerstone

Rough natural stones, cores, very large flakes, and discarded or worn-out choppers were used for pecking and hammering. Hammers were the basic percussion implements (Figs. 6.10d, 6.21). It is possible that choppers and high-domed scrapers were used to peck and "sharpen" surfaces of the nether grinding tools. Many hammerstones are unmodified except for extensive battering around the maximum perimeter that documents their use in pecking and pounding activities. The generalized hammerstone, like the sinuous-edged chopper, occurs throughout the sequence (Fig. 6.11).

Pebble hammerstone

A specialized hammer found only in the San Pedro stage is made of a small, elongated or flat oval-shaped, natural pebble that is chipped and battered in a limited area on the ends (Fig. 6.10e). It may have been used as a flaker for shaping the bifacial blades in the San Pedro stage sites. The standard antler flaker has not been found in Cochise sites except at Ventana Cave. This absence of the familiar antler flaker in open sites may be the result of differential preservation, but it is also possible that the pebble hammerstone served as a stone substitute for the antler tool.

Slightly Modified Flakes

About 25 percent of all artifacts are simple cutting and scraping tools made on slightly modified flakes. This count does not include the thousands of possibly used, but essentially waste, flakes found in some Cochise sites. Only those flakes that exhibit some secondary chipping or shearing from use have been classified and analyzed. Many of the classified flakes show only slight chipping, usually along one edge of one face. There are five types: thin flake knife, thick flake knife, large side scraper, small side scraper, and flake with ground edge (Figs. 6.12, 6.13).

Flake knife

Flake knives are often no more than convenient flakes that have been used with a sawing and cutting motion a few times and then discarded. A thin flake could be used only briefly as a knife, unless the materials being cut were soft, because continued use would produce a sheared and blunted edge (Fig. 6.12b). Thicker flakes (Fig. 6.12a) were more often chipped to produce a sawlike cutting edge. Some thick flakes appear to have been sheared and then retouched. The larger and heavier flake knives approach the size range of the sinuous-edged chopper (Fig. 6.10a). Flake knives are found in all stages (Fig. 6.13).

Flake scraper

Flake side scrapers differ from flake knives in that the working edge is generally beveled by chipping to produce a steeper cutting or scraping edge than is typical of the knives. Larger forms (Fig 6.12d) are more typical of the earlier stages (Fig. 6.13).

Ground-edged flake

Simple flakes with one longer edge ground blunt, but otherwise unmodified, is a characteristic form during the Chiricahua stage (Figs. 6.12c, 6.13).

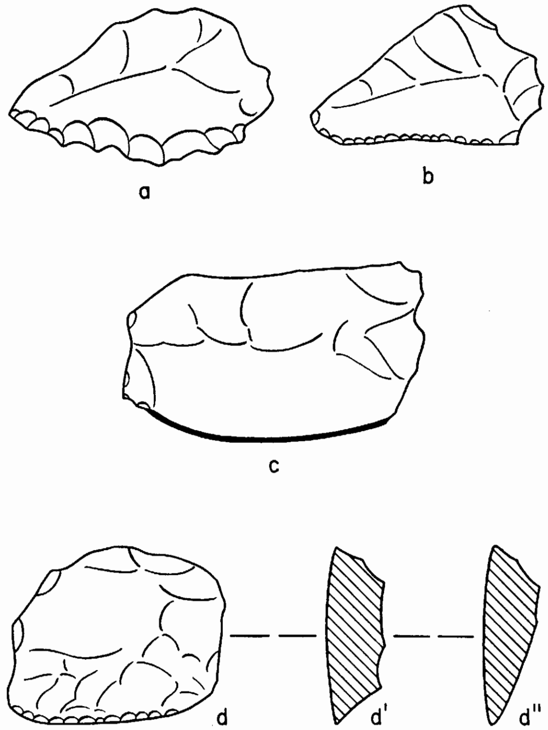


Fig. 6.12. Flake tools: a, thick flake knife, slightly modified; b, thin flake knife, slightly modified; c, flake with ground edge (heavy line); d, large flake side scraper. Scale, about 1/2. See Figure 6.13 for frequencies by stage.

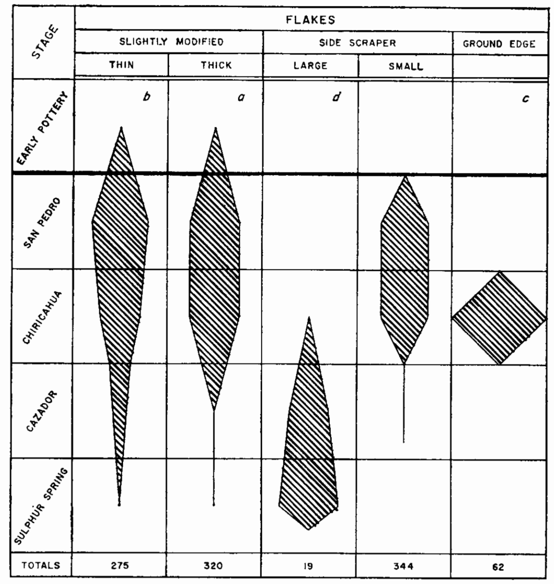


Fig. 6.13. Frequencies of flake tools. Italicized letters refer to artifacts in Figure 6.12 that illustrate various types.

Scrapers

Tools classified as prepared or formally chipped scraping implements constitute ten percent of the Cochise artifacts studied. There are six types of scrapers: ovoid, end, thumbnail, rough domed, fine domed, and hollow-edged (Figs. 6.14, 6.15).

Ovoid scraper

Flakes of oval shape are chipped along a third or more of the edge (Fig. 6.14a). There is a poorly defined ridge on the convex surface. These forms are usually comparatively thin. Ovoid scrapers are midway in size between the largest keeled types and the smaller thumbnail specimens.

End scraper (snub-nosed)

The smaller forms (Fig. 6.14b) are typical of the Chiricahua and San Pedro stages, and the larger ones (Fig. 6.14f) are more common in the Sulphur Spring and Cazador stages (Fig. 6.15). The scraping edge on these somewhat elongated forms is limited to one end. The back is often keeled and there is a wide range in size.

Thumbnail scraper

Small end scrapers (Fig. 6.14c) are found principally in Chiricahua stage contexts (Fig. 6.15). Many are keel-backed. They have both convex and straight scraping edges.

Domed scrapers

High domed shapes are the most numerous tools classified as scrapers. The rough, sinuous-edged type (Fig. 6.14e) is generally large, although some specimens are quite small. The larger specimens resemble planes (Fig. 6.10c). The smaller and finer forms range from very small circular types (Fig. 6.14d) to elongated ones. The height is always equal to, or greater than, the diameter. The edges are retouched or finely chipped from use. Many are characterized by one or more fine points along the edge and

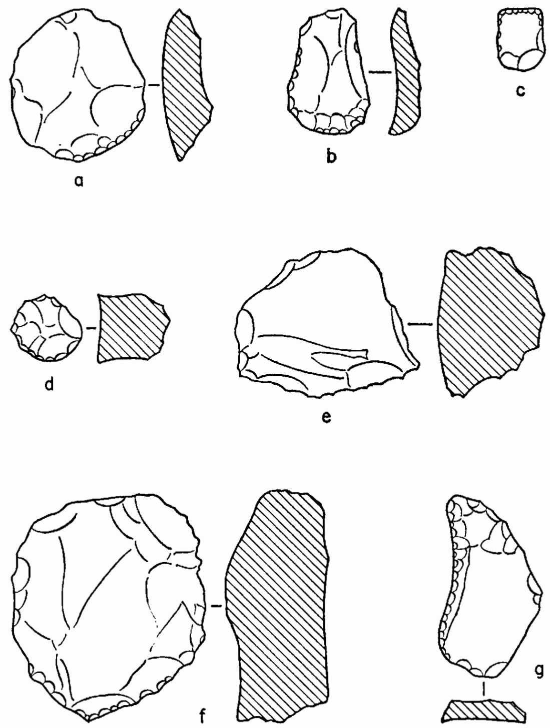


Fig. 6.14. Scrapers: a, ovoid; b, elongate end; c, elongate thumbnail; d, fine domed; e, rough domed; f, large elongate rough end scraper; g, hollow-edged. Scale, about 1/3. See Figure 6.15 for frequencies by stage.

may have served as incising tools. The finer specimens tend to earlier, and the rough ones to later, stages (Fig. 6.15).

Hollow-edged scrapers

Usually similar to the flake knife with a straight or slightly convex edge (Fig. 6.12b), hollow-edged scrapers with a concave edge, perhaps resulting from use (Fig. 6.14g), are more notchlike. All are confined to the Chiricahua stage.

Projectile Points

Projectile points and related bifacial blades represent 15 percent of the total artifact sample. The dominant types are notched and stemmed, but various leaf-shaped forms are also present. There are seven types: side-notched, side-notched and indented-base, stemmed, leaf-shaped, diamond-shaped, heavy leaf-shaped blank, and double-pointed blank (Figs. 6.16, 6.17).

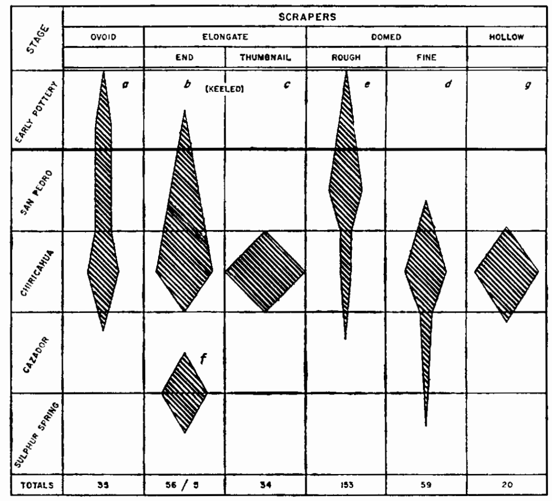


Fig. 6.15. Frequencies of scrapers. Italicized letters refer to artifacts in Figure 6.14 that illustrate various types. Rough domed types may begin to appear in the Sulphur Spring stage.

Side-notched projectile point

Bifacially flaked points have straight to slightly convex bases and wide lateral notches (Figs. 6.16a, 10.4a-c). They are long, with fairly thick midsection. The edges are often finely retouched. Often called the San Pedro point, it is diagnostic of that stage. Two rather large, diagonally notched or barbed points (Fig. 8.9a, b) found in the Cazador stage and a somewhat similar form from the Amargosa I (Red Sand) level in Ventana Cave may represent early examples of the side-notching idea.

Side-notched and indented-base point

Originally these small points were the earliest bifacial and pressure-flaked artifacts reported for the Cochise culture (Figs. 6.16b, 9.4a-f); they are characteristic of the Chiricahua stage. The broad lateral notches and indented or notched base produce a form that is reminiscent of the Pinto Basin type (Campbell and Campbell 1935). This type includes points with an expanded base and ranges into the stemmed form.

Stemmed point

Similar in many ways to the small side-notched and indented-base points, these

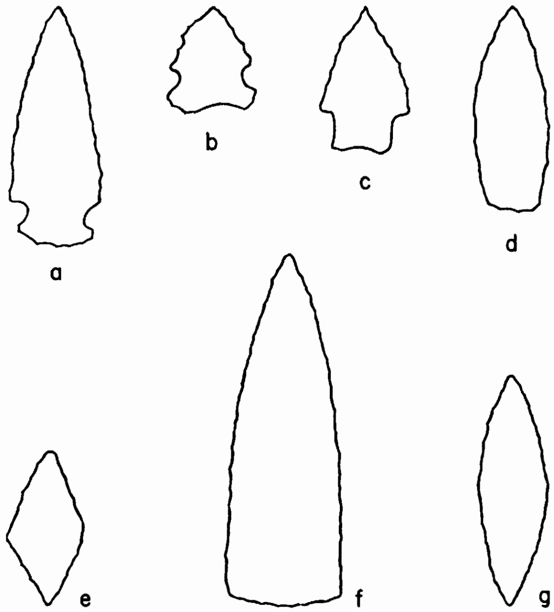


Fig. 6.16. Projectile points: a, side-notched, San Pedro type; b, side-notched with basal notch, Chiricahua type; c, stemmed; d, thin leaf-shaped; e, diamond-shaped; f, heavy blank; g, double-pointed blank. Scale, about 1/2. See Figure 6.17 for frequencies by stage.

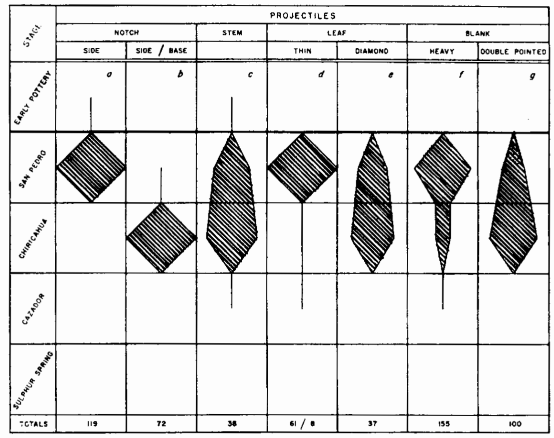


Fig. 6.17. Frequencies of projectile points. Italicized letters refer to artifacts in Figure 6.16 that illustrate various forms.

points have a stem in place of the expanded base (Fig. 6.16c). Stemmed points appear as early as the Cazador stage, are most common during the Chiricahua and San Pedro stages, and continue into the ceramic period (Figs. 6.17c, 9.4g-m).

Leaf-shaped points and blanks

Leaf-shaped forms are extremely varied, including thin leaf-shaped points (Fig. 6.16d), diamond shapes (Fig. 6.16e), heavy blanks (Fig. 6.16f), and double-pointed blanks (Fig. 6.16g). Both unifacial and bifacial forms, some thin and finely made, and others heavy and crude, are found in the Cazador stage; they are more frequent in the Chiricahua and San Pedro stages (Fig. 6.17d, e).

Thin, carefully flaked forms (Figs. 6.16d; 10.4f, g) are characteristic of the San Pedro stage. They may be unfinished tools, blanks for the side-notched San Pedro points (Fig. 6.16a). At Ventana Cave there is a wide variety of comparable thin leaf-shaped blades or projectiles in the Chiricahua and San Pedro stage levels. Some are finely chipped and others are simply thin flakes with little retouching similar to those from the Cazador stage (Fig. 8.9j). A few small leaf-shaped blanks that are found in the Chiricahua stage (Fig. 9.4r) are probably unfinished notched projectile points.

Diamond-shaped forms (Figs. 6.16e, 9.4o) and related tapered-stem forms (Fig. 9.4n), typical of the Chiricahua stage levels at Ventana Cave, are somewhat similar to Gypsum Cave points (Willey 1966). Heavy blanks (Figs. 6.16f, 10.4h-j), usually broken, are present in large numbers in the San Pedro stage. They are probably unfinished tools broken in the process of manufacture. A common blank in the Chiricahua stage is thick and pointed (Figs. 6.16g; 9.4p, q).

Other Stone Tools

A variety of other bifacial implements constitute only 2 percent of the artifact collection: graver, perforator, drill, bifacial disk, and four-pointed or "cruciform" object (Figs. 6.18, 6.19). The four perforating or penetrating implements (Fig. 6.18a-d) are found in both Chiricahua and San Pedro stages, especially at Ventana Cave, and are sparsely represented in the Early Pottery horizon.

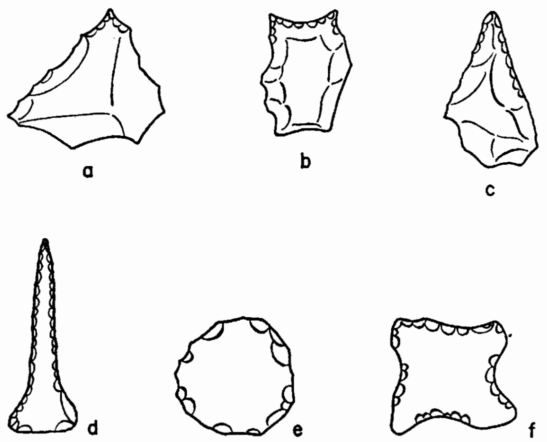


Fig. 6.18. Bifacially flaked tools: a, b, gravers; c, perforator; d, drill; e, disc; f, four-pointed. Scale, about 1/2. See Figure 6.19 for frequencies by stage.

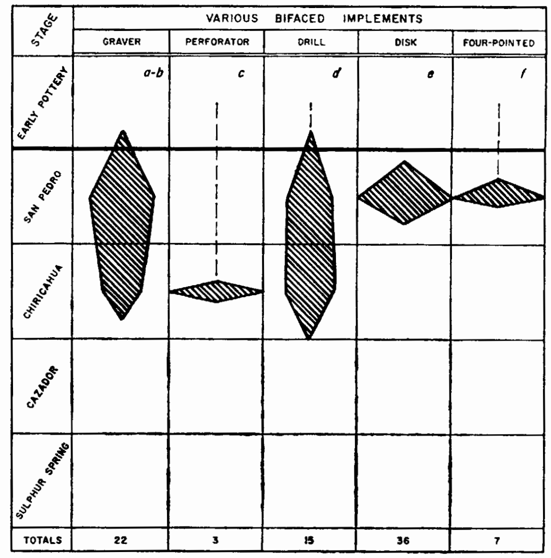


Fig. 6.19. Frequencies of bifacially flaked tools. Italicized letters refer to artifacts in Figure 6.18 that illustrate various forms.

Graver

These simple pointed tools consist of irregular flakes with pointed corners (Fig. 6.18a, b). The graver point, usually bifacial but sometimes unifacial, is often combined with a scraping edge.

Perforator

A triangular flake with a bifacially chipped penetrating point (Fig. 6.18c) is most common in the Chiricahua stage (Fig. 6.19) and may be a proto-drill.

Drill

An elongated, bifacially chipped pointed tool with an expanded base (Fig. 6.18d) is similar to drills common in later pottery sites in the Southwest.

Bifacial disk

Small, bifacially chipped tools, usually abraded around the edge, appear to have been used for some delicate operation (Fig. 6.18e). They occur in a variety of sizes in the San Pedro stage (Fig. 6.19).

Four-pointed object

A so-called "cruciform" artifact (Figs 6.18f, 10.4s) has concave chipped edges. Some of these tools are partially smoothed suggesting that they may have been used for some rubbing purpose. This form is found only in the San Pedro stage (Fig. 6.19), but similar objects, both chipped and ground, occur in later pottery sites.

SUMMARY

The combination grinding tool, consisting of a handstone and nether milling stone, is the most characteristic artifact of the Cochise culture. Various core and flake tools are much more numerous (70 percent of the total), but they are less diagnostic. Figure 6.20 presents synoptic sequences of the major grinding tool types found in the Cochise sites.

The typological development of grinding stones through the several stages of the Cochise culture into the Early Pottery horizon (Fig. 6.20) provides the best basis for achieving some insight into the nature of the Cochise economy. Milling stones are inferred to have been used primarily for processing plant foods.

The earliest form of grinding tool consisted of naturally flat stones modified only by use. Pitting of the ends of the handstone and the surface of the nether stone indicates that the tool was used for crushing, cracking, and pounding. The flat grinding surface of the handstone and the irregular ground depressions on the surface of the nether stone show that grinding and pulverizing were also important techniques of food preparation. Thus, during the Sulphur Spring and Cazador stages, all food processing techniques were used on the same basic milling stone combination. There was no specialization in grinding equipment.

The beginning of the Chiricahua stage is marked by the introduction of more efficient and more specialized tool forms. The more evolved form of nether stone in use then was a comparatively small thin boulder with a shallow grinding basin on the upper surface. The shallow-basin type of grinding surface is typologically derived from the irregular grinding depressions on the earlier slab type of nether stone. The matching handstone is shaped and often faceted. The change in the shape and nature of the grinding surface of the nether stone and the accompanying change in the conformation of the handstone used with it documents the growing importance of grinding in the Cochise economy and the need for more efficient grinding equipment. It is likely that these changes also reflect an increasing dependence on grass seeds, including primitive maize (Haury 1962).

At the same time that the grinding tool became more specialized, new forms began to be utilized for the crushing, pounding, and cracking functions of the older slab grinding stone. The slab nether stone and associated flat handstone continued in use through the Chiricahua stage, probably as all-purpose crushing and grinding tools. The lapstone gradually replaced the slab nether stone for paint-grinding purposes. The pebble mortar was used for crushing and pounding functions. Finger-pits in the modified handstone, pitted and battered ends of handstones, and the proto-pestle indicate an increasing specialization toward pounding in the matching mortar as well as in the nether stone.

These tendencies are intensified during the San Pedro stage with the introduction of developed grinding tools, consisting of the deep-basin nether stone with its convex unifacial handstone, and the true mortar and pestle. An interesting combination mortar-basin was developed in which grinding occurred in an upper shallow basin with the semirotary motion of a convex handstone, while crushing took place in a deeper circular basin with the pounding action of a pestle-type handstone. Occasionally basin-mortars have prepared holes in the bottom suggesting some kind of hopper-mortar. Both the idea of a circular or mortar basin and that of a hopper-mortar may have been introduced to the Cochise from southern California where the earlier oval-basin grinding or milling stone was later replaced by a circular basin.

The main feature of the San Pedro milling tool, however, is the deep grinding basin that requires a convex handstone. This combination indicates that a new grinding technique was being developed that must have involved back-and-forth or side-to-side movements as well as the semirotary motion associated with the shallow-basin Chiricahua grinding stone.

The deep-basin form gradually replaced all other kinds of nether stones. That this change is probably related to further advances in the development of maize is suggested by the elaboration of San Pedro milling equipment during the Early Pottery horizon. Both nether stone and handstone increase in size. Some of the late handstones are so large that two hands were probably required to manipulate them. The deep basin is usually located near one end of the boulder nether stone, resulting in an "open" basin resembling some of the earlier forms of the true metate.

The earliest chipped-stone assemblage is limited, with only percussion-flaked, sinuous-edged choppers, hammerstones, slightly modified flakes, and single-edge scrapers represented (Fig. 6.21). The Cazador stage is marked by a continuation of this Sulphur Spring stage complex and the foreshadowing of certain features of the Chiricahua stage--most importantly projectile points.

As in the case of the grinding tools, the Chiricahua stage is typified by the introduction of new forms that indicate a growing specialization in the Cochise tool kit. Several of these types are characteristic of the Chiricahua stage, even though there is minor continuity of some of them into later times. Diagnostic forms include the ground-edged flake, thumbnail scraper, hollow-edged scrap-

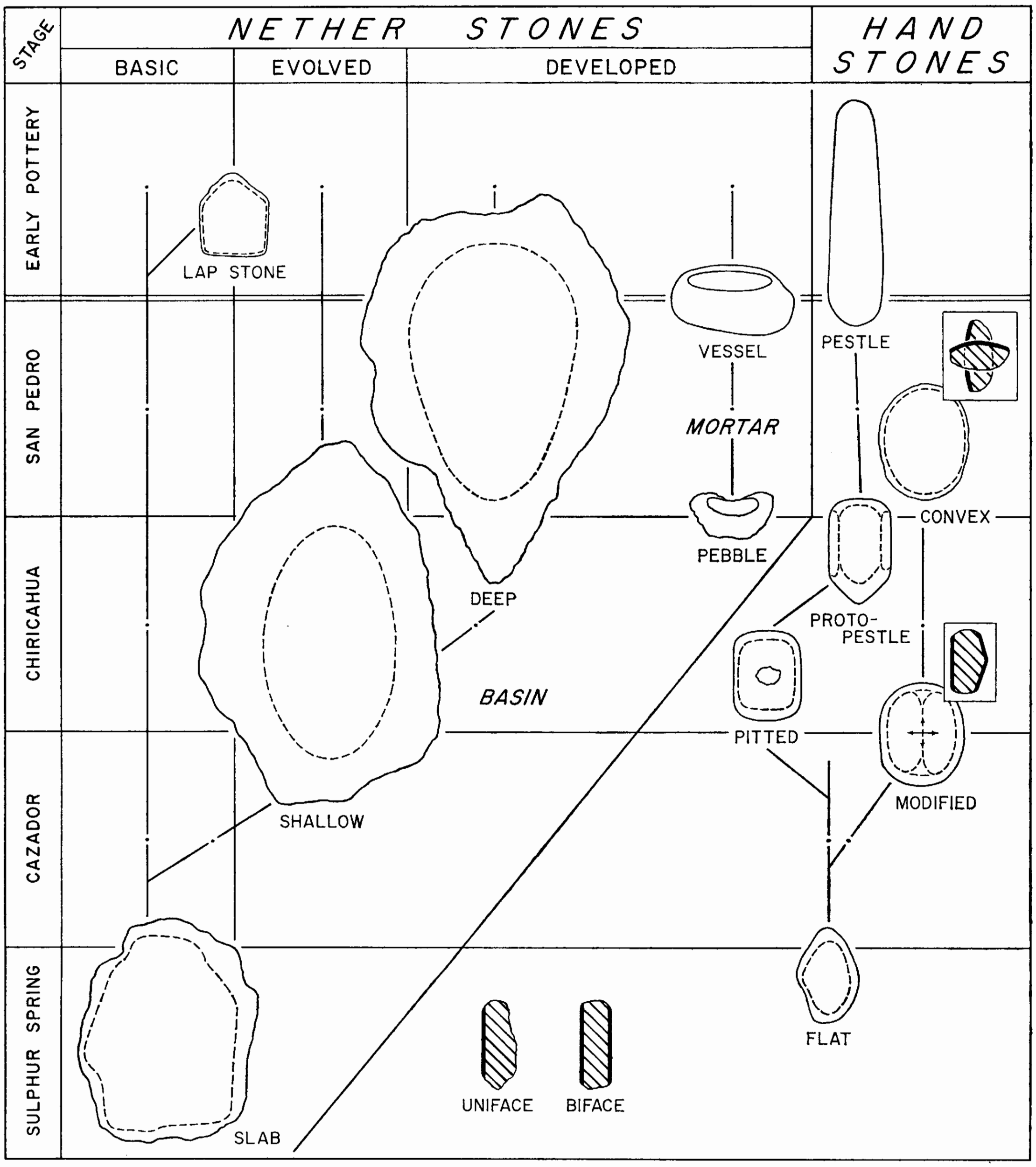


Fig. 6.20. Development of milling stones of the Cochise culture. Dashed lines outline grinding area; heavy lines in sections identify grinding surface. (No scale.)

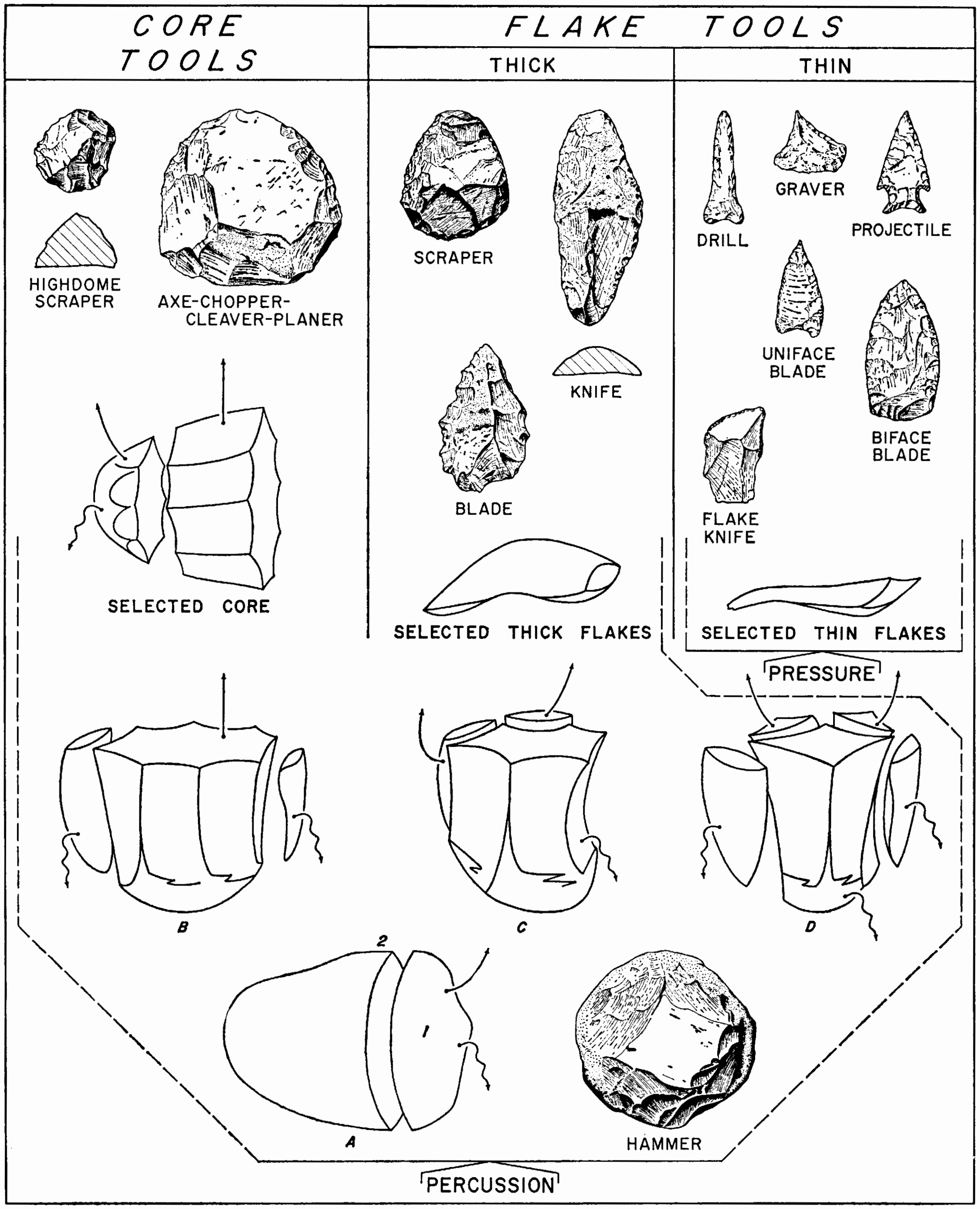


Fig. 6.21. Probable methods used in fashioning flaked stone tools. A, material selected for use was struck by hammer to remove thick flake (1), in order to produce a striking platform (2); the flake was discarded or used in making a plano-convex tool. B, additional flakes removed and discarded to produce core for tool making. C, thick flakes removed for making thick flake tools. D, selected material used for producing thin flakes and blades for making thin and small flake tools. (No scale.)

er, side-notched and indented-base projectile point, and perforator.

Elaboration of the chipped-stone assemblage continues into the San Pedro stage with increasing specialization and more new forms. Typical of the San Pedro stage are pebble hammerstones, San Pedro or large side-notched projectile points, thin leaf-shaped blanks, bifacially chipped disks, and four-pointed objects. Chipped-stone types outnumber grinding tool types in the San Pedro stage.

Pressure flaking was introduced during the Cazador stage and continued in later stages. Projectile points found in Cochise sites are relatively crude compared to those of other areas. The use of various volcanic rocks with poor chipping qualities, rather than obsidian or chert, may explain the relative crudity of the Cochise points. However, it seems more likely that the projectile points exhibit poor quality of chipping because they never had the significance for the Cochise economy that they seem to have had elsewhere. Projectile points are diagnostic for only the Chiricahua and San Pedro stages.

The typological continuity of the Cochise culture from the Sulphur Spring stage into the Early Pottery horizon is clearly documented by the sequence of grinding tools: first, by the persistence of earlier forms into later stages, and second, by the developmental relationship of the new forms to earlier prototypes. Chipped stone tools are not as useful in demonstrating this continuity, but they contribute to the over-all picture. The continuity of the Cochise culture is so strong that it is difficult to justify a statement made by Wormington (1957: 171-72): "Although it appears to be possible to trace an evolutionary sequence from the Sulphur Spring stage through the Chiricahua to the San Pedro, there is a definite typological break between the last two." The traits she cites represent elaborations of the basic tradition rather than fundamental changes. The archaeological context of each stage as represented by the artifacts and their occurrence is described more fully in the following sections.

7. SULPHUR SPRING STAGE

E. B. Sayles

The earliest evidence of the Cochise culture was found at the Double Adobe site (Fig. 6.2, Site 38) on Whitewater Draw in the southern portion of the Sulphur Spring Valley. These finds provided the basis for the establishment of the Sulphur Spring stage (Sayles and Antevs 1941: 11-15). Six other sites have been assigned to this early stage on the basis of both geological and archaeological criteria (Table 6.3, Fig. 6.2). All of these sites were known at the time of the first report on the Cochise culture (Sayles and Antevs 1941: 63), except Arizona CC:13:3 (Fig. 6.2, Site 15) on the western shore of ancient Lake Cochise. Geological dating (Chapter 4) places the Sulphur Spring stage in the period from at least 12,500 to 11,000 B.P. (10,500 to about 9000 B.C.; see Fig. 4.5). No radiocarbon dates have been obtained from any site identified with the Sulphur Spring stage. However, radiocarbon dates of the later Cazador stage of 8000 to 9000 years ago show that the earlier Sulphur Spring stage must be as old as the associated dated geological sediments indicate.

At the type site artifacts were found along with fire-cracked rock, charcoal, and burned and broken animal bones in association with an extinct fauna in old stream and gravel beds exposed in the arroyo walls of Whitewater Draw (ill., p. x., Figs. 7.1, 7.2; Tanner 1954: 12-14; Sayles and Antevs 1941: 11-15). Extinct forms found at Double Adobe were mammoth, horse, bison, and dire wolf. Camel and other extinct forms may be added to the assemblage on the basis of finds at other sites (Table 3.1).

The occurrence of the artifacts in stream beds of sand and gravel indicates that their source was from camp sites either on gravel

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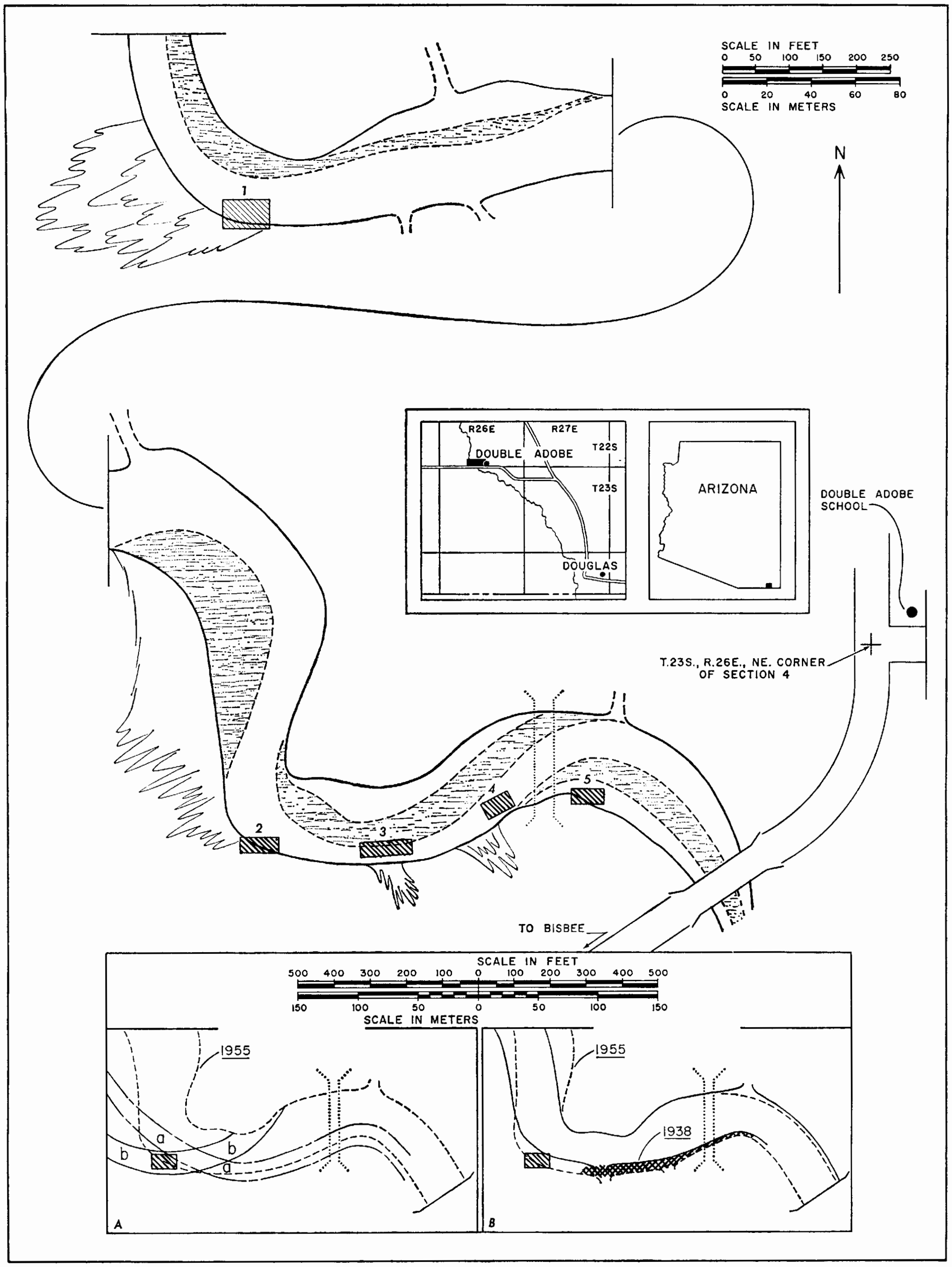
Fig. 7.1. Map of the Double Adobe area type sites of the Sulphur Spring stage (Loc. 1, 3, 4, 5) and Cazador stage (Loc. 2), Arizona FF:10:1 (GP Sonora F:10:1; Figure 6.2, Site 38), 12 miles northwest of Douglas. This map, drawn in 1955-1956 shows arroyo banks (solid line), stream-bed gravels (dashed line and enclosed pattern), location of old highway bridge (dotted bridge symbol), as of that date. Since 1926, when the site was first examined by B. Cummings and his students, the south bank at the old bridge and to the west has been cut back by erosion as shown by inserts A and B. The area to the east of the old bridge has been modified as described in Chapter 8. Hatched rectangles: 1, west extension of the site, excavated in 1938 by Gila Pueblo and in 1956 by the Arizona State Museum (Fig. 4.7); 2, Cazador type site excavated in 1953 and 1955 by the Arizona State Museum (Fig. 4.8); 3, location of excavations by Gila Pueblo in 1938; 4, location of mammoth jaw excavated by Cummings in 1926 (Fig. 4.6); 5, location of investigations by Gila Pueblo in 1938 and the Arizona State Museum in 1956. Inserts show relationship of Cazador stage deposits at Locality 2 (hatched rectangle) to various stages of the stream—A: dashed lines, arroyo banks in 1955; a, probable location of stream during Sulphur Spring stage; b, probable location of stream during Cazador stage; B: dashed lines, arroyo banks in 1955; solid line, arroyo banks in 1938 when Gila Pueblo excavated in Localities 3, 4, and 5 in patterned area representing extent of geological deposits associated with the Sulphur Spring stage. (For details of Loc. 2, 3, 4, 5, see Chapter 12, Fig. 12.2.)


SCALE IN FEET
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2
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TO BISBEE
SCALE IN FEET
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1955
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1955
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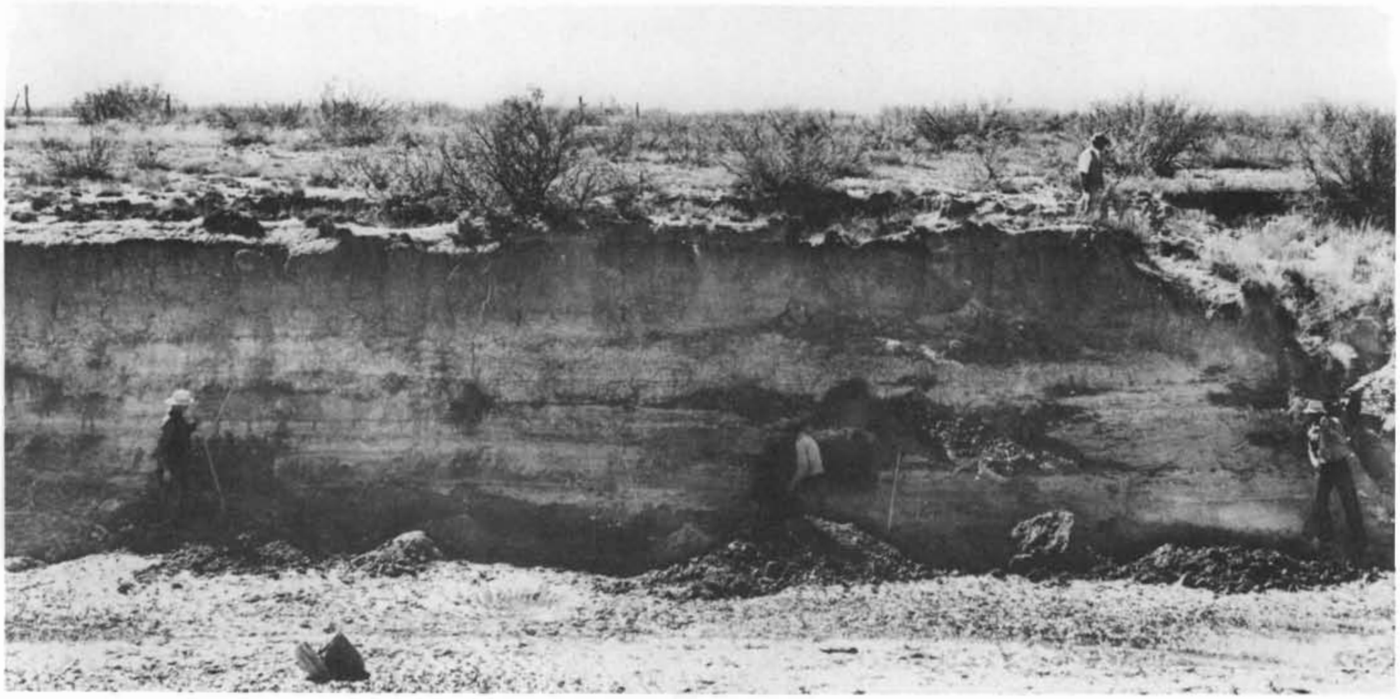
B

Figure 7.1



a

b

c

Figure 7.2

bars of the running stream or, more likely, on the banks themselves. Erosion probably dumped camp debris into the stream where it scattered and was later covered.

Sulphur Spring stage artifacts consist of small flat nether milling stones with matching flat handstones (Fig. 7.3), hammerstones, and percussion-flaked knives, scrapers, and choppers (Fig. 7.4). No bifacial blades or projectile points are known from sites of the Sulphur Spring stage. Projectile points from the Double Adobe site reported at the 1954 Great Basin Conference (Meighan 1955: 311) and mentioned by Wormington (1957: 171) and Willey (1966: 58) come from the locality (Fig. 7.1, Locality 2) that produced the assemblage now assigned on both archaeological and geological evidence to the immediately following Cazador stage.

The early Cochise grinding tools are small compared to those from later stages. Few complete specimens are found in Sulphur Spring stage contexts; most are badly weathered and broken into small fragments. Even the occasional complete handstones that are found are cracked and sometimes distorted from the weight of the overburden. The two parts of the grinding tool are essentially unmodified except for the evidence of use and wear. Shallow irregular grinding depressions are worn on the upper surface of the nether milling stone. The handstone shows abrasive wear on the flat side and pecking and pitting on the edges. All Sulphur Spring stage grinding tools are made of quartzite, some of it rather gritty. The immediate sources of material were probably stream beds where cobbles and boulders were selected. A sandy quartzite from the nearby foothills of the Mule mountains may have been utilized for nether stones, particularly.

Chipped-stone artifacts are typified by forms made from cores and thick heavy flakes such as the sinuous-edged chopper (Fig. 7.4j), large side scraper (Fig. 7.4a-c), and high-domed scraper (Fig. 7.4d, e, g, h). Plano-convex shapes predominate. Some of the larger side scrapers resemble straight-edged choppers (Fig. 6.10b), but are more finished in that the entire convex surface has been chipped. One type of scraper (Fig. 7.4f) characteristic of the Sulphur Spring stage has prepared edges on opposite faces of the flake. Chert, basalt, and jasper were common materials used for chipped stone tools. Crude hammerstones (Fig. 7.4i) were made of basalt or quartzite.

Two early, but not firmly dated, sites contained human bones in context with the sediments. Skull fragments and pieces of long bones found at GP Sonora F:10:17 (Fig. 6.2, Site 39) are probably Sulphur Spring age because of their association with extinct camel and bison (Sayles and Antevs 1941: 13, 65). A skull fragment and the head of a femur from early beach deposits at Arizona CC:13:3 on the west side of pluvial Lake Cochise (Fig. 6.2, Site 15) exhibit a degree of mineralization that indicates some antiquity.

The range of evidence now available indicates a way of life during the Sulphur Spring stage based on a gathering economy. Numerous grinding tools are inferred to have been used primarily for preparing plant foods, even

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Fig. 7.2. Sulphur Spring stage, Arizona FF:10:1 (GP Sonora F:10:1), Locality 3 (Figs. 6.2, Site 33; 7.1, Loc. 3). a, test trenches, first research by Gila Pueblo at the type site of the Sulphur Spring stage in 1937. b, lower section of arroyo wall, showing laminated silts and clay overlying sand (containing charcoal, bones, and artifacts) resting on bedrock of calichified clay. Handstone is shown below center of photograph. c, method of excavation. The massive cienega silt stands perpendicularly above the calichified silt that rests on the slope of the more resistent calichified clays and sand. Hand tools were used to excavate the lower part of the bank to determine the nature of the strata in which the artifacts, charcoal, and animal bones occurred. A record of the contents of the alluvial deposits was kept on a grid plan, with an elevation profile (by Antevs) to establish the location of artifacts with relation to the geology. The arroyo was used as a test trench through the alluvial deposits within the flood plain. Horsedrawn equipment was used to remove the back dirt from the excavation, and to reach bedrock clay, frequently below water level.

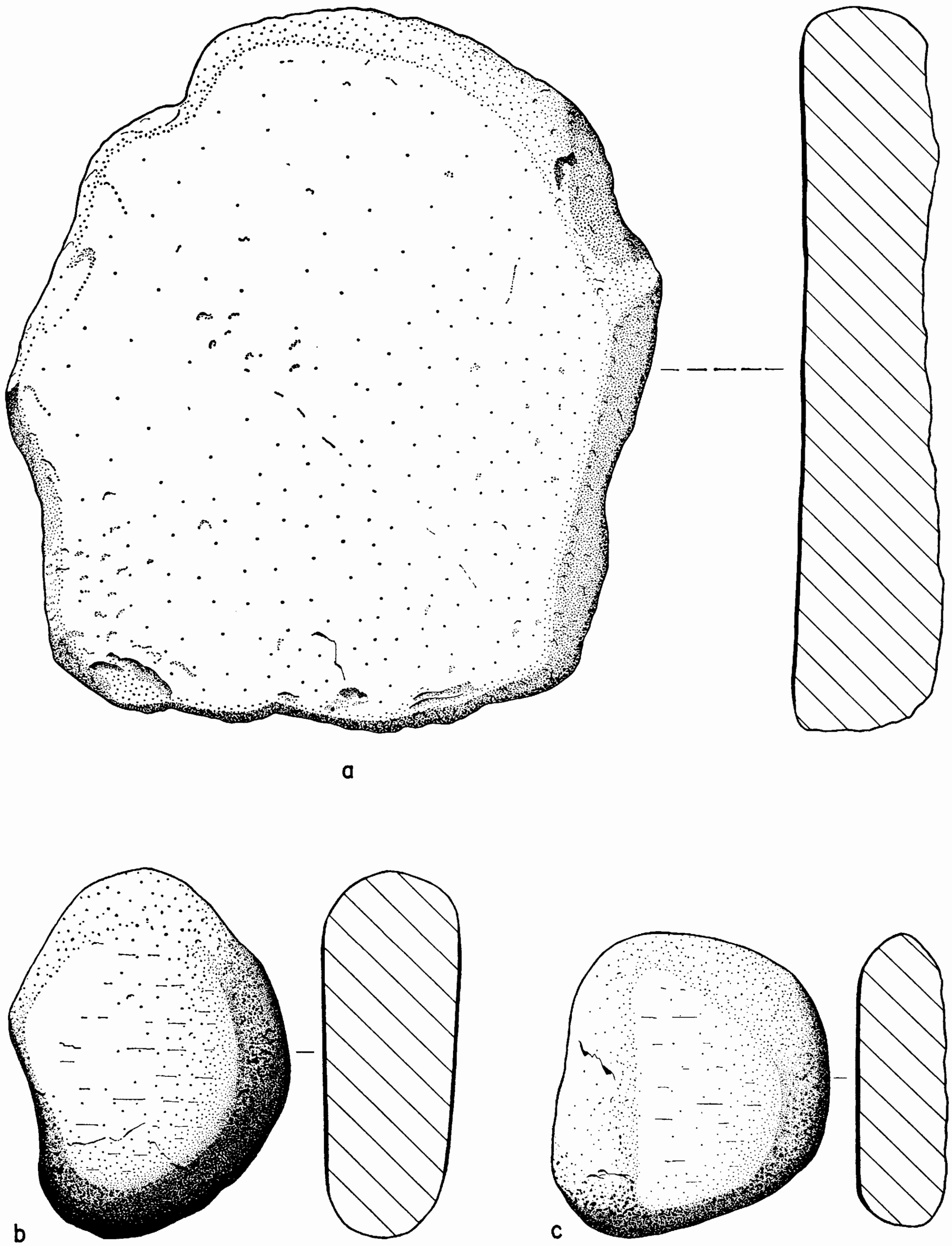

Fig. 7.3. Milling stones of the Sulphur Spring stage: a, nether milling stone, quartzite slab, one face pecked in limited areas and worn smooth from use, edges unaltered; b, asymmetrical quartzite handstone, both faces worn smooth from use, long axes of used surfaces flat except where they approach the edge, short axes slightly convex, edges unaltered; c, asymmetrical quartzite handstone similar to b except that only one face worn smooth from use. Heavy line indicates grinding surface. Length of a, 24.5 cm. Similar types occur in the Cazador stage.

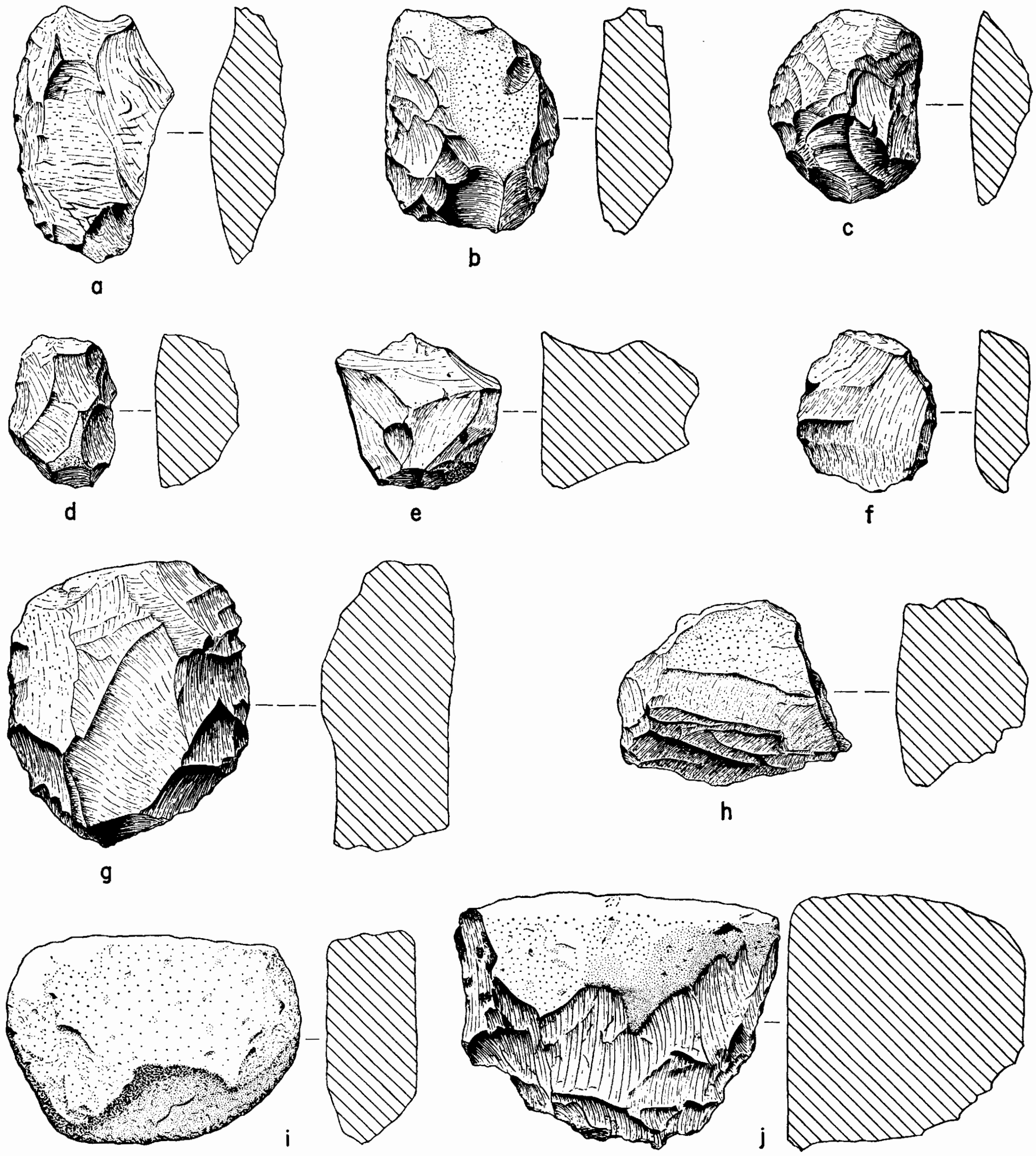

Fig. 7.4. Chipped-stone artifacts of the Sulphur Spring stage: a–c, Knives of the thick side-scraper type with straight or convex edge, usually only single-edged, chipping frequently precise; d–h, scrapers of the high-domed type; d, e, h, common, with range from precisely chipped (d) forms to those resembling cores (h); f, reversed end scraper, a distinctive type; g, end scraper, large size common; i, hammerstone made of flat spall-like pebble, roughly chipped around entire edge, battered; j, chopper made of a plano-convex pebble chipped to a sinuous edge on three sides, one edge unaltered, plane surface smooth, possibly from use (Sayles and Antevs 1941, Pl. 4 d). Length of a, 7.3 cm. Materials used were fine-grained quartzite, basalt, and infrequently, chert. Similar types in Cazador stage.

though it is not yet possible to determine the range of plants used. It seems likely that tule or cattail (*Typha*) was an important food. Climatic conditions were moist and cool enough to encourage its growth during the Sulphur Spring stage, and it is present today in all places where such conditions prevail. Cattails are known to be rich in fat, minerals, protein, and carbohydrates, and they were used extensively for food, basketry, and other purposes by historic tribes such as the Klamath (Cressman 1956). The rhizomes must be dried and ground to a powder before the plant can be cooked. The simple Sulphur Spring grinding tools would have served admirably for processing such food. Milling tools were probably also used for grinding pigments. Small flakes of hematite have been found at Double Adobe and other sites.

The presence of scraping and cutting tools and burned and broken animal bones indicate hunting activities were also a part of the subsistence economy of the Sulphur Spring stage, although projectile points have not been found in a Sulphur Spring stage site. The lack of projectile artifacts may simply be an accident of discovery; few sites have been explored and thoroughly excavated and the full range of artifacts for the stage may not yet be known. It is also possible that perishable materials such as wood were used for making projectile points. There is also a strong possibility that Sulphur Spring stage sites represent only the seasonal gathering phase of a subsistence economy that included both hunting and gathering methods of food-getting. The sites now known are representative of small groups of people living temporarily where natural foods, especially plants, were available. The artifact assemblage at these sites may reflect that part of the economy conducted by women. The seasonal hunting sites needed to round out this interpretation have not yet been found, although it has been suggested that the big-game hunters of the Llano complex may represent the seasonal hunting aspect of the Sulphur Spring stage, inasmuch as the same extinct faunal assemblage is associated with both complexes. It is my belief, however, that present evidence supports the view that the big-game hunters were antecedent to the Cochise gatherers rather than contemporaneous with them as a seasonal variant (Haury, Sayles, and Wasley 1959: 27). The lack of projectile points in the tool kit of the Sulphur Spring stage remains an unsolved problem.

In sum, the Sulphur Spring stage provides the basic pattern for the Cochise culture that persists in time despite the elaborations of later stages. Small groups of people living in temporary camps near natural food sources depended largely on the gathering of plant foods, supplemented with additions to the diet that hunting made possible.

FAIRCHILD MAMMOTH

The discovery of mammoth bones approximately 170 m north of the Fairchild site and 140 m southeast of the highway bridge at Double Adobe may lead to a fuller understanding of the occurrence of fossil bones in sediments with which the Sulphur Spring stage is associated. As a part of the investigation of the Fairchild site, a series of backhoe test trenches was dug within the proposed new highway right-of-way from the west bank of Whitewater Draw toward the site. These trenches produced fragments of mammoth bone from a depth of three and one-half to four meters below surface in a layer of mixed greenish sands and clays with considerable amounts of limonite staining (Huckell 1972). The layer is comparable in depth and general appearance to the sands at Double Adobe, Localities 3, 4, and 5, identified with the Sulphur Spring stage. With more trenching intact long bones and other elements of a single mammoth were uncovered, some of which may possibly show signs of having been redeposited. Two radiocarbon dates were obtained from charcoal collected in the bone stratum: 8920± 1150 B.P. (TX-1199) and 10420±100 B.P. (A-1152). The first date with the wide margins of error was derived from a small sample and is of questionable accuracy.

From the sand unit that overlay the bone bearing unit in two of the other trenches, two milling stone fragments and three unmodified flakes were recovered. There was no direct association of the artifacts with fossil bone although "one badly tumbled fragment of long bone shaft" was found a few centimeters from the three flakes (Huckell 1972). The artifacts were in a grayish-brown sand with clay lenses, overlain by two clay beds; the upper dark-reddish gray clay, with sparse small carbonate nodules, had a maximum thickness of one and one-half meters. The other light gray firm clay bed, with numerous carbonate nodules, had a maximum thickness of two meters.

The bone bed from which the mammoth remains were recovered was composed of grayish brown sand and gravel, interbedded with silty clay. This unit measured at least one meter in thickness, and may have attained a thickness of three meters or more. The sand and gravel formed the fill of an ancient channel, carved into an older series of bedded alluvial units.

8. CAZADOR STAGE

E. B. Sayles

Field work conducted at the Double Adobe site (Arizona FF:10:1; Fig. 6.2, Site 38) since 1950 has provided evidence for the establishment of a new stage in the Cochise cultural sequence that is transitional between the Sulphur Spring and Chiricahua stages. This intermediate stage has been designated Cazador, after the name of an old community near Douglas, Arizona (Figs. 8.1, 8.2). Cazador has a secondary significance as a stage name. It means "hunter" in Spanish, and thereby calls attention to the increased dependence on hunting as well as gathering that is suggested by the artifact assemblage.

The type exposure is Locality 2 at Double Adobe (Fig. 7.1, Loc. 2). The geological evidence as presented in Chapter 4 demonstrates that the Cazador stage is later than the Sulphur Spring stage. Deposits of sand and gravel in which Cazador artifacts are found indicate that the perennial stream that flowed in Whitewater Draw during the earlier Sulphur Spring period (Fig. 7.1A, a) had shifted its channel by Cazador times (Fig. 7.1A, b). Like the occurrence of Sulphur Spring stage artifacts, the Cazador stage stone tools, animal bones, charcoal, and hearthstones are found in sand and gravel strata. Concentrations occur only on the surface of the underlying base (bedrock) clay strata, indicating their placement by stream action and not by man.

At the type site, most of the artifacts were found near the center of the excavation (see Fig. 8.5). They probably represent only a small part of the total inventory originally associated with the site before stream erosion exposed it. The overlying strata record events correlated with the latter part of the Anathermal when intermittent ponds had replaced the earlier running streams and lakes. Changing climatic conditions are also indicated by a modern fauna that replaced the extinct forms present in the deposits of the earlier part of the Anathermal (Table 3.1). Antevs (in Chapter 4) assigns a geological date of 8000 to 11,000 B.P. (9000 to 6000 B.C.) to the late Anathermal times of the Cazador stage (Fig. 4.5). The radiocarbon dating of the Cazador stage, based on associated and related dates, ranges from roughly 8000 to 9000 B.P. (Table 5.2).

Cazador stage deposits are found at two other sites stratigraphically later than the Sulphur Spring stage deposits at those sites (Table 6.3): GP Pearce 8:21 (Figs. 4.9; 6.2, Site 32; 8.1) and Arizona FF:10:5 (GP Pearce 8:10; Figs. 4.10; 6.2, Site 33; 8.2). These sites produced grinding tools and chipped stone implements comparable to those found in the Sulphur Spring stage and also some modified handstones similar to the Chiricahua stage type, but they lacked the full complement of percussion flaked projectile points and blades found at the Cazador type site (Fig. 7.1, Loc. 2).

Implied evidence of hunting in the Sulphur Spring stage was based on the presence of animal bones and stone tools such as knives and scrapers normally associated with hunting activities. The Cazador bifacial blades and projectile points (see Fig. 8.9) provide

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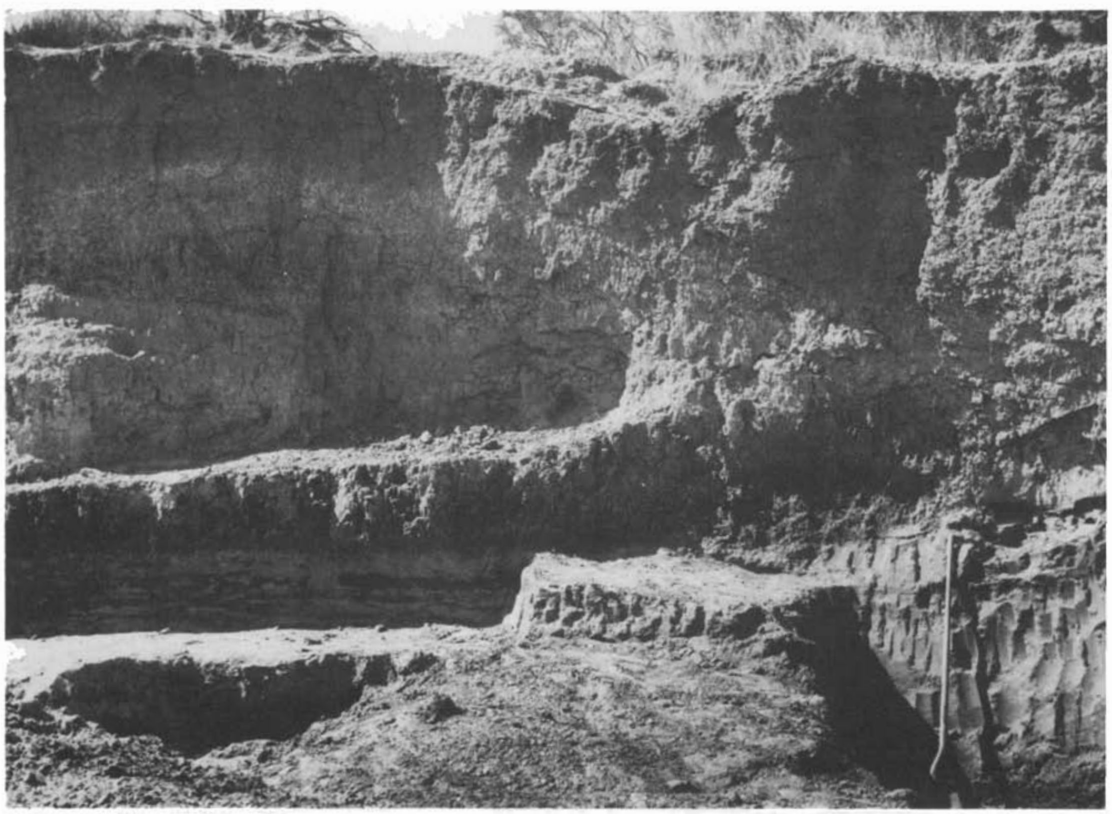
Fig. 8.1. Cazador stage deposits overlying Sulphur Spring stage deposits (GP Pearce 8:21; Figs. 4.9; 6.2, Site 32). a, exposure of site on west wall of Whitewater Draw arroyo, 3.5 miles north of the Double Adobe area, before excavation in 1935-1937; Cazador stage deposits on left, overlying Sulphur Spring stage on right. b, superimposed strata identified with Cazador stage overlying Sulphur Spring stage at right; shovel rests on bedrock clay. (Profile and description in Fig. 4.9.) This site was re-examined in 1953 to verify identity of Sulphur Spring and Cazador stages.

a



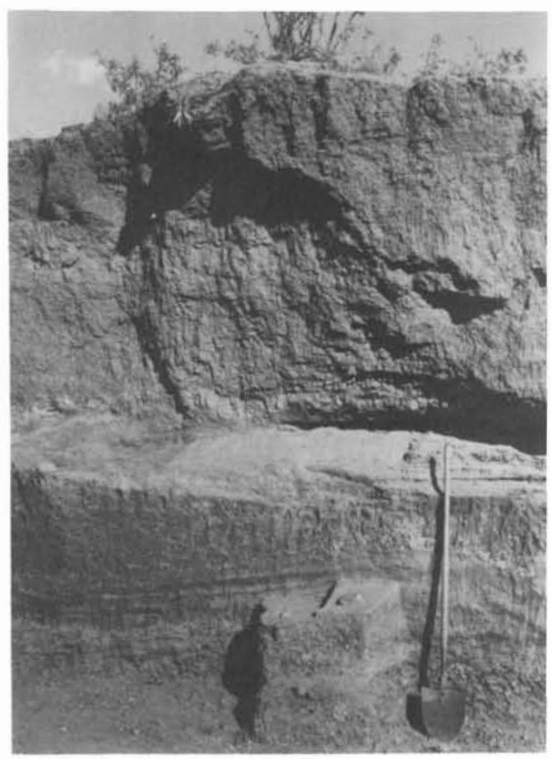
b

Figure 8.1

a

b

c



d

Figure 8.2

the first positive evidence of hunting as a part of the Cochise subsistence pattern. In addition, the heavy, barbed, and leaf-shaped projectile points are similar to those in the Amargosa or Red Sand level at Ventana Cave (Haury 1950, Fig. 56f, q).

Modification of the simple handstone also took place in the Cazador stage. Some handstones are shaped by edge-pecking similar to specimens found in the Chiricahua stage. This occurrence, and the fact that percussion-flaked points and blades are a part of the Chiricahua stage, imply that the Cazador stage occurred during that period defined by geology as between the Sulphur Spring and Chiricahua stages, Double Adobe II Subpluvial.

A lump of hematite, apparently shaped by man, was found at the Cazador locality at Double Adobe (see Fig. 8.14). An ounce of it was ground to a powder and it resembles the red pigment made from hematite in later periods. Flecks of hematite occur in early Cochise horizons, and it is possible that paint, as well as food, may have been prepared on Cazador milling stones.

EXCAVATION

The exposure designated Locality 2 at Double Adobe was discovered in April, 1953, while we were searching the Whitewater Draw for a locale that would produce charcoal dating for the Sulphur Spring stage. The south bank of the arroyo, west of Locality 3, presented a fresh face from recent erosion. The vertical face of the arroyo bank overlay a rusty sand bed resting on the pink base clay (Fig. 8.3a, b). On the surface of the slope adjoining the stream bed were loose hearthstones and both chipped and ground stone tools, apparently coming from the sand strata in which were many specks of charcoal. The presence of hearthstones and artifacts was assurance that the charcoal was man-made and not from a natural fire.

Samples of charcoal were hand-picked (by Bannister) and delivered to the Geochronology Committee of the University of Arizona. At that time we believed that the locale represented an extension to the west of the area excavated in 1937 (Locality 3) that had provided the information on which the Sulphur Spring stage was established. Initial inspection of the new location, with a good showing of both charcoal and artifacts, resulted in plans to investigate Locality 2 further.

The sloping face of the exposure below the vertical section was first cleared to expose the strata resting on bedrock clay. Charcoal, hearthstones, and stone flakes were found, some in place but most in the loose surface material, for a distance of approximately 75 feet extending east of the eroded area (Fig. 8.3a). The limits of the investigation were defined by the occurrence of this material, and a horizontal plan and vertical profile of the area were drawn.

The sloping exposure was excavated by hand to define the strata and observe their contents, including charcoal, artifacts, bone, and other archaeological material. Sections of the slope were left undisturbed or stepped to provide a footing while clearing the face of the overlying vertical section of the arroyo wall (Fig. 8.3d), and for later geological observations by Antevs, who was not present when the preliminary work was undertaken. The horizontal and vertical positions of the artifacts were recorded on the field map and later incorporated into the final records of the excavation of this locality (see Figs. 8.5-8.7). Photographs were

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Fig. 8.2. Cazador stage deposits overlying Sulphur Spring stage deposits (Arizona FF:10:5; GP Pearce 8:10; Figs. 4.10; 6.2, Site 33), 2.6 miles north of Double Adobe. a, Site in east bank of arroyo extends both north and south a total distance of approximately 300 feet. b, preliminary trenching designed to determine relationship of strata and to establish control points for mapping profile. c, artifacts exposed in upper strata. d, relationship of upper stratum, Cazador stage (end of shovel handle), to lower strata, Sulphur Spring stage. (Profile of site, Fig. 4.10.) The site was re-examined in 1953 and the upper stratum was identified with the Cazador stage in sediments deposited following erosion of earlier sediments identified with the Sulphur Spring stage.

taken of the strata and artifacts in situ. Bone, charcoal, and soil samples were collected for study and identifications by specialists.

This preliminary work showed that the base clay (bed a in Fig. 4.8), common in all sites heretofore identified with the Sulphur Spring stage, was overlain by a rusty sand (b^1) containing some gravel. Bed b^1 was covered by a laminated rusty sand (b^2), and it was overlain by a massive dark stratum of clay with laminae of silty bands (bed c).

The artifacts, including hearthstones, were primarily in contact with bedrock clay. Hearthstones, in particular, were also present where the overlying strata of laminated sands came in contact with the sandy clay. In addition to a large number of hearthstones, represented by small fragments of grinding tools, the preliminary investigations produced not only some of the chipped tool types heretofore identified with the Sulphur Spring stage, but also projectile points and quantities of flakes usually associated with hunting industries. These kinds of projectile points and flakes had not been found with Sulphur Spring stage assemblages. Whole or large fragments of both milling and handstones, grinding tools characteristic of the Sulphur Spring stage, were scarce.

Results of the preliminary excavations at Locality 2, especially the discovery of chipped stone tools represented by projectile points and blades not found in the Sulphur Spring stage, demanded more investigation. Since spring and summer are not conducive to field work in southern Arizona because of water in Whitewater Draw (both from rains and irrigation drainage), further work was delayed until fall.

Information obtained from the preliminary excavation was used to establish the exact location of the site with reference to previous work done in that area. The eastern limit of the preliminary investigation (Locality 2) was 350 feet west of the old bridge along a base line established 25 feet to the south on ground level (see Fig. 8.5). The County Commissioner of Cochise County agreed to provide a power shovel to remove the overburden at the site in order that it might be completely excavated. After obtaining permission from the owner of the land, Mr. James E. Brophy, II, of Bisbee, Arizona, personnel from the Arizona State Museum began excavations late in 1953, continuing at intervals through 1955 (see Figs. 4.8, 8.3, 8.4).

The second stage in the excavation of the site was undertaken in October, 1953, with Antevs on hand to observe and record the geology (Fig. 8.4). Profiles were drawn of the south wall of the exposure, including an extension to the west beyond the eroded area. Archaeological information from the preliminary excavation was added to the plan, incorporating the horizontal relationship of the excavation with reference to artifacts, geology, and other observed features. The geological and archaeological field records are shown in Figures 8.5–8.7.

Since the placement of all foreign inclusions in the strata, cultural and noncultural, was by natural deposition and not attributable to man, a record was carefully kept of their horizontal positions within the grid plan and their vertical positions in relation to the geological sediments. The thicknesses of the strata are natural ones (not man-made), and are distinguished from one another not only

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Fig. 8.3. Discovery site of Cazador stage, Locality 2, Double Adobe area, Arizona FF:10:1 (GP Sonora F:10:1). a, Locality 2, right; Locality 3, left, in shadow, with only the remaining upper perpendicular strata resting on the pink basal clay. b, site extends between the two figures; perpendicular face of upper strata at left, sloping face of lower strata in mid-ground, and stream bed gravel at right. c, site extends to right of plane table; surface erosion had removed the recent silt sediment, leaving the upper strata exposed in the perpendicular face of the arroyo; the lower strata, resting on the bedrock clay partially concealed by shrubs and recent stream deposit of silt and gravel. d, south face of preliminary excavation showing upper strata overlying sand b^1 and sand b^2 containing artifacts, and resting on bedrock pink clay a (in foreground). The lower strata were stepped for mapping of profile.

a

b

c

d

Figure 8.3

a

b

c

d

e

f

Figure 8.4

in elevation but in geological characteristics. This simplified the excavation but demanded close observation in order to correctly identify the strata. The geological formations were meticulously delineated as a basis for reconstructing the geological stratigraphy. Noting erosion surfaces and their overlying deposits was essential in establishing the identity of the stages of the Cochise sequence.

GEOLOGY

The geology of the site has been described by Antevs in Chapter 4 (see Fig. 4.8), and is summarized here. The main part of the site may have originally covered an area about 75 feet long adjacent to the south bank of a meander in the stream. The width of the site, from water's edge to the bank of the stream, is uncertain as erosion may have partially destroyed it. The distance between the banks of the stream may not have exceeded 100 feet, as indicated by base clay a situated approximately 15 feet below the top of the bank—three feet deeper than the base clay at the Sulphur Spring sites, Localities 3, 4, and 5, to the east.

The human activities that produced the artifacts may have taken place on a sand bar against the south bank. As shown in Figure 8.5, most of the artifacts were in sand b^1 and in contact with pink clay a. Erosion by wind and water may have caused the distribution of these artifacts and their concentration on pink clay a. There is no reliable evidence that the artifacts were tumbled and transported any distance, rather that the gently flowing water of the stream through the sand had caused them to settle.

Other occurrences of artifacts at the base of the massive blue pond clay c, and in contact with the surface of sand b^2 (Table 8.1), suggests that artifacts may have been deposited in several different ways. As shown by the section in Figure 8.7, the base clay rises gradually toward the southern part of the excavation and inclines steeply just beyond the area where it outcrops on the surface as caliche. The surfaces of all strata, including the sands, are fairly level, unlike those identified with the Sulphur Spring stage. Where the base clay begins to rise steeply, the lower sand b^1 pinches out; sand b^2 also thins farther to the south.

Overlying strata, including the massive blue clay, all appear fairly level; the massive silt deposit d^2 is sandier where it slopes from south to north. Silt and clay strata are indistinguishable where they join the base clay in a highly calichified zone (similar, somewhat, to the broad zone in the nonconformity to the east of Locality 2, fully described by Antevs in Chapter 4). It seems most probable that while human activities were taking place on the sand bar below the bank, use was also being made of the adjoining ground level above the bank. Later erosion may have brought this ground level

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Fig. 8.4. Excavation of Cazador stage deposits at Locality 2, Double Adobe area, Arizona FF:10:1 (GP Sonora F:10:1). a, power shovel used to strip the overburden to a depth of 8 feet below the surface. Preliminary excavation and erosion west of the site had shown that the artifact-bearing strata and overlying blue clay lay within the lower four feet. b, a team of horses with a "slip" was first used to clean up the shovel work. c, the area was prepared for final excavation by scraping with a hoe and brushing with a broom to remove the upper part of the laminated clay bed. d, a broadside trench was then prepared across the entire north side of the site where preliminary work had removed the lower sand strata resting on bedrock clay. Work progressed by excavating grids starting from the broadside across the north side of the site; the broadside trench (in background) was cleared of back dirt by the team of horses. Profiles were kept by Antevs and a complete sequence of strata was left in the south and west walls of the excavation. e, south wall, showing artifacts and hearth stones on bedrock clay a; in background sand b^1 containing gravel and artifacts overlain by sand b^2. f, south wall (extension) showing entire profile.

Table 8.1

Distribution of Artifacts Beyond
Area of Concentration, Locality 2, Double Adobe

Artifact Number (Fig. 8.5)	Illustration Figure	Catalog No.	Artifact	Exception*
1	8.11f	A-9163	Uniface flake	Clay c on clay a
2	8.8e	A-12558	Hammerstone	Caliche on clay a
3	8.10j	A-12554	Flake knife	
4	8.10d	A-12557	Biface bit	
5	8.9g	A-9137	Scraper	
	8.9j	A-12561	Scraper	
	8.11i	A-12563	Base of preform	Caliche overlying clay c
6	8.12e	A-39330	Handstone	
7	8.13d	A-12553	Milling stone	In sand b^2
8	8.10b	A-9188	Uniface flake	Surface, preliminary excavations
9	8.12b	A-39314	Handstone	Sand b^1 on clay a
10	8.11b	A-9178	Projectile point	Sand b^1

*All artifacts contact clay c with sand b^2 except as noted.

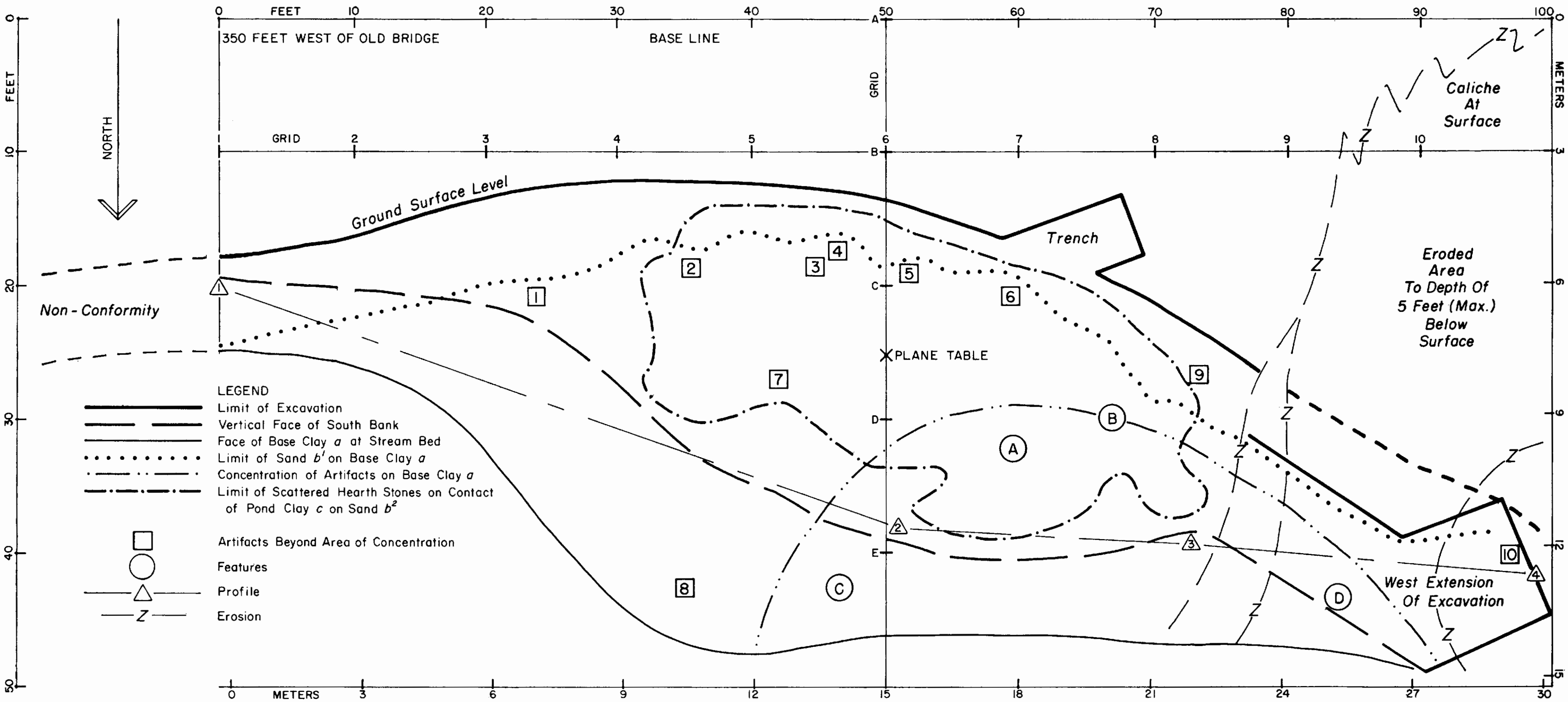

Fig. 8.5. Plan of Locality 2 (Cazador stage), Double Adobe area (Arizona FF:10:1, GP Sonora F:10:1). See Table 8.1 for listing of numbered artifacts occurring beyond area of concentration.)

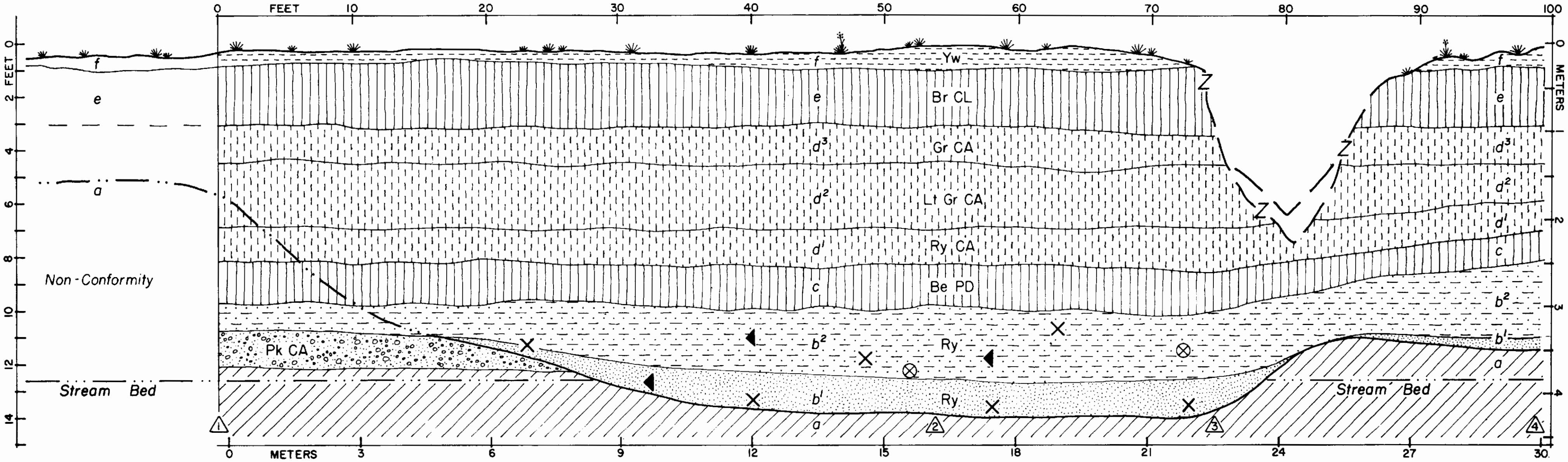

Fig. 8.6. Profile of Locality 2 (Cazador Stage), Arizona FF:10:1 (GP Sonora F:10:1).

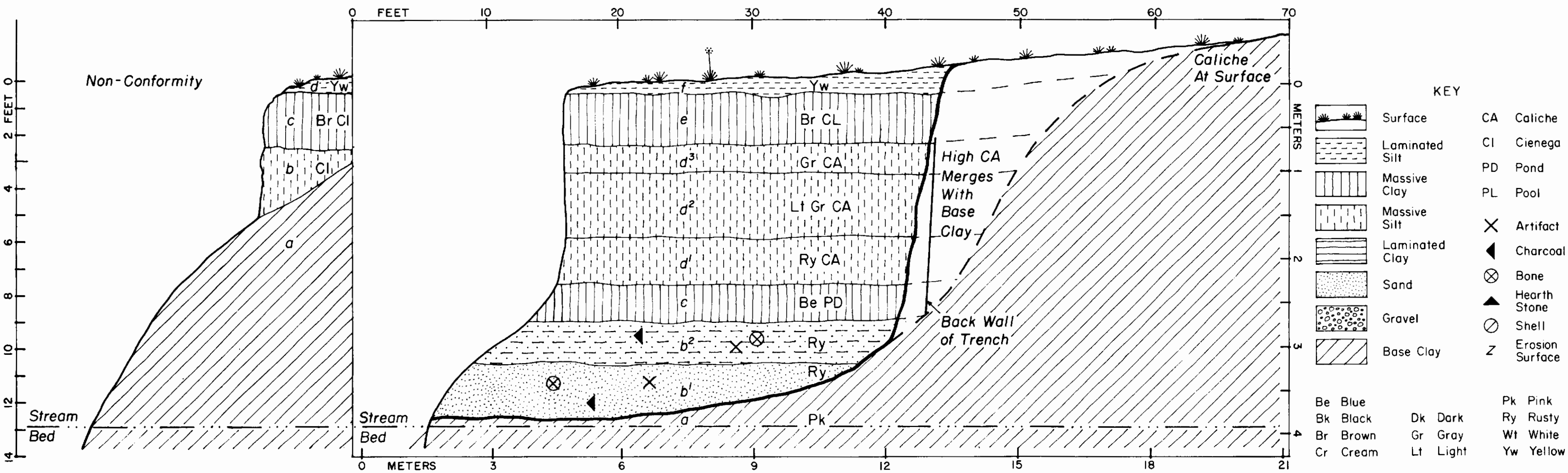

Fig. 8.7. Section of Locality 2 (Cazador Stage), Arizona FF:10:1 (GP Sonora F:10:1).

debris to the surface of sand b^2, representing debris contemporaneous with that in the lower stratum, sand b^1. Alternatively, the ground level area could have been used later than the sand bar and there may be a time lapse between the artifactual assemblages found in the two levels. As shown by the artifacts, however, with the possible exception of the two fragments of concave basin milling stones shown in Figure 8.13a, b, it seems more likely that the two activity areas are contemporaneous.

The occurrence of the artifacts in sand b^2, in contact with the overlying blue clay c, can be explained as follows. It is likely that the human activities revealed by these artifacts took place during a comparatively short time while the sand bar lay piled against the bank. The artifacts nearest the water's edge would have been engulfed in the stream bed with a single rise in water level and distributed in the sand and gravel in contact with pink clay a. The artifacts nearest the bank and on the highest part of the bar would have been left undisturbed, except by wind, until the site was finally covered by pond clay.

ARTIFACTS

Chipped Stone Tools

The outstanding feature of the artifacts found at Locality 2 was the preponderance of chipped stone over ground stone tools. No specific locale has been identified as the source of lithic materials used at the Cazador site. The stones could have come from the stream bed itself or from the slopes adjacent to the site. These surfaces frequently contain nodules of raw materials, and flakes, cores, and occasionally hammerstones occur with no associated indications of campsites such as hearths or concentrations of implements. The large quantity of flakes at the site suggests that selected materials were reworked in camps or habitation areas. The presence, not only of flakes, but especially of finished tools, broken pieces, and rejects, reflects various steps in the manufacturing process.

The quantity of projectile points indicates that hunting was a part of the economy along with food-gathering, the dominant pattern in the Cochise area proper. In addition to the descriptions accompanying the artifact illustrations, the nature of the stone tools and their probable functions are examined by categories. No distinctions have been made in these categories between modifications to the cutting edges caused by retouching or through use.

Core tools

Figure 8.8 illustrates the heavy core tools made from natural cobbles, generally plano-convex. All core (cobble) tools contain a part of the natural surface (cortex), providing a hand hold. They show little retouching or use along the cutting edge. Both specimens d and e show use as hammerstones, but they, too, may have been initially fashioned as hand-axes, or choppers, and used in coarse work on wood or as pecking tools in roughing the face of grinding implements. Such reuse is not uncommon in ceramic complexes when a finely made grooved axe may exhibit wear from use as a hammerstone. Even the Cazador hunters may have used some of their grinding tools for hearthstones.

Like the majority of the stone implements found at the Cazador sites, core tools are of local materials readily found in stream beds or on ground surface in the area. Fine-grained quartzite was the most frequently used material, followed by basalt and dense limestone. There is evidence, however, of selection of materials both for the form of the natural stone and its flaking possibilities. No large, high-domed tools, suitable for the depulping of leafy, fibrous plants in twine making, were found. Such tools are usually classified as planing tools and have been identified with both the Sulphur Spring and later Chiricahua stages.

Scrapers

Somewhat similar to the heavy core tools are smaller ones classified as scrapers, shown in Figure 8.9. The majority are retouched along one or more edges and, like the heavier tools, may have been used primarily in fashioning other implements of wood or bone, or working on hide. Small, high-domed tools such as artifacts d, e, and h in Figure 8.9 must have served a specialized need. Comparable forms occur in the Red Sand and Ventana levels at Ventana Cave (Haury 1950:

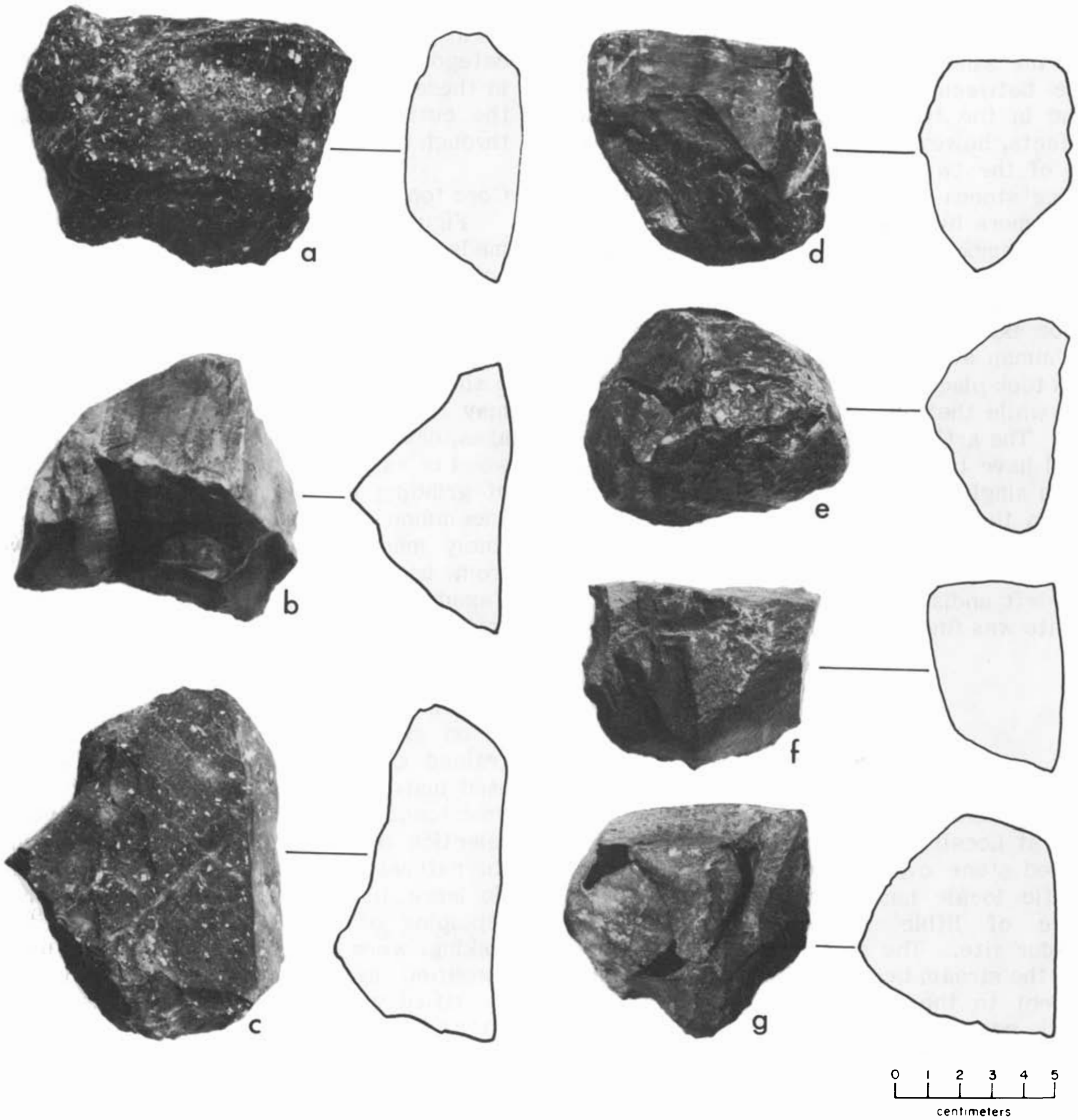

Fig. 8.8. Core-cobble axes and hammerstones, Locality 2, Double Adobe area (see Fig. 8.5). All tools are from the sand b^1 area of concentration except item e (No. 2, in caliche 12 inches above clay a). a, chopper (plane, axe), purplish rhyolite with white specks (A-9152); b, chopper (plano-convex axe), dense banded pink quartzite (A-9155); c, chopper (plano-convex axe), purplish rhyolite with white specks (A-9139); d, biface hammerstone, moss green quartzite (A-9148); e, hammerstone, edge battered, purplish quartzite (A-12558); f, chopper (plano-convex axe), dense green quartzite (A-9150); g, chopper (plano-convex axe), black limestone with gray patina (A-9154).

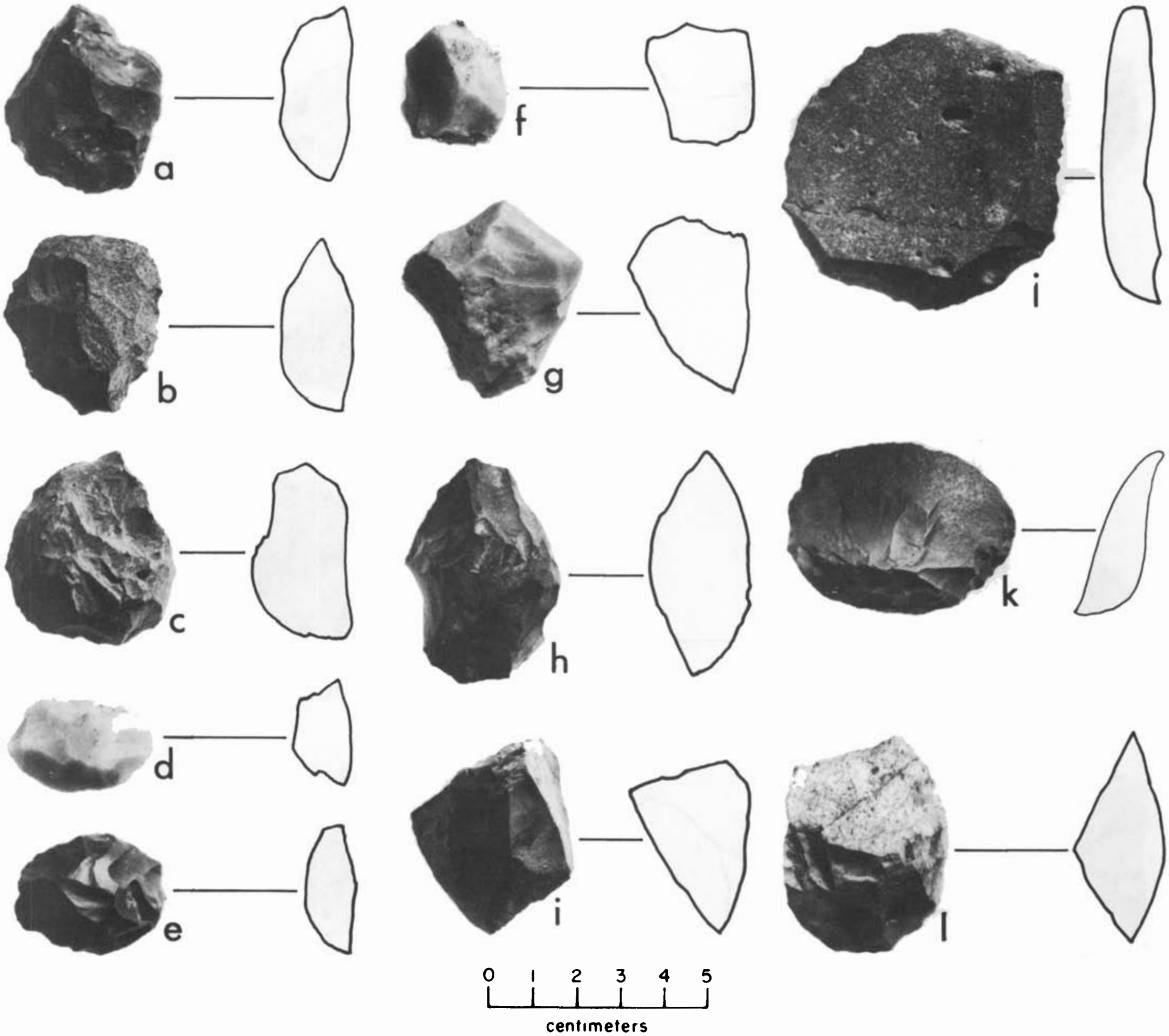

Fig. 8.9. Scrapers, Locality 2, Double Adobe area. All tools are from the area of concentration, sand b^1 on clay a, except items g and j (No. 5, clay c on sand b^2). a, thick ovoid flake, flaked entire edge, rechipped upper end, facets smooth, edge worn, basalt (A-9141); b, plano-convex scraper, one end sloped and other steep, edge worn, black limestone, gray patina (A-9147); c, high-domed, plano-convex end scraper, steep face, base broken, gray rhyolite with rusty stain (A-9151); d, high-domed, ovoid, plano-convex, steep end, edge worn, white chalcedony (A-9162); e, ovoid, plano-convex, sloping sides, partially chipped on plane surface, brown chert with rusty stain (A-9136); f, high-domed, steep-faced, plano-convex scraper, edge retouched with graver(?) points, gray chalcedony with inclusions (A-9138); g, high-domed, steep-faced, plano-convex scraper, edge rechipped and worn, one end slopes and other overhangs base, yellow-tinted chalcedony (A-9137); h, ovoid, high-domed scraper with sloped ends and steep sides, edge worn, reverse face convex, dark gray andesite (A-9143); i, slope end of plane scraper, base and one side broken, edge worn, gray quartzite with raspberry-colored clouds (A-9135); j, circular outline, opposite edge flaked on reverse surface, cortex on one surface, basalt (A-12561); k, biface flake scraper with opposite cutting edges on reverse sides, surface worn smooth, dark red-brown jasper (A-9144); l, slope and scraper with steep edge, worn, reverse face convex, gray quartzite with raspberry-colored cloud (A-9146).

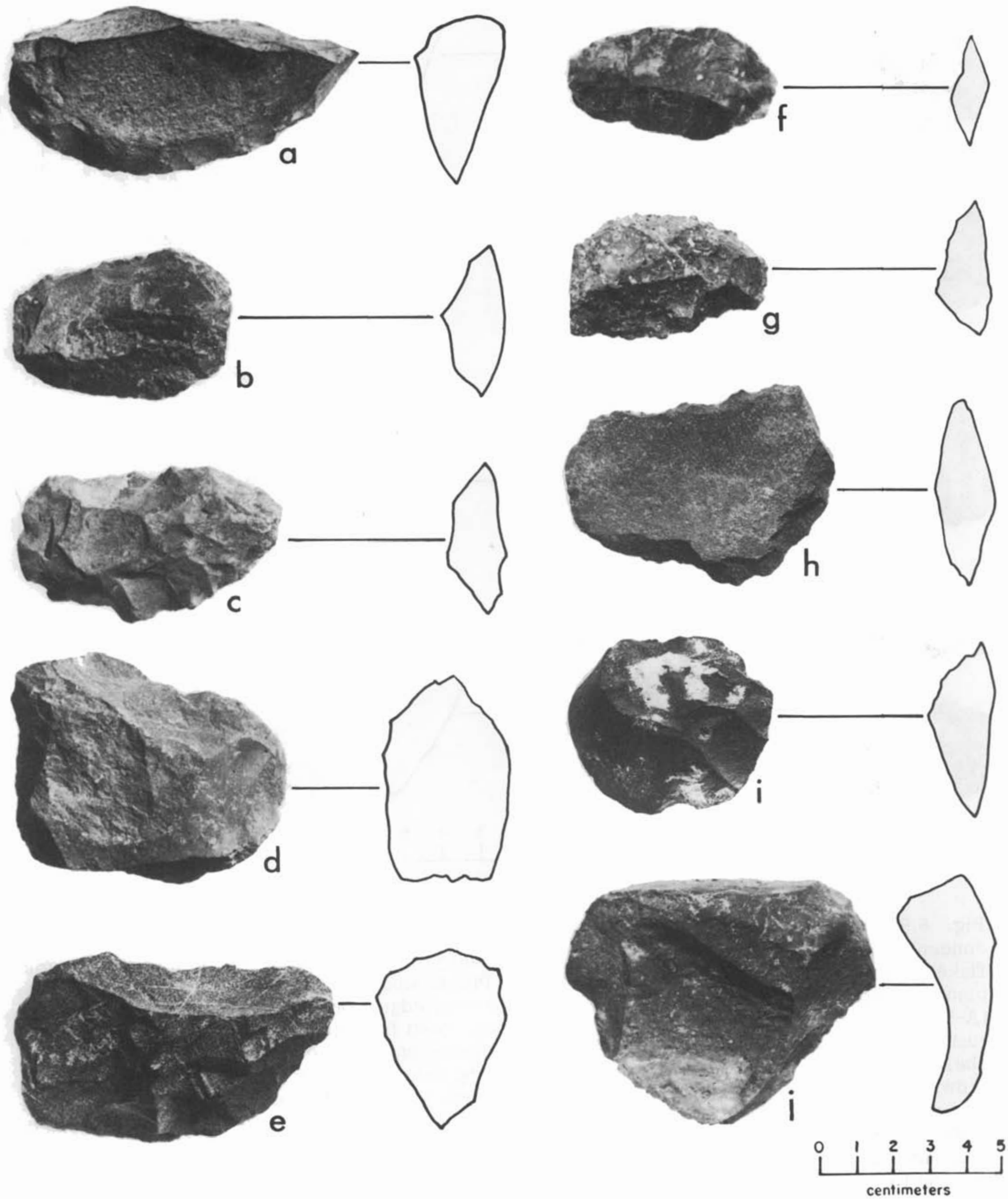

Figure 8.10

Figs. 55d; 56i). These objects frequently contain graverlike micro-points along a serrated edge and could have served to incise bone and wood, or even to cut skin.

Most of the artifacts shown in Figure 8.9 have a sloping or steep face, in the form of a snub-nosed scraper. Exceptions are specimens j and k, both fashioned from thinner flakes than the others. Item j may have served both as a knife with a straight cutting edge along the right side, showing retouching, and as a scraper along the lower edge. Item k was fashioned with reverse scraping facets along the upper and lower edges, a technique that also occurs in other early stages of the Cochise culture.

Flake tools

Chipped stone tools fashioned from flakes (Fig. 8.10) are usually thinner than those used for scrapers. Plano-convex flakes are chipped only on one surface, resulting in rough serrated edges. Other flakes have fine retouching along the edge. Only artifact a is finely chipped with a convex, bevelled cutting or scraping edge. Flakes i and j have thin sharp edges. On specimen j the edges are partially scored, probably from use. While most of the flakes could have been used as knives, with a sawing action, they might also represent waste or discard in the manufacture of projectiles. Tools d and e, both biface fragments or discards, are unlike any type identified with the Cochise culture.

Projectile points and blanks

Figure 8.11 illustrates flakes in the form of projectiles and blanks. Plano-convex flakes f and g, with little retouch on one surface and the striking platform intact, are comparable to similar forms found in the lower levels at Ventana Cave (Haury 1950: Fig 55c).

Small stemmed specimens d and e are comparable to similar forms associated with the Chiricahua stage as defined at Ventana Cave (Haury 1950: Fig. 45l, m). In addition to the presence of projectile points at the Cazador stage site, indicative of hunting, specimens representing blanks and fragments help establish another activity that took place there—stone chipping in the manufacture of implements. The discard flakes (debitage) range in size from those passing through a quarter-inch screen to those comparable to complete implements.

Flakes, as well as other chipped tools, are made of local materials. In addition, there are flakes of other materials such as obsidian that are undoubtedly foreign to the vicinity.

Ground Stone Tools

Grinding and rubbing stones usually have pecked edges; they are illustrated in Figure 8.12. Specimen h closely resembles the type most frequently associated with the Sulphur Spring stage, but it occurs in later periods also. The type characteristic of the Cazador

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Fig. 8.10. Flake knives and scrapers, Locality 2, Double Adobe area. All tools were found in the area of concentration, sand b^1 on clay a except items b (No. 8, surface, preliminary excavations) and d (No. 4, clay c on sand b^2). a, uniface, heavy flake knife, finely retouched convex cutting edge, red rhyolite (A-9176); b, uniface flake knife, edges retouched(?), red-brown rhyolite (A-9188); c, uniface flake knife, retouched at pointed end, gray quartzite (A-9174); d, biface bit, balance of edge chipped with plane surface as striking platform, greenish-gray quartzite (A-12557); e, biface bit, broken(?) along upper edge, bit edge retouched, dark gray (black) limestone (A-9149); f, uniface flake knife, lower edge sheared (from use?), reddish brown jasper (A-9177); g, uniface flake knife, edges retouched, pink rhyolite with white inclusions (A-9170); h, uniface flake knife, side and steep end retouched, gray rhyolite with cortex on convex face (A-9171); i, circular uniface flake, lower edge dulled, convex surface with spots of caliche, dark red basalt (A-39331-x); j, flake knife-scraper, retouched along upper edge, green-gray basalt (A-12554).

stage is a natural cobble of dense sandstone, only one surface modified by use, convex along the short axis and flat lengthwise. Handstone g is somewhat similar but bifacial; it is of dense quartzite, the used surfaces highly polished or rubbed. One end of the handstone was also used as a hammerstone, or for abrading, exposing the crystalline nature of the material. Specimen f also shows multiple use; the surface is abraded and contains a shallow pit. The reverse had been rubbed and the edges pecked, leaving the stone a modified ovoid.

All other handstones are ovoid, probably selected for shape, but with pecked edges and bifacially ground surfaces. The specimens shown in Figure 8.12b and c are similar with the long axis on one face convex, the reverse surface flat; the remaining handstones are convex on both surfaces. Three handstones, a, b, and e, had been broken, probably from use as hammerstones.

Milling Stones

Figure 8.13 includes all tools recovered that could be defined as milling stones. (Fragments of ground stone objects that are considered hearthstones are discussed below.) Milling stones a and b, fashioned of light red sandstone, are the largest specimens that had sufficient wear, or curvature of the surface, to determine the nature of their basins. Specimens c and e are portions of nether milling stones, each found in two sections; they represent the largest nether milling stones fashioned from thin sections of laminated sandstone.

Artifact d is the only complete nether milling stone found; it is made from a natural slab of indurated sandstone. Each surface is covered with slight depressions or rubbed areas that may have resulted from the preparation of food.

The source of material for ground stone tools was local, like that for the chipped stone implements. Laminated sandstone reportedly occurs in Mule Mountain near Bisbee, Arizona. Quartzite, and other denser stones, are widely distributed in the Cochise area.

There are analogies in the grinding implements of the early stages of the Cochise culture (Sulphur Spring and Cazador stages) with those found at Ventana Cave in levels associated with the Chiricahua and later assemblages.

Hearthstones

A large quantity of hearthstones, composed of broken milling stones and handstones, was recovered. Possibly these stones came from fires in a nearby campsite on the bank of the stream or, more likely, from a sand bar beside the running stream. After the area was vacated and covered by alluvium the hearthstones were moved by natural agencies, not by man, causing many of them to settle on the surface of pink clay a or in the sand bed b^1 along with stream bed gravel. This distribution of the hearthstones by water action explains the lack of charcoal except for "specks" visible throughout the strata in which the artifacts occurred. There is also the possibility that the charcoal originated from oak and mesquite wood that usually burn to ashes unless covered.

A field count was taken of hearthstones that could be identified as originating from a grinding implement with smooth surfaces. Of 90 specimens from the southern part of the site, from the blue clay on sand context, 61 were probably originally milling stones with flat surfaces and 29 were handstones with convex surfaces. Only 34 specimens were counted from the area of artifact concentrations covering the northern part of the site, perhaps because it was difficult to readily distinguish small portions of artifacts from the coarse gravel and natural stones also occurring in sand b^1 and in contact with base clay a. Of these, 21 were probably milling stones and the others handstones. At least a comparable number of ground stone tool fragments came from the surface along the face of the slope of the south bank of the arroyo during preliminary excavation. Another large quantity of ground stone was found in the southern part of the excavation where a trench had been excavated to determine the relationship of the south bank of the stream to the sand bar at the time the site was occupied. Since these artifacts were in the zone of high calichification where the slope of base clay a steepened, their association with sand b^1 or b^2 could not be determined. No artifacts were found in a higher level corresponding to the massive silts.

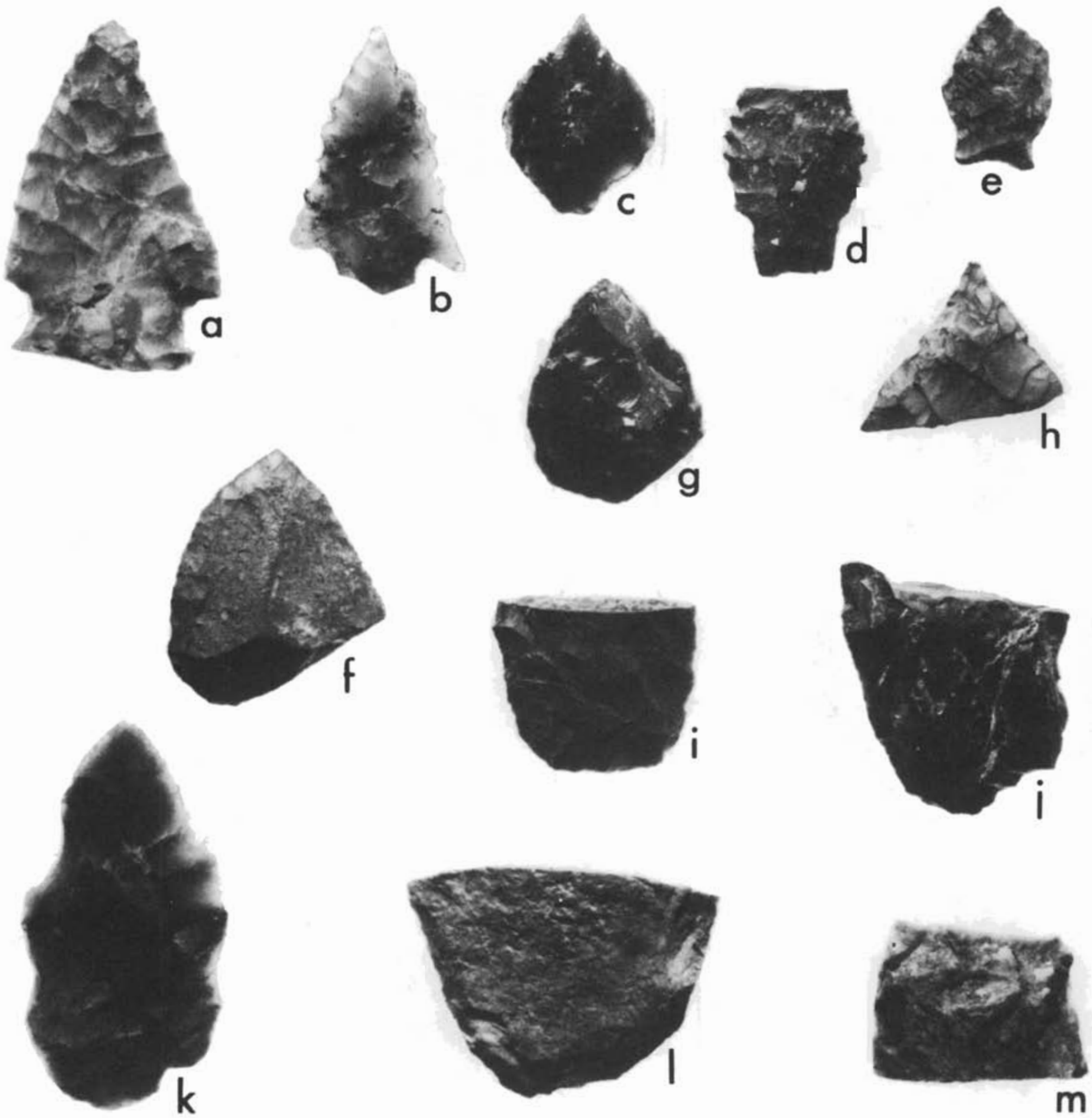


Fig. 8.11. Projectile points and blanks, Locality 2, Double Adobe area. All tools are from sand b[1] in the area of concentration except item i (No. 5, caliche overlying laminated clay c). a, barbed, bifacial, gray chert (A-9175); b, barbed, serrated, bifacial, base broken, chalcedony (A-9178); c, leaf-shaped, fine retouching, stemmed, obsidian (A-9156); d, stemmed, serrated, red jasper (A-9161); e, stemmed, basalt (A-9164); f, unifaced flake, slightly retouched along edges, striking platform intact, rhyolite (A-9163); g, bifaced-flake, striking platform intact, black chert (A-9168); h, broken, leaf-shaped(?) bifacial, fine point, gray basalt (A-9134); i, base, roughly-chipped, bifacial, black chert (A-12563); j, base, roughly-chipped, bifacial, red jasper (A-9142); k, rough, bifacial, petrified wood, banded gray-purplish (A-9167); l, base of roughly-chipped biface, yellow-gray chalcedony (A-9145); m, mid-section of roughly-chipped biface, gray chert (A-9159). Scale, full size.

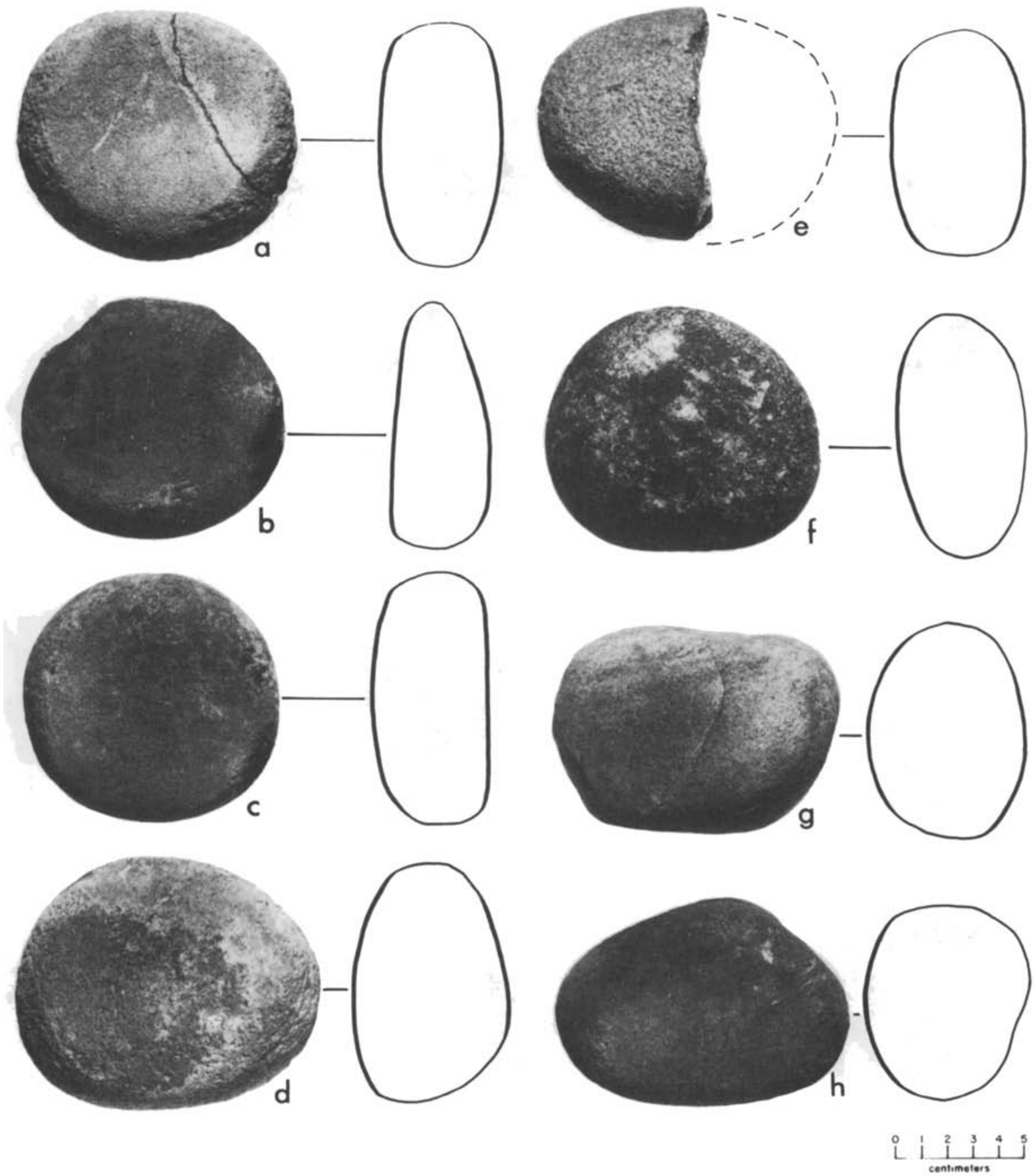


Fig. 8.12. Cobble handstones, Locality 2, Double Adobe area. All tools are from the area of concentration in contact with clay c on sand b^2 except item b (No. 9, in sand b^1 on clay a). a, ovoid bifaced handstone, convex short axes, flat long axes, edges pecked, broken along one end of one face and part of one end, gray sandstone (A-9157); b, similar to a in shape, edge slightly pecked, broken partway along one edge, dark gray sandstone (A-39314); c, similar to a (nearly round), pecked edges, dark gray sandstone (A-9140); d, ovoid bifaced handstone, edges slightly pecked (?) in mid-section, gray sandstone (A-39328); e, fragment of biface handstone, long axes flat and short axes convex, edges natural, gray sandstone, break shows darker core than surface, one surface slightly pecked near center (A-39330); f, irregular ovoid, one surface rubbed (polished), other scarred, edges natural, quartzite (A-12555); g, natural pebble handstone, both surfaces worn smooth, long axes flat and short axes convex, edges natural, tapered toward abraded end, dense quartzite, raspberry-colored core with gray surface (A-39313); h, natural, unmodified uniface pebble hand-stone, long axes of one surface flat, edges natural, dense dark gray sandstone (A-39327).

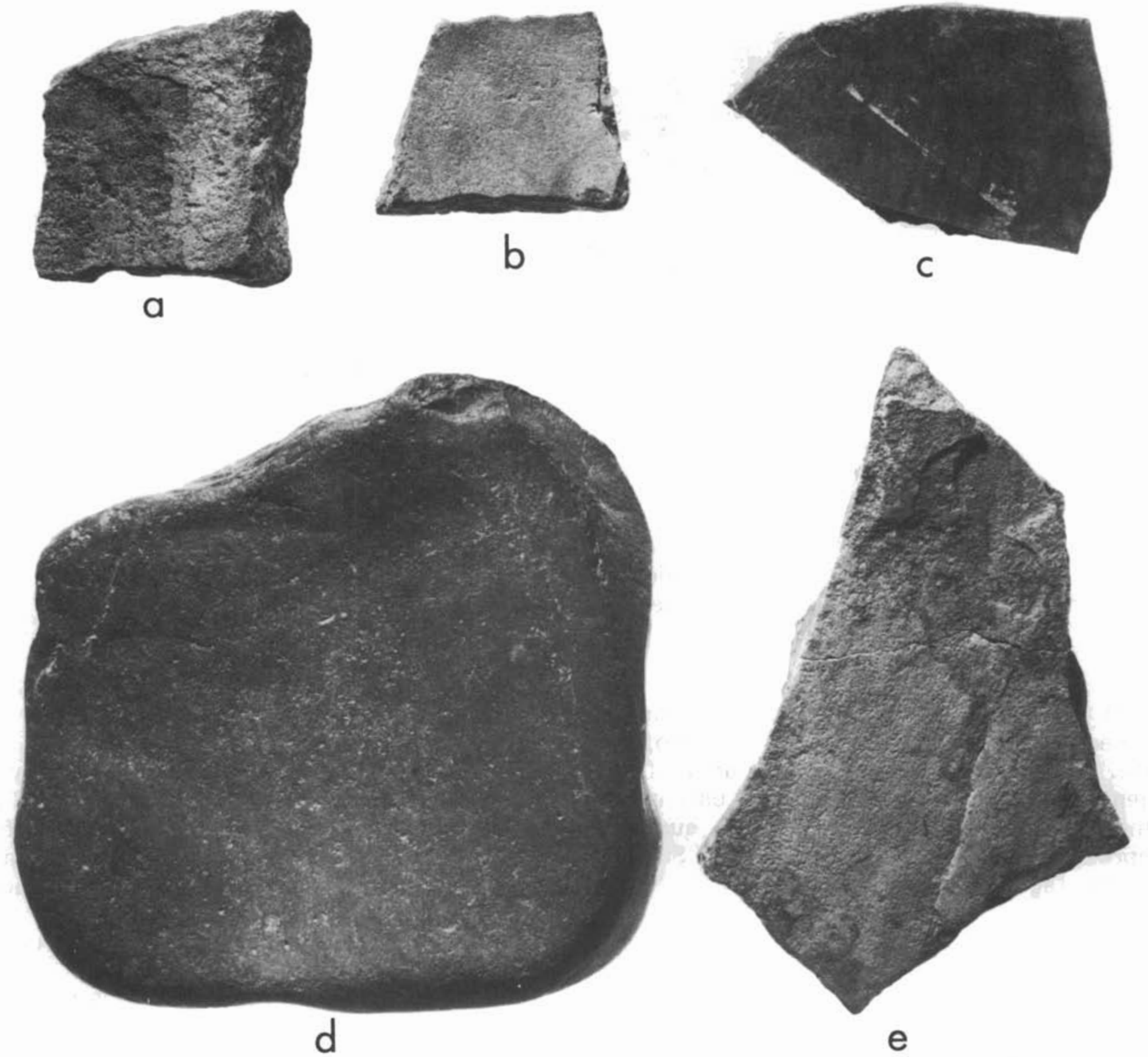


Fig. 8.13. Slabstone nether milling stones, Locality 2, Double Adobe area. All tools are from the area of concentration in contact with clay c on sand b2 except item *d* (No. 7, in sand b2). *a*, fragment of milling stone, both surfaces smooth and one slightly concave, gray sandstone, 3.8 cm thick (A-39326); *b*, fragment of bifaced milling stone, both surfaces concave, pecked, gray sandstone, 2.9 cm thick (A-39312); *c*, fragment of unifaced milling stone in two parts, light tan, laminated sandstone with rusty, iron-stained surface, 1.9 cm thick (A-39310); *d*, nether milling stone, both surfaces smoothed and slightly concave in limited areas, indurated sandstone, purple with rusty iron stains (A-12553); *e*, fragment of bifacial tan-gray sandstone with rusty iron-stained surfaces, 3.2 cm thick (A-39316). Scale, about 1/2.

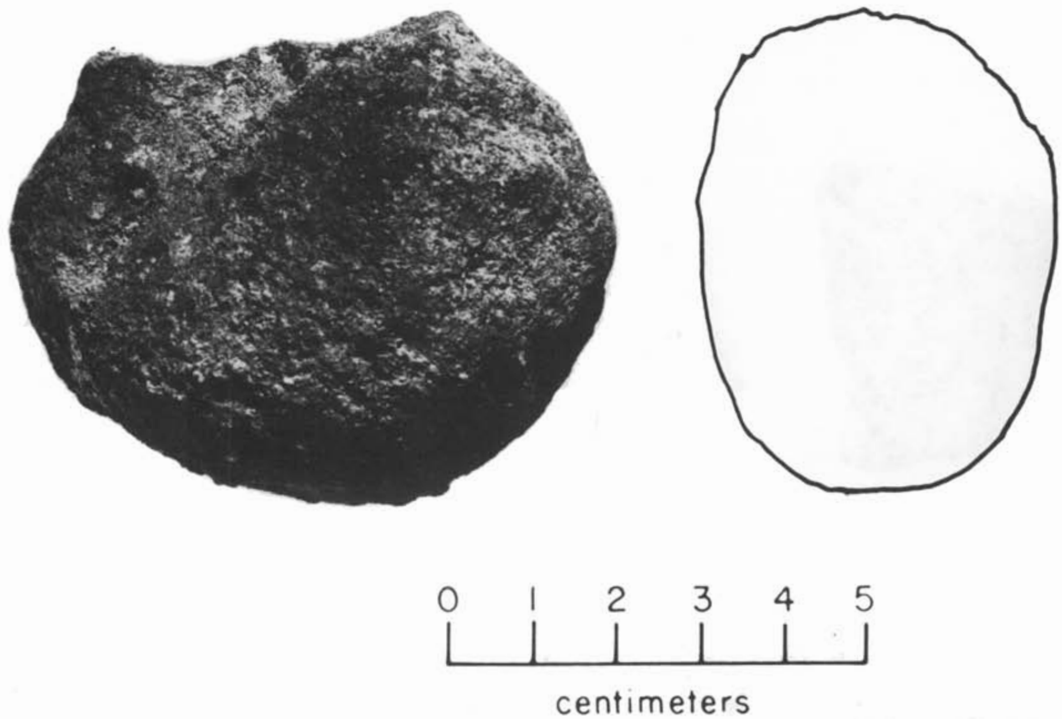


Fig. 8.14. Man-made lump of hematite, weighing approximately 7 ounces. (Identified by the late F. G. Hawley, Chemist, Miami Copper Co.)

It is assumed, therefore, that all hearthstones are a part of the artifact record of the site. Their numerical total, including fragments not counted, may represent only a few whole specimens, far less than the quantity represented at most of the earlier Sulphur Spring stage sites.

Paint

Evidence of the use of the site for activities other than food preparation is the red paint represented by the lump shown in Figure 8.14. It was identified as hematite by the late F. G. Hawley, Chemist, Miami Copper Company, and weighed about 7 ounces. In the area of artifact concentration in contact with the base clay, specks of brightly colored red powder, easily spread by finger pinching, were found scattered in sand beds throughout the site. They were frequently noticed by the laborers, miners from Bisbee, who called our attention to them in a shovel of dirt, and especially in the dirt from the fine screening. The red pigment may have been used as body decoration or for painting objects of wood, bone, or hide.

DEPRESSION

A depression occurred in the pink clay in the area of artifact concentration (see Fig. 8.5). If it had been formed naturally before the site was occupied, its fill would have contained stream bed gravel and sand, lacking artifacts. If man-made before the site was occupied it must have been constructed during a period of extreme drought in an attempt to secure water, a common practice as shown by wells reported at the Clovis site and at Point of Pines. In that case there would have been some indication in the lowest sediments covering the depression. Since the depression fill contained the same kind of camp debris as found in sand b^1 in contact with base clay a^1, it must have been open during the time the site was occupied.

POLLEN AND RADIOCARBON DATING

Locality 2, designated Double Adobe II by Martin (1963b), was sampled for radiocarbon dating and pollen identification as a site representative of the Cazador stage. The results of this sampling as shown in Martin's Figure 22 are discussed here as they apply directly to this site (identified with the Cazador stage), and are discussed further in Chapter 12 in examining the relationship between the geological-archaeological records and the radiocarbon dating and pollen records. The sampling by Martin was conducted after excavations had ceased and no archaeologist was present. While the profile recorded in Martin's Figure 22 does not conform precisely to the profile uncovered in the excavation, it is assumed that the differences are those of observation and description (see Fig. 8.6).

The pollen record may represent an unbroken sequence because the excavation disclosed no erosion surface other than that of the pink clay a. In chronological order, the radiocarbon-pollen sequence is identified with the geological-archaeological sequence as follows: Pink caliche, 370-380 cm (pink clay a); Rusty sandy clay, 300-370 cm (includes rusty sand b^1 and laminated rusty sand b^2, both containing artifacts of the Cazador stage); Blue clay, 230-300 cm (massive blue sand clay c); White clay, 100-230 cm (silts d^1, d^2, d^3); Indurated silt, 50-100 cm (massive brown Cienega clay e); Silt, 0-50 cm (yellow laminated silt f).

Figure 8.15 shows three of the five Pollen Zones Martin described; they are characterized by certain combinations of dominant pollen in geological sediments, radiocarbon dated, within the Desert Grassland. Zone I covers the past 500 to 1000 years and the pollen is similar to that of today. Zone V represents the Wisconsin pluvial of more than 20,000 years ago; it has not been recognized in alluvial deposits in the Whitewater Draw area. The earliest zone recorded at Locality 2 is Zone IV, in which composites are dominant. Plants now associated with a wet environment are well represented along with some, like sage (*Artemisia*), of limited distribution in the modern pollen record.

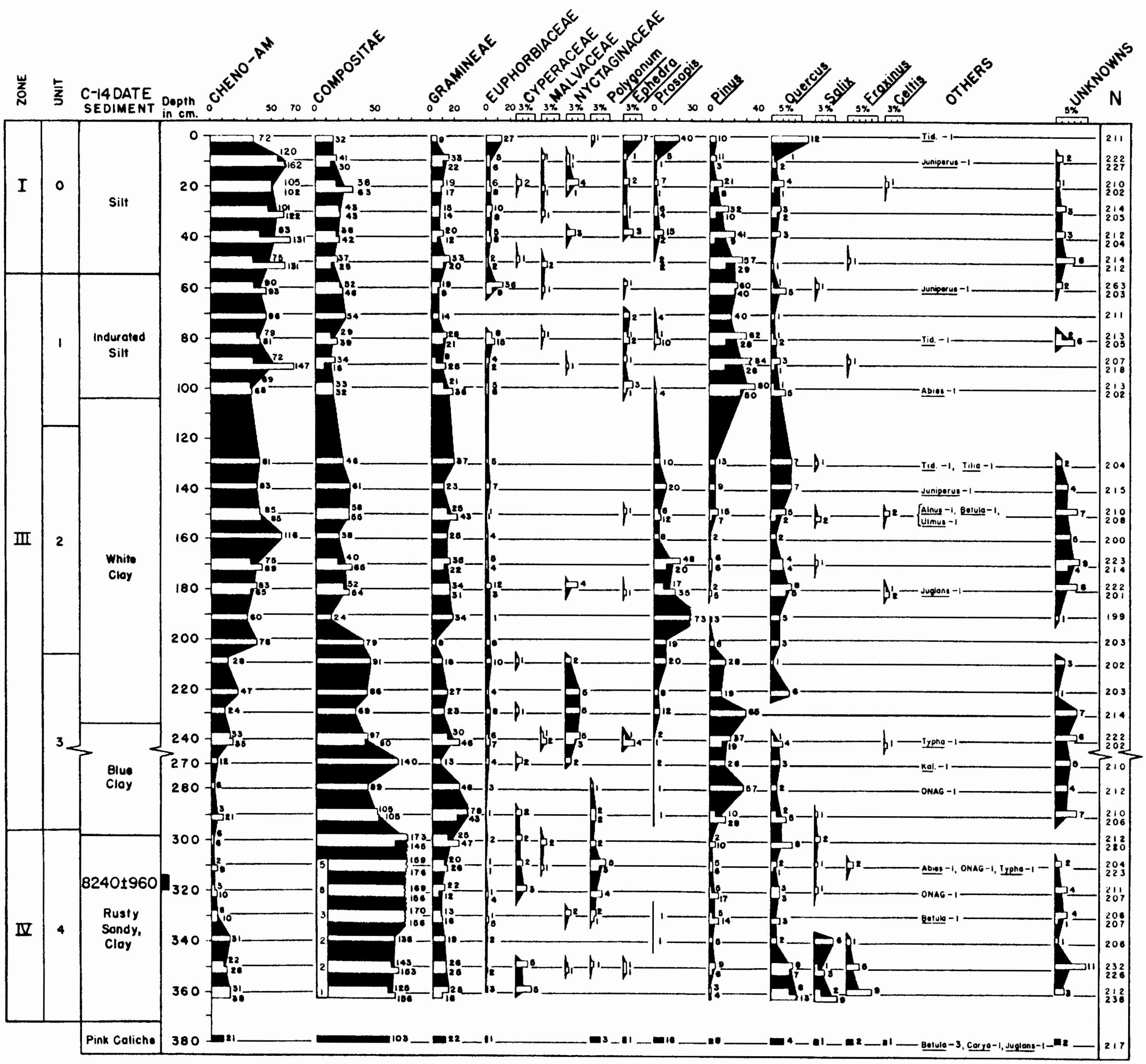
The relative percentages of commonly occurring pollen types are shown in Figure 8.15 along with those Martin has designated as "noteworthy" or "rare." Three of these--elm (*Ulmus*), hickory (*Carya*), and linden (*Tilia*)—are not native. Birch (*Betula*), fir (*Abies*), alder (*Almus*), and juniper (*Juniperus*) are not now a part of the Desert Grassland but grow in cooler and wetter environments on the nearby mountains. *Pinus*, one of the highest producers of wind-borne pollen, is represented, and it occurs in varying amounts in the modern pollen record through the Desert Grassland. The record of oak (*Quercus*) is similar to that of pine, but the quantity of oak is less. Some types that produce little or no recorded pollen and those that are animal (insect) pollinated are not represented in the fossil records and are seldom found in the modern.

The relatively high percentage of both willow (*Salix*) and ash (*Fraxinus*) at Locality 2 in the lowest sand level (on the pink clay), along with the occurrence of the noteworthy and rare kinds, supports the geological-archaeological evidence of a perennial stream at the time the site was occupied by man. Similar pollens also occur in the underlying pink clay, most likely where the laminated sand b^1 contacts it. The base clay does not usually produce any recoverable pollen. The sand, with laminae of silty clay, was probably the source of the pollen, or it could have originated from the overlying Blue clay as pointed out by Martin (1963b: 38-39):

> At the bottom of the profile composite pollen is very abundant; there is a relatively high frequency of Liguiliflorae and pine is scarce. Such features also typify unit 3 at Double Adobe I. I conclude that these sediments are of the same age. A pollen count from pink calichified valley fill was obtained at level 380. The birch pollen grains and one hickory might be taken to indicate pluvial climatic conditions. On the other hand, the major features of the spectrum are quite similar to those of strata immediately above. I doubt that the pollen is primary; possibly part or all of it infiltrated down from higher levels. The pink caliche is generally void of pollen.

The single radiocarbon sample recovered at 320 cm, 8240 ± 960 B.P. (A-184C) is from hand-picked charcoal. The same sample, minus the hand-picked charcoal (HCl leached alluvium), dated at 7030 ± 260 B.P. (A-184E).

I believe the significance of the Cazador stage, both to the proper reconstruction of prehistoric events and as a defined cultural



ZONE
UNIT
C-14 DATE
SEDIMENT
Depth in cm.
CHENO-AM
COMPOSITAE
GRAMINEAE
EUPHORBIACEAE
CYPERACEAE
MALVACEAE
NYCTAGINACEAE
Polygonum
Ephedra
Prosopis
Pinus
Quercus
Salix
Fraxinus
Celtis
OTHERS
UNKNOWNS
N
Silt
Indurated Silt
White Clay
Blue Clay
8240±960
Rusty Sandy, Clay
Pink Caliche

Figure 8.15

stage for further consideration by archaeologists, rests in its intermediate position between the better defined Sulphur Spring and Chiricahua stages. It thrived during a period of geological and climatic transition. Cazador stage occupations occurred at a time (radiocarbon dated about 8000 years ago) when there was a perennial stream and plant life indicative of wetter and cooler conditions than any following period. The presence of pollen of plants no longer living within the Desert Grassland and of those found only at higher elevations on the mountains indicate that the climate was more like that of the earlier period than of the following one.

The Anathermal, with which the Sulphur Spring materials are associated, was on the wane; the Altithermal with its Chiricahua assemblage had not yet reached its maximum. The intermediate character of the artifact collection calls attention to the typological continuity in the Cochise culture. The climate changes and the accompanying shift to modern fauna set the scene for the Chiricahua stage that follows.

Fig. 8.15. Pollen diagram of Locality 2, Double Adobe II, Arizona FF:10:1 (GP Sonora F:10:1). Facsimile of Figure 22 in Martin (1963b) reproduced with permission of the Board of Regents, University of Arizona. The pollen graph shows the relative percentages of pollen types found at various depths in alluvial sediments; they are interpreted as defining specific Pollen Zones. Units 0-4 represent the number of comparable samples of pollen identified with a specific Pollen Zone. Pollen types that are considered inconsistent with the ecology indicated by the dominant types are listed as Noteworthy or Rare (see Chapter 12).

9. CHIRICAHUA STAGE

E. B. Sayles

The Chiricahua stage of the Cochise culture was originally synthesized (Sayles and Antevs 1941: 15-21) by comparing the rich collection of artifacts from the Cave Creek midden (GP Chiricahua 3:16; Figs. 6.2, Site 61; 9.1; 9.2) with the material found in geological context at sites along Whitewater Draw. In general, the body of evidence used in establishing the Chiricahua stage was more extensive than that used in setting up either the Sulphur Spring or San Pedro stages.

In the years since publication of the original Cochise report, more information has been obtained on the Chiricahua than on the other stages. The important stratigraphic record from Ventana Cave (Arizona Z:12:5; Fig. 6.3) is the major source of additional data (Haury 1950). Excavations of sites under the auspices of the Arizona State Museum, described in the following pages (Windmiller 1970, 1973; Agenbroad 1970) have further established the nature of the Chiricahua stage in the Cochise sequence. The Cienega Creek site at Point of Pines (Haury 1957) and the Wet Legget site in the Pine Lawn region (Martin, Rinaldo, and Antevs 1949) have extended the range (Fig. 6.3) and time of the Chiricahua portion of the Cochise culture.

Antevs classified the Chiricahua stage as the first postpluvial period of the Cochise culture. The climatic situation changed from the cooler and wetter circumstances of the Anathermal (Provo Pluvial) to the warmer and drier conditions of the Altithermal. The associated fauna is completely modern. Geological dating (Chapter 4) places the Chiricahua stage in the period from 3500 to 8000 B.P. (6000 to 1500 B.C.; see Fig. 4.5). Radiocarbon dates (Chapter 5) show a range from 4000 to 500 B.C.; some later dates come from sites beyond the Cochise area proper that are related to or inferred to be comparable to the Chiricahua stage (Table 5.3).

The archaeological assemblage is characterized by a wide range of traits occurring in varied associations. The milling-stone complex consists of shallow-basin nether stones and shaped handstones with Sulphur Spring forms surviving (Fig. 9.3). The presence of protopestles (Fig. 9.3d) suggests the beginnings of the mortar and pestle. The Chiricahua chipped stone industry represents a considerable increase in both variety and frequency over the Cazador assemblage. Chipped tools, mainly plano-convex, bifacial forms, were made by both percussion and pressure techniques (Fig. 9.4). Characteristic

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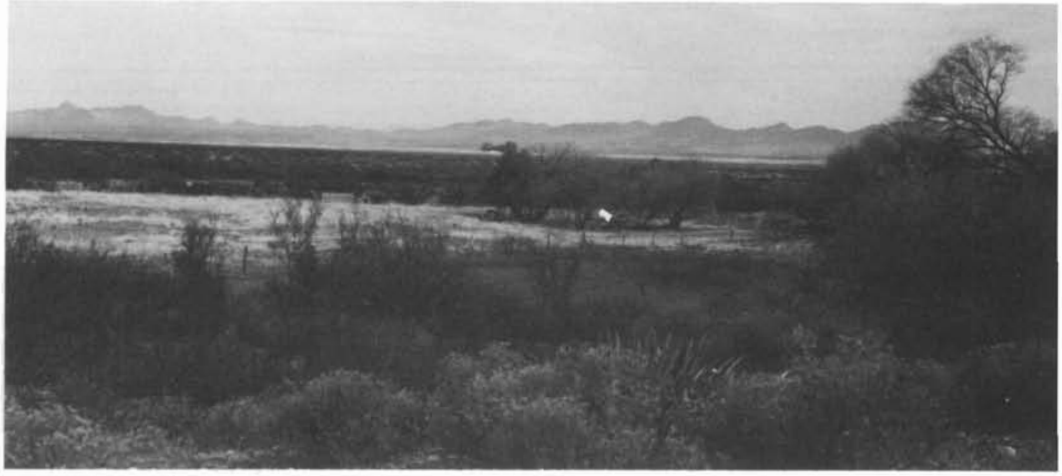
Fig. 9.1. Chiricahua stage type site (GP Chiricahua 3:16), at mouth of Cave Creek. a, looking east toward San Simon Valley; site in midsection of picture beyond group of trees; chaparrel growth in foreground; cienega remnant to right, adjoining tall trees. b, cienega remnant; cattails (*Typha*) below trees. c, midden, looking west toward tent camp; drainage ditches alongside excavation; earliest section of midden in foreground partly covered by sand; midden grew toward west, covered by peat. The midden was removed by levels in grids, and the contents screened. The area surrounding the cienega shows human use from the present into the prehistoric, with artifacts and scattered hearthstones on eroded surfaces (Fig. 9.2). The midden was composed largely of grinding tools (many only slightly used) that accumulated on a natural sand-gravel bar, probably at the margin of a cienega. Numerous flakes, of the same lithic materials as many of the stone tools, indicated that tools were made on the site. Flakes may also have served as cutting tools; some have a blunted edge, probably from scraping. The site was reused, as the midden grew, for gathering and processing primarily plants (cattails).



a

b

Figure 9.1

c

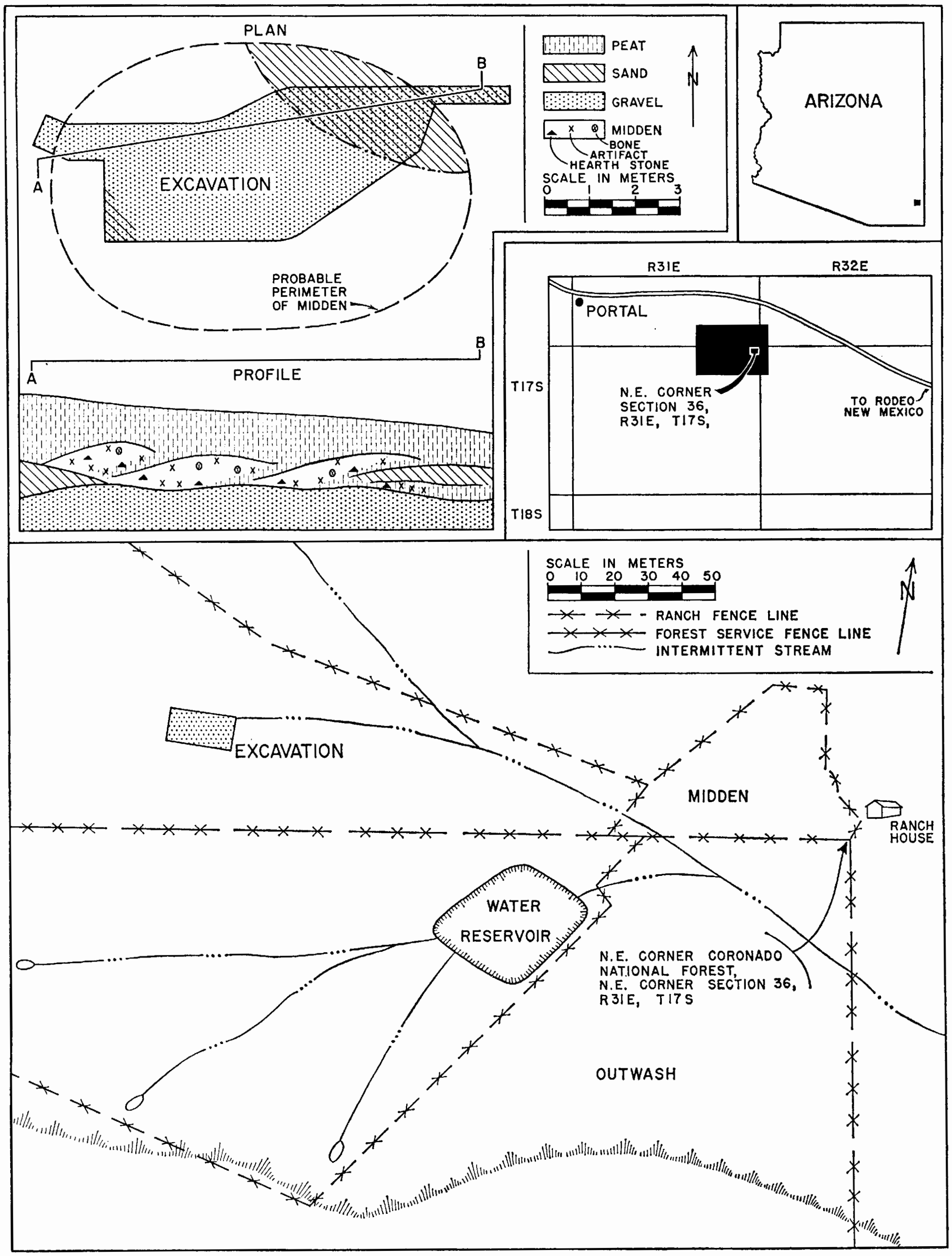


Fig. 9.2. Map and plan of the Cave Creek midden, Chiricahua stage (GP Chiricahua 3:16; Fig. 6.2, Site 61; 1 mile east of Portal). Map based on work by Gila Pueblo in 1936. The unexcavated midden shown between the area of excavation and the ranch house was tested. It produced primarily firecracked rock; no grinding tools were found beneath the surface. A late pottery site, dating about A.D. 1200 to 1400, is situated just to the west of the excavated midden. (Area of excavation has since been bulldozed.)

implements include a variety of projectile point forms with both side and basal notches and a wide range of scraping, perforating, and incising tools. Flakes in varying forms are extensively found, and the ground edge type is distinctive. Core tools consist of spalls, planes, and choppers. Hammerstones with an encircling abraded surface produced by use are common. Materials used for all tools except hammerstones are basalt, jasper, chert, and, rarely, obsidian, in that order; hammerstones may be of basalt, but are more commonly of quartzite. All sites contain large quantities of fire-cracked stone and numerous fragments of grinding implements.

Four kinds of sites are identified with the Chiricahua stage: (1) arroyo-bank sites with geological context, (2) surface hearths or middens, (3) cave sites, and (4) sites identified as Chiricahua by either archaeological or geological criteria, but not both.

Most common are sites in typical arroyo-bank circumstances found in stream channels of the Altithermal. The filling of these channels together with later alluvial deposits overlying them provide further data for the geological interpretations of the Chiricahua stage. Artifacts, along with charcoal, animal bones, and hearthstones, occur in concentrations in shallow clay deposits that may have formed in small pools in an intermittment stream. Typical sites with Chiricahua stage material in geological context are Arizona FF:10:7 (GP Sonora F:10:30; Figs. 4.11; 6.2, Site 36), GP Sonora F:10:26 (Figs. 4.12; 6.2, Site 42), and the San Simon Cienega (Fig. 4.4 B, b), Arizona CC:16:3 (GP San Simon 9:6; Fig. 6.2, Site 55).

The Wet Leggett site (Fig. 6.3, Site 35), explored in 1947 by scientists from the Chicago Natural History Museum as part of a program in the Pine Lawn Valley, New Mexico (Martin, Rinaldo, and Antevs 1949: 34-79) is an important locality for confirming the geological placement of the Chiricahua stage (Fig. 9.5). The Cochise complex from the Wet Leggett arroyo banks shows affinities with both the Chiricahua and San Pedro stage materials in southeastern Arizona. Typologically, the shallow-basin grinding stones, shaped handstones, and chipped stone tools resemble standard Chiricahua specimens. On the other hand, there are some San Pedro resemblances and the high ratio of chipped to ground tools suggests that the collection is late in the Chiricahua stage. It may represent the continuation of the Chiricahua tradition into the San Pedro as that stage has been defined within the Cochise area proper.

The Cienega Creek site (Arizona W:10:112) near Point of Pines (Fig. 6.3), excavated in 1955 and 1956 in conjunction with the University of Arizona Archaeological Field School program (Haury 1957), is an important site for the understanding of the Chiricahua stage in the mountainous regions north of the southeastern Arizona heartland of the Cochise culture. This site is similar to Wet Leggett in the continuity of basically Chiricahua culture into San Pedro times. The extensive prehistoric digging of holes at the Cienega Creek site is interpreted as the result of efforts to tap ground water (Haury 1957: 11). The large number of cremations, some buried in pits and others in coiled baskets, represent the earliest evidence for cremation in the Southwest (Haury 1957: 11-15). No other Cochise site has produced cremations. Martin and Schoenwetter (1960) have identified maize pollen from the Cienega Creek site, and radiocarbon dates indicate that it was occupied as early as 2000 B.C.

Evidence from the Wet Leggett and Cienega Creek sites suggests that there was a conservatism in the kind of Cochise culture that moved into the more mountainous regions in Chiricahua times. This mountain variant of the Cochise culture does not appear to have participated in full San Pedro stage development. In both the Point of Pines and Pine Lawn regions the basic Chiricahua complex continues until the introduction of pottery.

Second in frequency of recorded sites are hearths and middens found most commonly near the foothills on the eastern slope of the Chiricahua Mountains where cienegas were formerly present, and to the south (Figs. 9.6; 6.2, Site 64). The type site for the Chiricahua stage is located at the mouth of Cave Creek Canyon in the Chiricahua Mountains (GP Chiricahua 3:16; Figs. 9.2; 6.2, Site 61; Sayles and Antevs 1941: 15-19, Fig. 6, Pl. 7).

Excavation showed that the eastern portion of the Cave Creek midden accumulated contemporaneously with black peat resting on

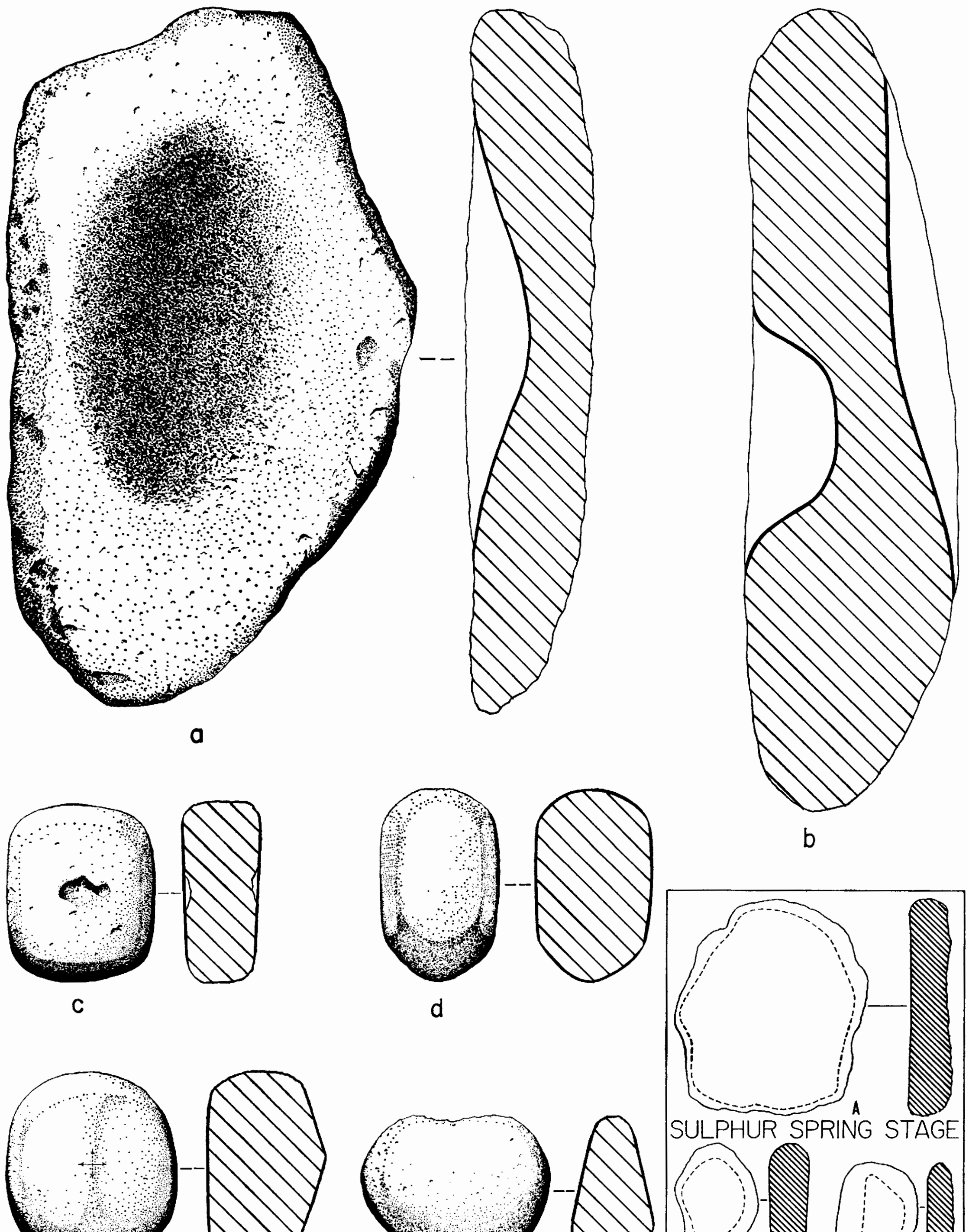


Figure 9.3

natural sand and gravel. During early growth of the midden a layer of light-colored sand was deposited over the area, probably by water. The sand covered some of the midden and some of the peat. The midden eventually grew over the sand to the southeast, south, and southwest and, in turn, was entirely covered by peat. The midden was composed largely of stones carried to the site by man. Most of them had been used as milling stones, although some only slightly. Hundreds of flakes were found, most showing no evidence of use. The Cave Creek midden contained more than 600 artifacts, exclusive of flakes.

There was little evidence of the use of fire at the Cave Creek midden. However, another midden area about 150 m to the east (Fig. 9.2) was composed almost entirely of fire-cracked stones. Tests made there showed midden accumulation of 0.75 m in depth, but no grinding tools were found beneath the surface. The fluted point described and illustrated by Sayles and Antevs (1941: 20-21, Pl. 11a, a') was considered intrusive. Since then, the technique of pressure flaking has been recognized as a part of the Cochise culture. The Clovis fluted point, not recognized when we described it as a Folsom point in the 1941 report, may have been found and used by the occupants of the site, as it is definitely an intrusive in the Chiricahua complex. The presence of the Clovis point suggests that the Cave Creek region was used by man for a long time, although the point is not a component of the Chiricahua tool assemblage. At the time of excavation the area surrounding the midden was rich in surface stone tools and hearthstones. Adjoining it was a patch of cattails (*Typha*), a remnant of a cienega filled with these plants when the owner of the land first arrived in 1880 and probably the source of food and fibers sought after by prehistoric man for many centuries.

The Lone Hill site (Agenbroad 1970; Arizona BB:10:17) provides confirmation of the Chiricahua stage assemblage of tools in a habitation site. Lone Hill is located in the San Pedro River valley about 20 miles southeast of Tucson, Arizona, on the eastern flank of the Catalina mountains. It is significant in establishing the importance of tool making in the Chiricahua stage.

The excavation of another habitation area, the Fairchild site (Windmiller 1973; Arizona FF:10:2, GP Sonora F:10:15) revealed traits that may represent a late phase of the Chiricahua stage with some San Pedro elements. The area excavated was a small part of a sandy ridge extending from the Double Adobe area on the west side of Whitewater Draw for an undetermined distance toward the south. The ridge shows much evidence of man's use, extending from modern ranching and farming to prehistoric occupation. In addition to the habitation site, the arroyo walls adjacent to the area contain artifacts identified with the Cochise culture (Sayles and Antevs 1941, Fig. 4; GP Sonora F:10:4, 5). Although the excavation was a salvage operation confined to the right-of-way of a proposed highway, it showed the potential of further defining the relationship of the Chiricahua and San Pedro stages.

The third kind of Chiricahua site is cave

Fig. 9.3. Milling stones of the Chiricahua stage: a, nether milling stone with elongated oval basin, entire surface of basin pecked and ground smooth, edges unmodified, cross section shows depth and shape of basin; b, cross section of a nether milling stone with a small mortarlike basin on the left face and an oval grinding basin on the right face; c-f, modified handstones, long axes flat except where they approach the edges, short axes also flat except for faceted types shown in section, all edges altered by pecking; c, rectangular with opposed pit on each flat surface; d, multifaceted proto-pestle, both ends shaped; e, bifacal handstone, each grinding face composed of two planes sharply angular to each other through the short axis, long axes of the opposite faces are at right angles to each other; f, wedge-shaped. Heavy lines indicate grinding surfaces. Length of a, 33 cm. Milling stones commonly of quartzite; many nether stones are of rhyolite. Inset shows milling stones of the Sulphur Spring stage, from Figure 7.3, for comparison.

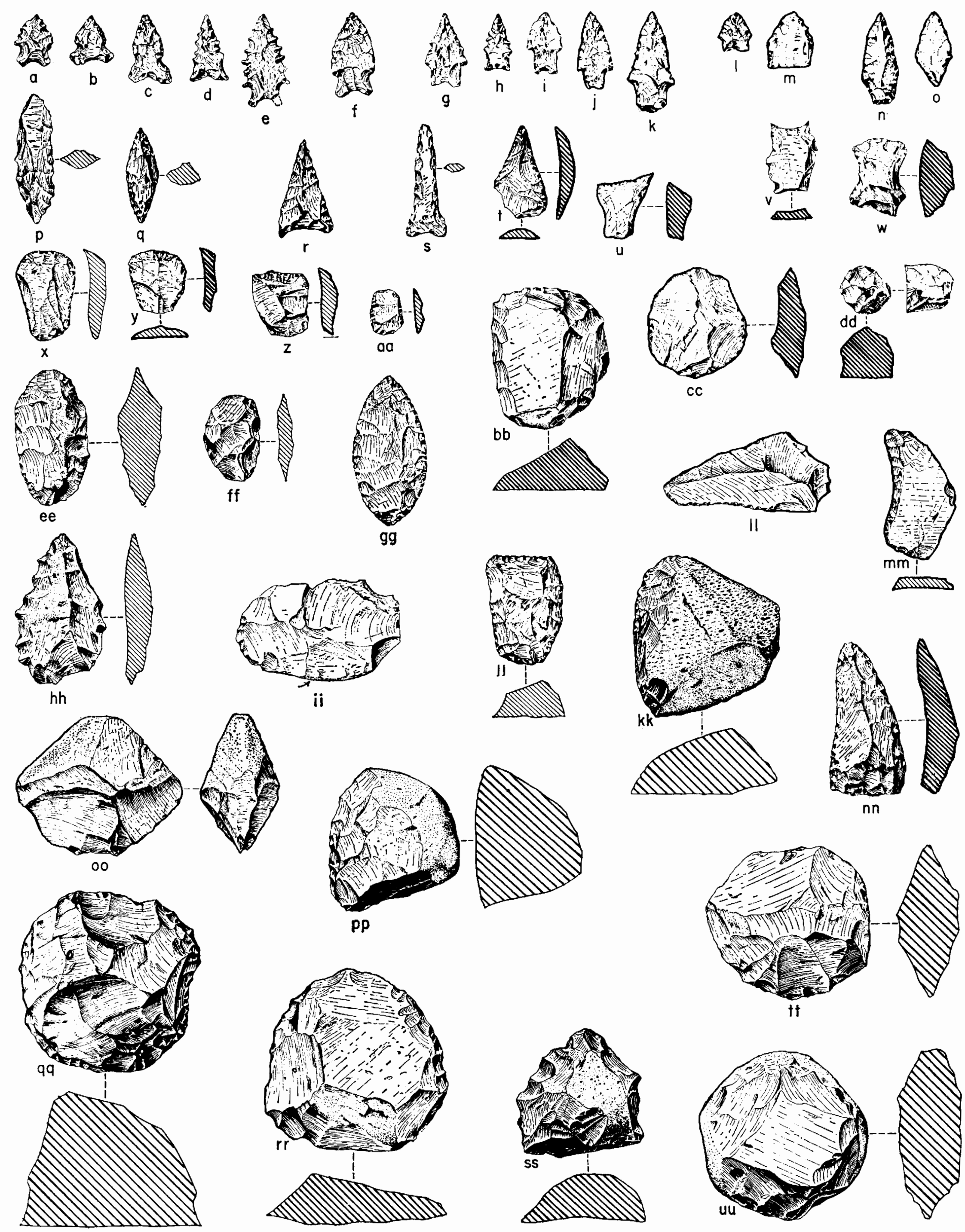

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Figure 9.4

habitation. The most important excavated example is Ventana Cave (Arizona 2:12:5; Fig. 6.3). Haury (1950: 532-36) compared the Chiricahua-Amargosa II assemblage in the lowest part of the midden deposits at Ventana with the Chiricahua stage of the Cochise culture. The Ventana materials add some types of perforating tools to the Chiricahua assemblage (Fig. 9.4m, o, s) and provide a full range of chipped stone implements (Fig. 9.4). The lower levels of Bat Cave, located on the plain of San Augustin in west central New Mexico (Fig. 6.3, Site 36; Dick 1952, 1954, 1965), contained projectile points of Chiricahua type as well as primitive forms of maize that are believed to date to about 2000 B.C. (Mangelsdorf and Smith 1949; Mangelsdorf 1958: 1314).

The fourth category of Chiricahua sites consists of a number of widely scattered sites lacking complete geological context but assigned to the Chiricahua stage on the basis of artifact typology (Figs. 6.2, Sites 11, 26, 52, 55; 6.3, Sites 5, 35). The sites are composed of groups of hearthstones, some typical Chiricahua grinding tools, and a few flake implements.

Cochise sites that are less well placed chronologically include several locations near the beaches of ancient Lake Cochise (Sayles and Antevs 1941: 33, Pl. 1). None of these sites (Fig. 6.2) have been excavated (Haury, Antevs, and Lance 1953: 11-12), but since Antevs believed the maximum stand of Lake

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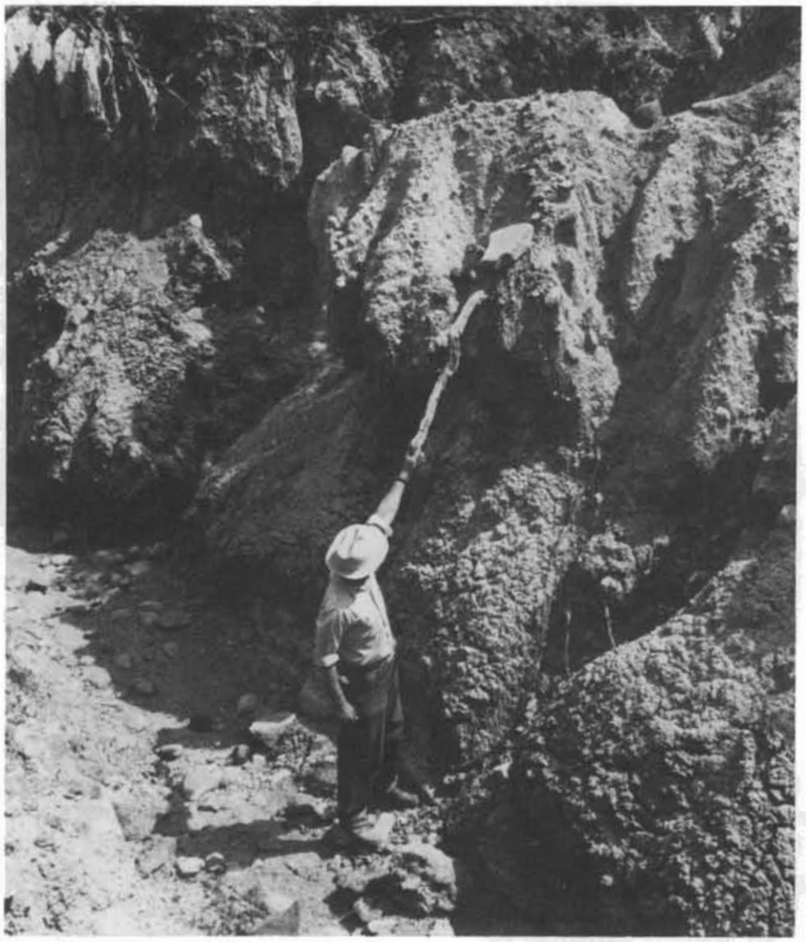
Fig. 9.4. Chipped-stone implements of the Chiricahua stage. a-r, projectile points: a-f, expanded base, stem frequently wider than blade, edges of blade usually serrated (Figs. 64i, 58r, g, n, 62r, k; this and following figure references to Haury 1950); g-m, straight stem, edges parallel, indented base except k, rounded base, and straight base (m), edges of blade infrequently serrated (Figs. 61h, 62n, 61f, 61k, 60k, 61l, 57i); n, diamond-shaped, slightly shouldered with straight base (Fig. 57f); o, diamond-shaped, pointed at both ends (Fig. 57a); p, pointed at both ends, coarse chipping (Fig. 52i); q, pointed at both ends, thinned toward points, retouched edges (Fig. 52h); r, leaf-shaped with indented base and straight sides (Fig. 56l); s-w, drills and gravers (Figs. 67g, 34a, 38e, 42j, 38d): s, drill, based with slender shaft; t, flake perforator, triangular outline; u, graver with concave sides, thick, probably also used as a scraper; v, common graver with one or more sharp points; w, graver with concave sides, thick, probably used as hollow scraper or spokeshave; x-dd, scrapers (Figs. 36g, f, a, 39h, 36d, 44e, 39e) grade into knives (ll-nn), choppers (oo-pp), and planes (qq-rr): scrapers range from small, thumbnail (aa) to large keeled form (bb) and vary in shape from circular (cc) to angular (z); dd, discoidal, domed scraper, characteristic of early stages of Cochise culture; ee-nn, knives (Figs. 44b, a, 52f, 35a, 78h, 36h, 31b, 41f, 37a, 34f): range from thick, side-scraper type (kk-ll) to thin flakes with little retouching or shearing along one edge from use (ii, arrow shows ground edge); ee, large, thick, bifacial blade; ff, small, bifacial blade; gg, finely chipped, thin blade, earliest occurrence in Cochise culture; hh, thick, unifacial blade, serrated or sinuous edges, common; ii, rough flake with ground edge (arrow), characteristic form; mm, specialized, hollow-edged, or spokeshave form; nn, specialized, two-edged form; oo, pp, tt, choppers (Figs. 46b, 28h, 47a): oo, rough core tool with bifacial cutting edge; pp, plano-convex, trimmed partly around edges leaving a smooth hand hold; tt, bifacial form, may be a core used for flake production; qq-ss, planes (Fig. 28a, 40b, 32b): plano-convex, trimmed all around the edge; facets on convex surface frequently worn smooth; plane surface rarely shows any wear; qq, domed upper surface; rr, plane upper surface; ss, rough, may represent discard from the making of a more finished tool (for example, removal of dome from form qq to make form rr); rough, domed planes or scrapers are the most common form of Cochise chipped artifact; uu, hammerstone, edge battered all around, rest of surface only roughly chipped (Fig. 48c). Length of a, 2.7 cm. Materials used are dense quartzite, basalt, and other igneous rock, usually in the form of pebbles from stream beds.



a

b

Fig. 9.5. Chiricahua stage. a, Wet Leggett site, Pine Lawn area (Fig. 6.3, Site 35), in the mountainous region of west central New Mexico; milling stone eroding from Chiricahua stage level. b, preliminary examination of site by the Chicago Museum of Natural History Archaeological Expedition; conifer forest of pines and juniper in background.

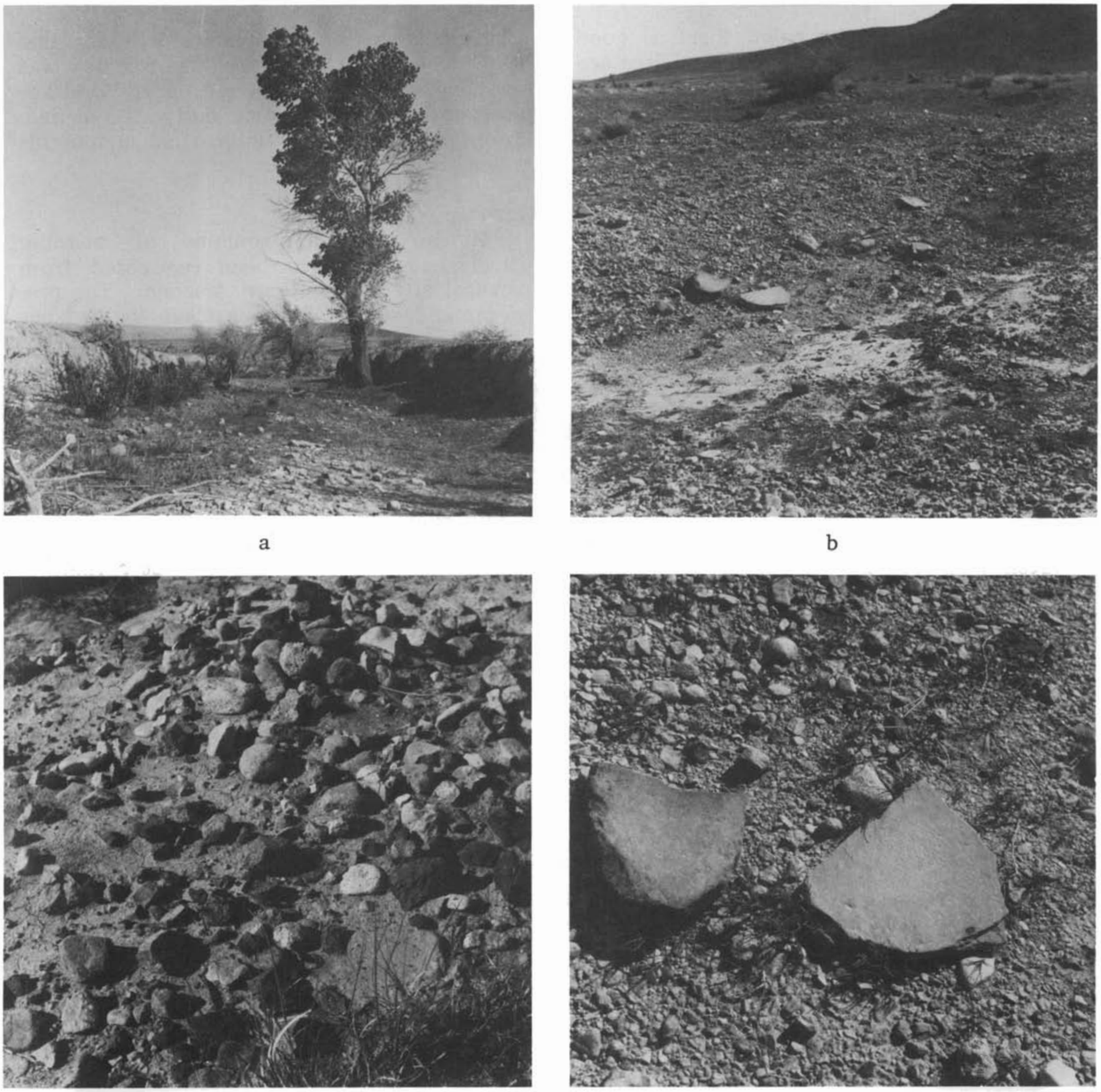


Fig. 9.6. Chiricahua stage site, Arizona FF:8:2 (Fig. 6.2, Site 64): a, erosion through cienega area, habitation area on surface of right bank; b, camp debris exposed by sheet erosion, showing areas of artifact concentration; c, hearth material; d, fragments of milling stones. This site is representative of the small habitation areas identified with the Chiricahua stage when cienegas (or other water sources) existed. The few hearths suggest that the site was used by small bands for gathering plants rather than for hunting.

Cochise was pre-Altithermal, there is good reason to expect that some of these sites are earlier than Chiricahua stage.

A number of Cochise-like sites that seem to belong to the Chiricahua horizon have been found in New Mexico, but few of them have been reported in published accounts. Hurt and McKnight (1949: 192) report grinding tools on the shores of pluvial Lake San Augustin. Agogino and Hibben (1958: 422) discuss several sites that may have Chiricahua affinities. The San Jose complex has produced grinding tools and amaranth seeds in an Altithermal context with a radiocarbon date of about 4900 B.C. (Agogino 1960b: 46). The earliest Santa Ana material appears to have similarities with the Chiricahua assemblage (Agogino 1960a: 20).

Although the climatic evidence for the Altithermal indicates an unfavorable environment, all kinds of Chiricahua sites were located near prehistoric sources of water: temporary pools in stream beds, impounded lakes, springs, or cienegas. These situations doubtless attracted game and provided a varied supply of vegetable material for food and other uses.

The depth of midden deposits such as those at Cave Creek and Ventana Cave, plus the frequent and widespread occurrence of Chiricahua material, indicate a long time span during which the grinding complex was evolving, whether it utilized purely wild resources or included some cultivated maize. Tool development was intensified in the following San Pedro stage.

Burials

Human skeletal remains of possible Chiricahua age have been recovered from several sites in southern Arizona. The preceramic levels at Ventana Cave yielded one fragmentary skeleton and two undisturbed flexed burials. These differed morphologically from remains found in later pottery levels (Haury 1950: 463). A flexed burial, believed to be associated with the Chiricahua stage, was excavated from Cienega Creek wash in the Empire Valley in 1943 (Haury 1950: 463). In the same area two extended burials, probably of Chiricahua age, were found in 1926 (McGregor 1965: 126). Another human burial of Chiricahua or San Pedro age has been reported by McWilliams (1971).

Fragmentary human bones have been found in several other associations indicating contemporaneity with the Chiricahua stage. None of these are burials but merely represent the presence of human bone material as a part of the context of the deposit.

10. SAN PEDRO STAGE

E. B. Sayles

The San Pedro stage marks the final phase of Cochise development (Sayles and Antevs 1941); it is immediately antecedent to the Early Pottery horizon, as defined in the Mogollon culture (Sayles 1945; Martin and others 1952). Geological evidence and a clustering of radiocarbon dates indicate a time range from 2000 to 3500 B.P. (1500 B.C. to A.D. 1), a considerably shorter span than that for each of the earlier stages. San Pedro occupation is followed by the appearance of pottery at about A.D. 1 (Haury and Sayles 1947). [More recent findings suggest that pottery may have been introduced into the Southwest by the third or fourth century B.C. (Wheat 1954). E.W.H.] Although there was in general an amelioration of the dry, warm climate of the Altithermal, the Fairbank Drought occurred during this period.

The San Pedro stage is known from (1) sites exposed in arroyo banks with geological context; (2) caves, and (3) surface sites, identified typologically by artifactual remains.

Eleven sites have been located in strata underlying pottery (Figs. 6.2, Sites 1, 4, 8, 9, 28, 29, 30; 6.3, Sites 3, 6, 8, 15). Five of these sites indicate the presence of houses in the form of shallow pits dug in old surfaces of the floodplain (Fig. 6.2, Sites 1, 4, 8, 9, 30). Few of these sites have been excavated; their relationship with the San Pedro stage rests mainly on geological associations as shown in Figure 10.1.

The San Pedro assemblage was defined originally on the basis of the type site Arizona EE:8:1 (GP Benson 5:10; Figs. 6.2, 10.2), exposed by erosion on the San Pedro River near Fairbank (Sayles and Antevs 1941). The extent of the site indicates a longer period of occupation than is true for earlier Cochise sites. Several large depressions may represent houses with floors slightly below ground level. A number of large bell-shaped pits, hearths, and possible cooking pits were excavated. No pottery was found in San Pedro stage context, but overlying deposits produced some plain ware sherds.

Another San Pedro site located about 500 m north of the type site was investigated and the results described by Cattanack (1966). The stone artifacts from this site (Arizona EE:8:7) were comparable to those found at the type site and to those identified with the San Pedro stage at Ventana Cave.

The site extended over the top and slope of a small mesa adjacent to the San Pedro River, separated from the type site (GP Benson 5:10) by a tributary drainage. A late occupation was indicated by two houses identified with the Salado culture of the fourteenth century. Artifacts occurred on the mesa top and slope and in the vertical face of the wash. Items assigned to the San Pedro stage were classified by Haury on the basis of typology, using patination as a criterion.

The occurrence of San Pedro stage artifacts in valley fill below the mesa also further established their affiliation with the Cochise sequence. In the overlying recent silts were both San Pedro and Salado artifacts, including pottery, comparable to the occurrence of pottery at the San Pedro type site (Cattanack 1966, Fig. 5).

The most extensively excavated San Pedro site in a geological context is located in Matty Canyon near its junction with Cienega Creek in the Empire Valley (Ariz.EE: 2:12; Fig. 6.3, Site 15; Eddy 1958). Exposed by erosion of the arroyo channel, the site consists of a cultural deposit over 0.5 m thick extending into the arroyo bed beneath an eroding gravel bar. A number of hearths were present as well as 19 well-defined pits: straight-sided, bell-shaped, and flare-rimmed. The first two types ranged from 72 to 82 cm in diameter at the rim and 25 to 80 cm in depth. The presence of charcoal and animal bones in five of the pits indicates their use as pit ovens. The others were

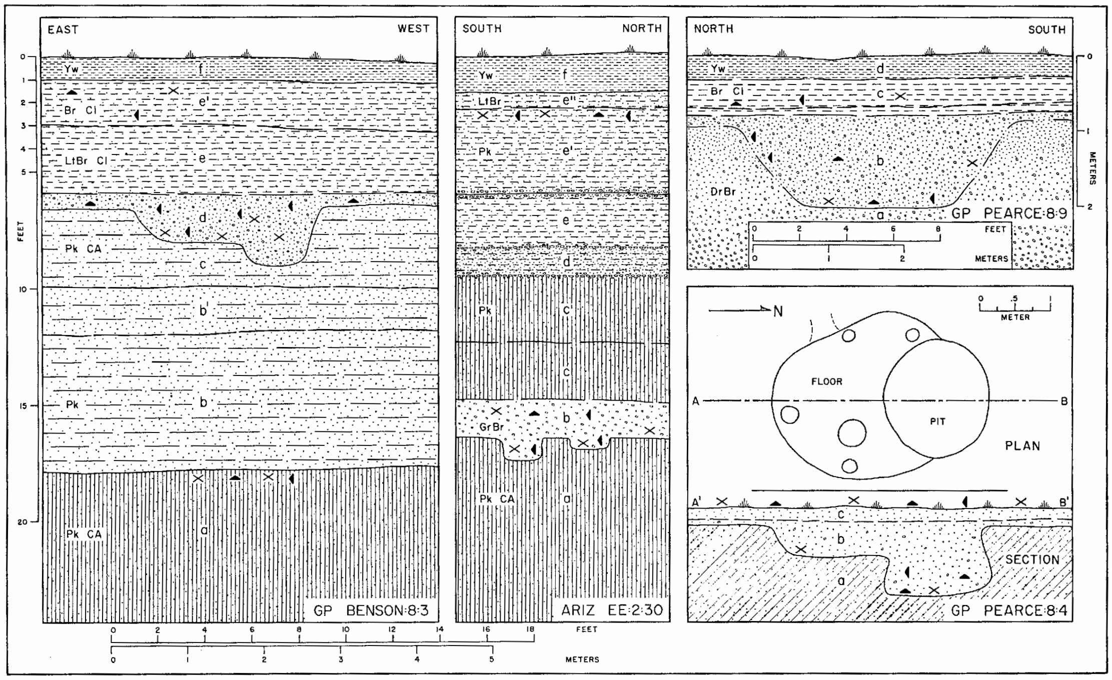


Fig. 10.1. Profiles of San Pedro stage sites showing house floors and pits. Left, GP Benson 8:3 (Fig. 6.2, Site 8), on west bank of San Pedro River 7.5 miles southwest of Tombstone; section through house floor in stratum overlain by late pottery horizon; excavated by Gila Pueblo; bed a, compact, red, sandy clay containing small caliche nodules; beds b, b', unconsolidated, laminated, pink sand; bed c, consolidated, laminated, pink, sandy silt, slightly calichified; bed d, dark gray sandy fill of house floor and adjoining area; beds e, e', brown cienega silt (e' contains charcoal, hearthstones, and late potsherds); bed f, yellow laminated silt. Center, Arizona EE:2:30 (Fig. 6.3, Site 15) in Matty Canyon, 50 miles southeast of Tucson; pits overlain by late pottery horizon; excavated by the University of Arizona (Eddy 1958); bed a, compact, red, sandy clay containing small caliche nodules; bed b, pits and adjacent area filled with gray sandy silt containing artifacts, charcoal, and hearthstones; beds c, c', compact pink, sandy clay; beds d, e, e', laminated, pink, sandy silt, separated by lenses of sand and fine gravel, (d largely sand, e' contains charcoal, hearthstones, and potsherds, e" similar to e' but light brown in color); bed f, yellow laminated silt. Upper right, GP Pearce 8:9 (Fig. 6.2, Site 30), 4.5 miles north and 1.5 miles west of Double Adobe on the east bank of Whitewater Draw (500 feet north of GP Pearce 8:3, Fig. 6.2 Site 31); investigations by Gila Pueblo; bed a, dark brown, compact, sandy, massive clay, containing gravel, calichified; bed b similar to bed a, but containing charcoal, hearthstones, and artifacts, lower surface is ashy and flat, suggesting a house floor, although site has not been excavated; bed c, brown cienega silt, upper portion containing charcoal, hearthstones, and late potsherds; bed d, laminated yellow silt (see Fig. 12.11). Lower right, plan and section of house excavated by Gila Pueblo at GP Pearce 8:4 (Fig. 6.2, Site 30); bed a, compact, red, sandy clay; bed b, loose, sandy fill of house floor with pit containing charcoal, hearthstones, and San Pedro stage artifacts, smaller holes in floor probably held roof supports; bed c, similar to b; late potsherds, dated A.D. 1200-1400, and other artifacts on surface only. See Figure 4.3 for explanation of symbols used in the geological sections.

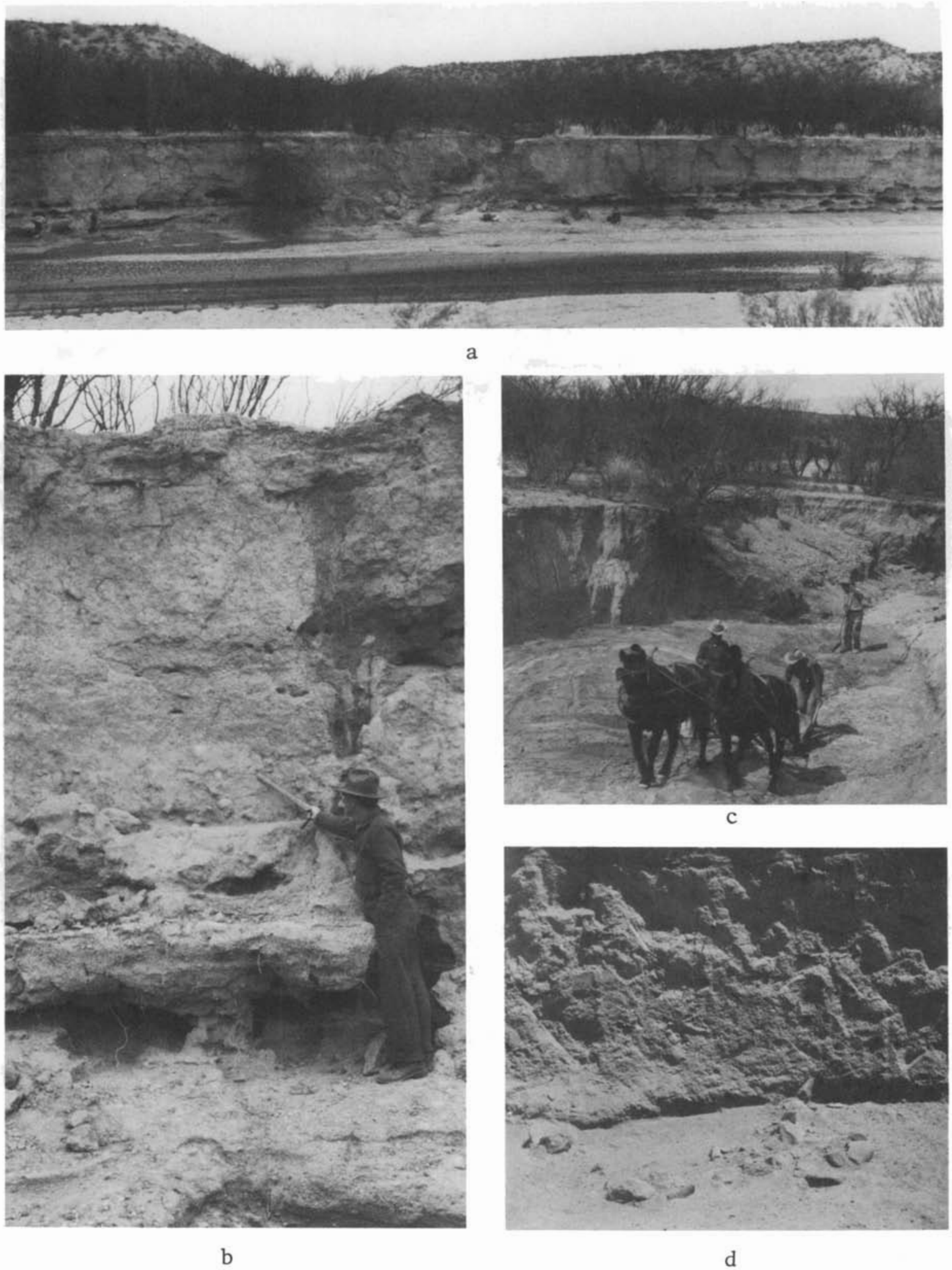


Fig. 10.2. San Pedro stage deposits. a, west bank of San Pedro River, Arizona (GP Benson 5:10), showing extent of site exposed in lower section of vertical face. b, occupation level 5 feet thick, occurring 5 feet below surface, consists of consolidated, calichified, gritty-silt containing charcoal, hearth stones, and artifacts. Lower section in shadow, with concentrated area of charcoal, indicates pits similar to those defined in the excavation of a portion of the site. c, a team of horses was used to remove overburden of occupation level and back dirt from excavation of features. d, circle of hearth stones, underlying silt strata, exposed on occupation level.

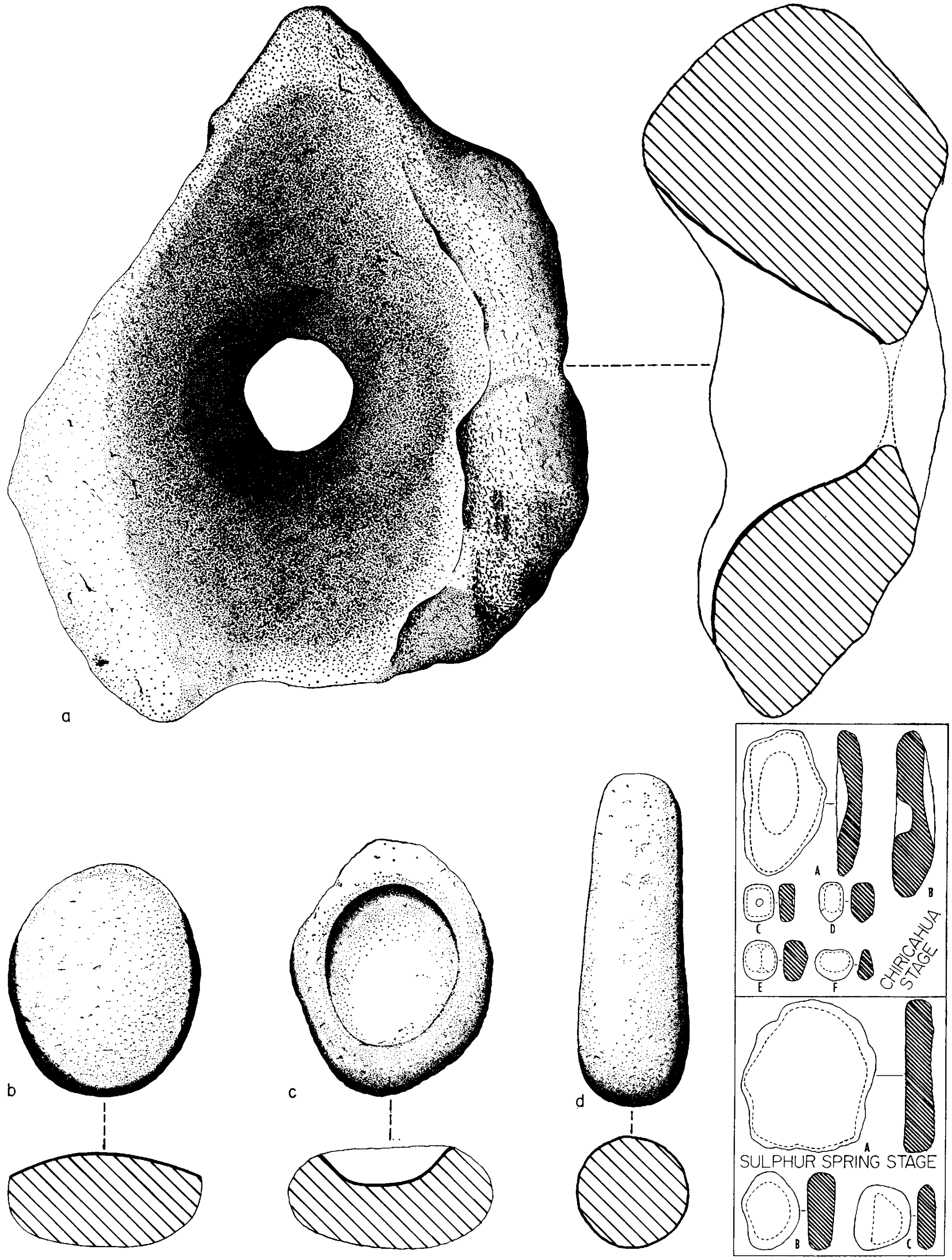


Fig. 10.3. Milling stones of the San Pedro stage: a, nether milling stone, oval basin 11 cm deep, deepest portion is circular forming a hopper-mortar, hole in bottom of basin broken through to shallow grinding basin on the reverse side, edges of the hole are smooth (Sayles and Antevs 1941, Pl. 15g); b, unifaced handstone, grinding surface highly convex, edges slightly modified by pecking; c, pebble mortar, flattened basin 2 cm deep, thick walls, exterior unmodified (Sayles and Antevs 1941, Pl. 15d); d, pestle, tapered cylinder with rounded ends (Sayles and Antevs 1941, Pl. 15h). Heavy line indicates grinding surface. Length of a, 57 cm. Insets show milling stones of the Sulphur Spring and Chiricahua stages, from Figures 7.3 and 9.3 for comparison.

presumably intended for storage or burial. Four of the pits, clustered in one area of the midden, contained seven burials, possibly representing secondary usage. Two large flare-rimmed pits with secondary depressions are analogous to house pits at the Fairbank site, but they lack evidence of post holes, fire pits, or entrances (Eddy 1958). The earliest occurrence of maize pollen in southern Arizona, dated by radiocarbon at 500 B.C., is found in San Pedro age strata of Cienega Creek near the Matty Canyon site (Arizona EE:2:35; Martin 1963b: 31, 34).

The presence of houses in the San Pedro stage was not firmly established until after publication of the first Cochise report (Sayles and Antevs 1941). At GP Benson 8:3 (Fig. 6.2, Site 8) near Charleston, and at GP Pearce 8:4 (Arizona FF:6:2; Fig. 6.2, Site 30) near McNeal, excavation revealed shallow oval floors, hardpacked but unplastered, with poorly defined hearths and no evidence of roof support. Storage pits occupied much of the floor space. There is some indication of side entrances (Sayles 1945: 1-14).

As mentioned above, burials made in large pits have been found in several San Pedro stage sites (Figs. 6.2, Sites 1, 6; 6.3, Site 15, and Arizona EE:2:30). These are tightly flexed, occurring singly or in pairs in the same pit. No artifacts have been found with any of these burials, possibly because of deterioration of perishable items. Burials are also found within habitation areas and many indicate secondary use of what were originally storage pits (Eddy 1958: 52). Pit interment within the site is also characteristic of Early Pottery horizon sites.

The San Pedro stage is represented at Ventana Cave in the middle portion of the man-made midden (Haury 1950: 173-74, Fig. 5). The assemblage of stone tools shows a wide range in projectile point form, reflecting a greater dependence on hunting (Fig. 10.4), than in other San Pedro sites.

Evidence of hunting and food gathering activities defined by the San Pedro tool inventory is widespread (in surface sites) within the Cochise area proper.

Huckell (1973) reported the results of an excavation of a small preceramic site approximately eight miles west of Bowie, Arizona, on a tributary of Gold Gulch (Arizona CC:10:2). The site was tentatively assigned to the San Pedro stage, representing a short occupation by a small group. The chipped stone forms and large amount of debitage indicate one of their principal activities was tool-making. This site is near San Simon Village (GP Arizona L:10:2; Fig. 6.2, Site 19), which contained some early houses comparable to those in the San Pedro stage (ovoid) with little pottery, followed by a long sequence of pottery phases (Sayles 1945). Early Mogollon development is well represented in the San Simon valley, but few Cochise sites have been found there. This San Pedro site is significant because it adds to the evidence of a hunting aspect of the Cochise culture.

The widespread occurrence of Cochise material is further corroborated by an intensive survey by Whalen (1971) of a ten square mile area in the drainages that empty into the San Pedro River east of the Whetstone Mountains. From an examination of the artifacts shown me (presumably from all sites) and from an inspection of a part of the area surveyed (containing about one-fifth of his locations), I would judge that Whalen's intensive survey confirmed what early observations in the Cochise culture area discovered: the long sequence of the Cochise culture established by archaeology and geology is also supported by the common occurrence of "surface" artifacts, both singly and in clusters, in association with camp sites used by food-gatherers and hunters in varied environments. (Readers of Whalen's thesis should know that the Sayles 1958 manuscript to which he refers was not complete at the time he used it and had not been confirmed by its various collaborators. Some of Whalen's interpretations of this preliminary material are not substantiated by the present report.)

The grinding tool assemblage of the Chiricahua stage is further developed during the San Pedro stage (Fig. 10.3). Most notable is the presence of a deep basin nether stone with its accompanying larger, convex handstone; the basin mortar and true pestle; and the hopper-mortar, a basin mortar with a prepared hole in the bottom. These artifacts, along with pebble mortars and development of the stone bowl, suggest a further use of food resources, such as seeds and nuts, that were only incipient in the earlier Chiricahua stage. Materials used for grinding tools are coarse and fine grained basalt and quartzite. Similar types of pestles to that shown in

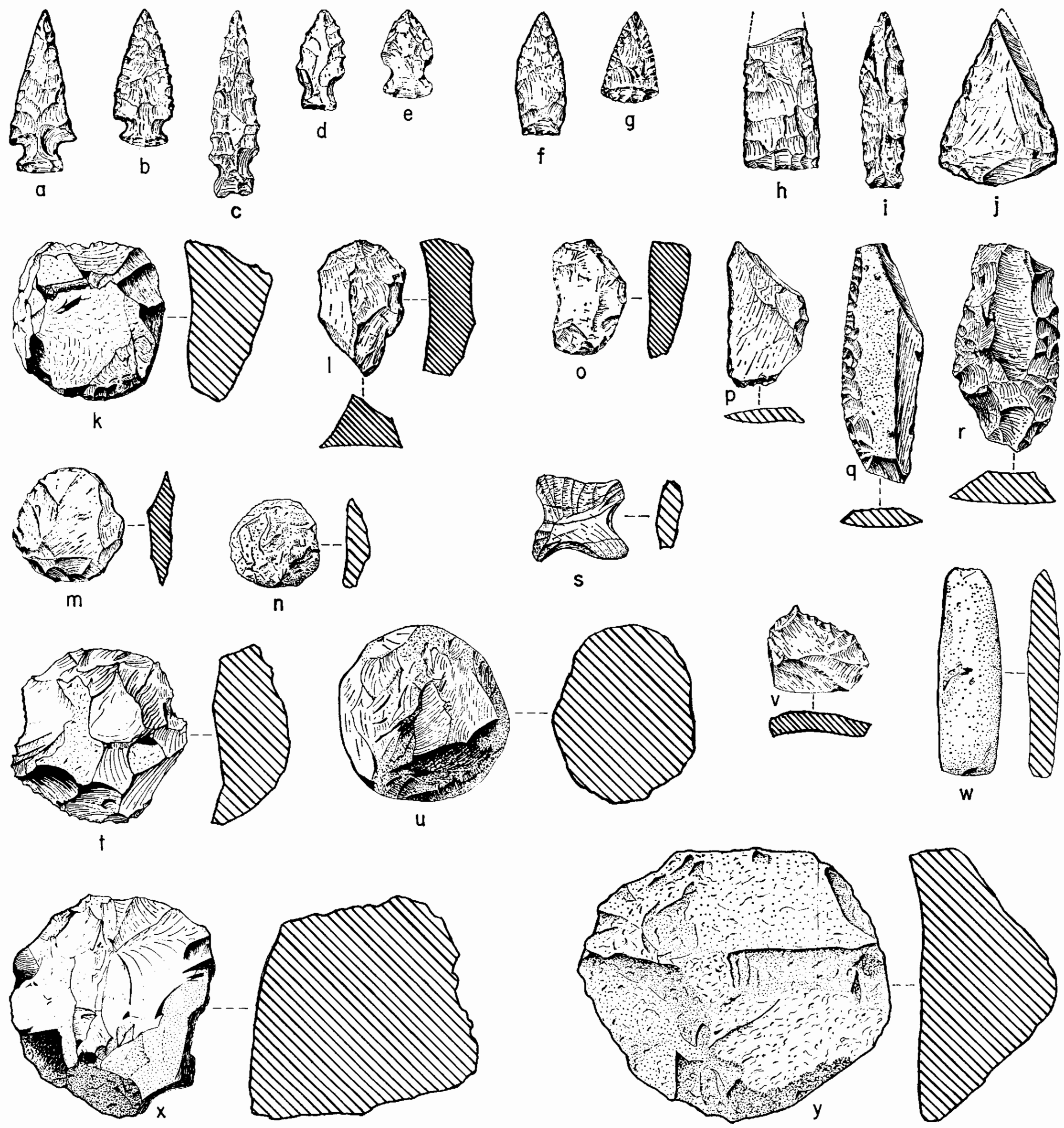


Fig. 10.4. Chipped stone implements of the San Pedro stage. a-g projectile points: a-e, expanding stem, rounded notch, straight, rounded, and concave bases (Figs. 64d, 63o, 62t, g, b; these and following figure references are to Haury 1950); f, g, leaf-shaped thin, finely chipped (Figs. 54c, 56b); h-j, blades: thick, straight or convex base, sinuous edge, shape ranges from long and narrow with shallow side notches (i) to short, wide-based, triangular (j); h, straight-sided form predominant in San Pedro stage, usually occurs broken, point fragments also found (Figs. 56f, 54g, 56d); k-n, scrapers: range in size and finish from large, crudely chipped discoidal (k) to small, finely chipped (n), larger forms are comparable to planes; l, end scraper, common, frequently keeled and large (Fig. 36c); m, discoidal scraper, basalt (Fig. 44d); n, discoidal, finely chipped around entire edge; o-r, knives: vary from thin flake with little or no retouch, but some shearing from use (p), to thick side-scraper (r); o, concave edge, hollow or spokeshave form; p, straight edge (Fig. 41c); q, convex edge, fine chipping (Fig. 29h); r, coarse chipping (Fig. 33e); s, four-pointed object, both chipped and ground, three concave sides have ground or worn surfaces as if used for smoothing objects like shafts, chert (Sayles and Antevs 1941, Pl. 15b); t, chopper, fist-sized stone with a few flakes removed to produce sinuous cutting edge; u, hammer, nearly all edges battered, probably used to "sharpen" nether grinding stones; v, graver, thick flake with one sharp point (Fig. 42d); w, pecking stone, unmodified natural pebble, except ends are battered and flaked, may have been used for pressure flaking (Sayles and Antevs 1941, Pl. 16m); x, core, typical form with flat surface, usually a prepared striking platform, from which flakes were struck;

Figure 10.3d, but with a point or cutting edge on one end, occurred in Ventana Cave and may have served as digging tools (Haury 1950: Fig. 76a); they are common in later pottery horizons (Sayles 1945: Pl. 34a, b).

Core tools include several types of choppers, planes, and hammerstones (Fig. 10.4w-y). Pebble hammerstones are found only in the San Pedro stage.

Tools fashioned from flakes are less varied in the San Pedro stage but represent a larger proportion of the lithic assemblage than in earlier periods. Several new types of chipped implements foreshadow developments in the Early Pottery horizon, while some types from previous stages are absent. Distinctive to this stage are: large, side-notched San Pedro points; thin, leaf-shaped points and blanks; bifacially worked disks; and four-pointed or cruciform objects (Figs. 6.17-6.20). Drills and gravers are also present. Material used for chipped tools is most frequently basalt; smaller implements are made from jasper, chert, and obsidian. For the first time in the sequence, tools of bone and horn are plentiful. They were probably used in the preparation of skins and the manufacture of chipped stone tools (Eddy 1958: 49-51).

Other complexes occurring beyond the Cochise area proper have been correlated with the Cochise culture: the Atrisco assemblage of hunting tools found in the middle Rio Grande area shows strong similarities to both San Pedro and Amargosa III forms; grinding implements resemble those of the San Pedro stage in southeastern Arizona. Geological dating indicates contemporaneity (Campbell and Ellis 1952). Typological similarities exist with the Lobo (Agogino 1960b) and Santa Ana tool assemblages of New Mexico (Agogino and Hibben 1958; Agogino 1960a).

Also similar to the San Pedro stage assemblage, though not identified with it, are Concho complex tools (Wendorf and Thomas 1951; Breternitz 1957) and Basketmaker II artifacts (Morris and Burgh 1954). They indicate a subsistence pattern incorporating both hunting and gathering, as in the San Pedro stage.

The Peralta complex, found west of Hermosillo, Sonora, contains projectile points similar to both the San Pedro and Pinto-Gypsum types, as well as slab and basin grinding stones. The assemblage as a whole corresponds most closely to the San Pedro stage (Fay 1967: 2-4) and may represent a Sonoran variant of Cochise culture. No attempt has been made in this report to point out specific analogies between Cochise complexes and those identified with Desert cultures, other than the relationship with Ventana Cave where the San Dieguito-Amargosa sequence is present (Haury 1950).

Houses, storage pits, definite burials, and the increased size of occupation areas suggest more permanent occupations during the San Pedro stage. These sites may represent seasonal or semisedentary habitation by the same group on a regular basis, perhaps with the gathering together of small social units during times of communal subsistence activities (Eddy 1958: 59). Maize pollen in San Pedro age deposits on Cienega Creek suggests the possibility of maize cultivation as a supplement to the diet during this period. In any case, further evolution of grinding tools indicates continuing refinement in the use of plant resources. The quantity of stone projectile points reflects the importance of hunting in the economy. These trends culminate in permanent settlements based on agriculture in the Early Pottery horizon.

Fig. 10.4 (continued)

y, plane, symmetrical plano-convex type of chopper, refined version of t, precisely shaped around edge, convex surface seems designed to fit into palm of hand. Length of a, 6.3 cm. Chipped stone tools of the San Pedro stage were made of materials similar to those used in the Chiricahua stage, along with an increased use of chert, obsidian, agate (petrified wood), and other silicates with good conchoidal fracturing qualities.

11. EARLY POTTERY HORIZON

E. B. Sayles

Although the Cochise culture may be said to end with the San Pedro stage, the Early Pottery horizon, which immediately follows it in southeastern Arizona, represents a continuity of many Cochise traits. It is distinguished primarily by the presence of pottery, Alma Plain and San Francisco Red (Fig. 11.1). Ceramic technology was probably introduced to late Cochise peoples from an outside source, as there is no evidence of its origin in Cochise sites (Sayles 1945: 66). Changes in the stone tool assemblage exist but are of no greater magnitude than those that distinguish the earlier Cochise stages from each other (Figs. 11.2, 11.3). The assemblage is augmented by shell artifacts, implying contact with areas to the west, and an increase in bone implements (Fig. 11.4).

Some of the houses of the Early Pottery horizon, as found at Cave Creek (GP Chiricahua 3:21; Fig. 6.2, Site 58) and San Simon Village (GP L:10:2; Fig. 6.2, Site 19), are similar in plan to those of the San Pedro stage (Sayles 1945: 1-4). They indicate permanent habitations, and many of the features of San Pedro occupation are still in evidence: hearths, pit ovens, storage pits, and pit burials. A number of Early Pottery horizon sites are located outside the confining valleys in which Cochise sites were first found (Figs. 6.2, Sites 12, 21, 57-60; 6.3, Sites 33, 35), although their dispersal is roughly comparable. In some cases early pottery sites are found in strata directly overlying San Pedro stage sites, giving further evidence of continuity (Sayles 1945: 1). Pottery found in recent soil strata overlying sediments in

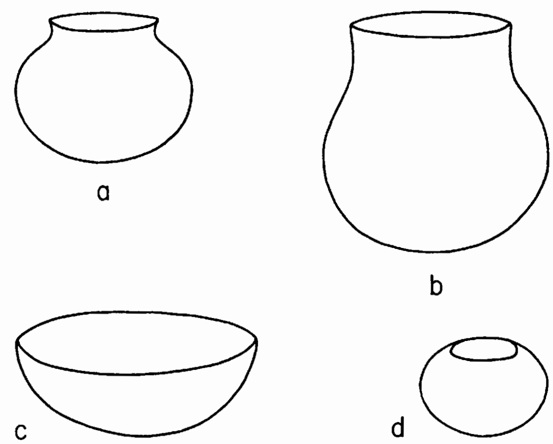
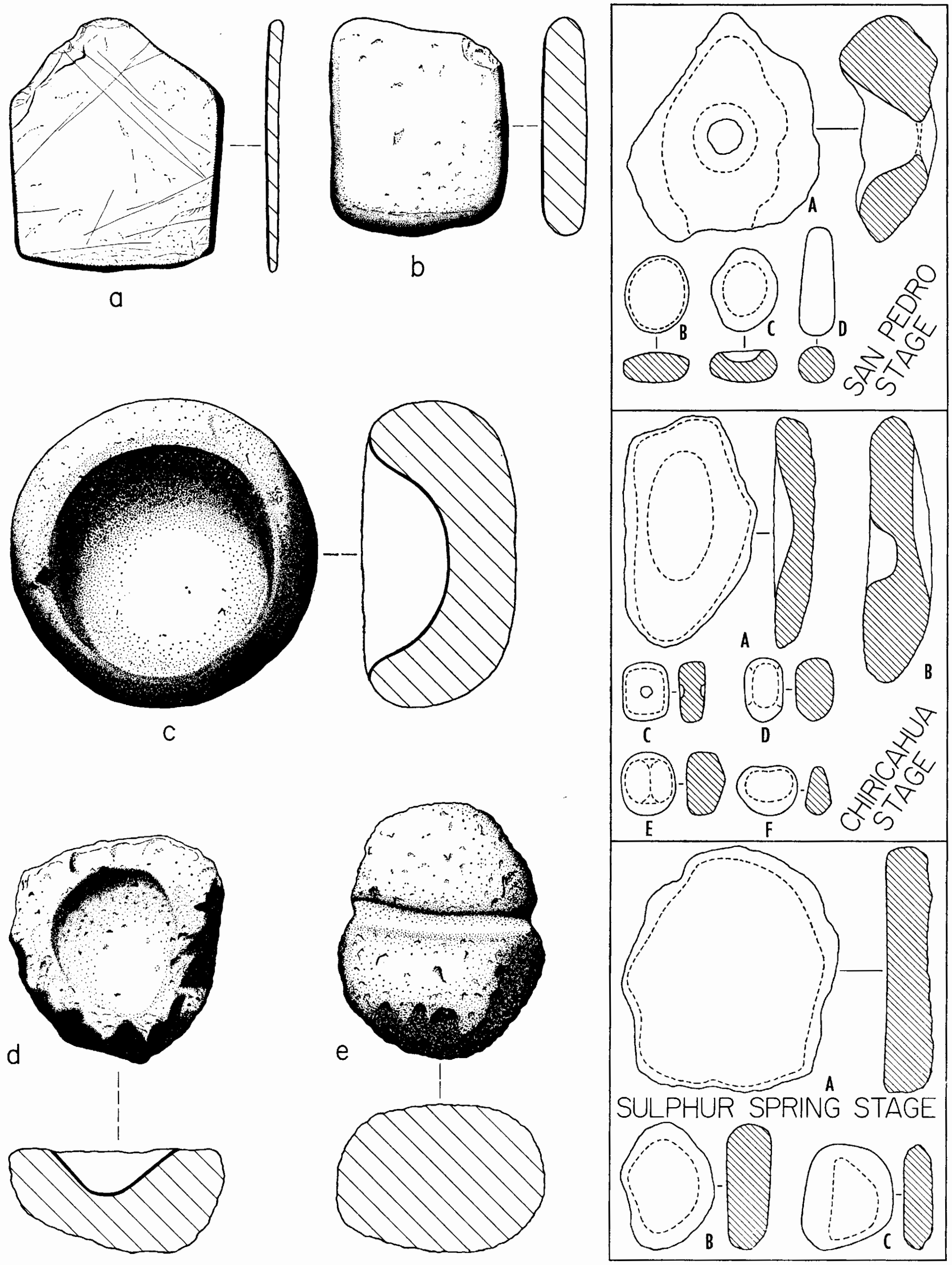


Fig. 11.1. Typical shapes of early pottery vessels: a, Alma Plain, globular jar with recurved rim; b, Alma Plain, large, globular jar with straight rim; c, San Francisco Red, shallow bowl; d, San Francisco Red, neckless seed-jar. Vessels are from Cave Creek excavations (Sayles 1945). Scale, about 1/6.

Fig. 11.2. Milling stones of the Early Pottery horizon: a, lapstone or proto-palette abrading stone, edges and both surfaces ground smooth; b, natural, flat, quartzite pebble with surfaces ground smooth; c, plain stone vessel with flattened basin 4.2 cm deep, exterior modified; d, pebble mortar, irregularly shaped limestone pebble with flattened basin; e, grooved hammerstone or maul, natural basalt pebble with shallow encircling groove and battered ends. Heavy line indicates grinding surface. Length of a, 12.5 cm. Insets show milling stones of the Sulphur Spring, Chiricahua, and San Pedro stages, from Figures 7.3, 9.3, and 10.3 for comparison; there is limited persistence of earlier forms.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b
c
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e
A
B
C
D
SAN PEDRO STAGE
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CHIRICAHUA STAGE
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B
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Figure 11.2

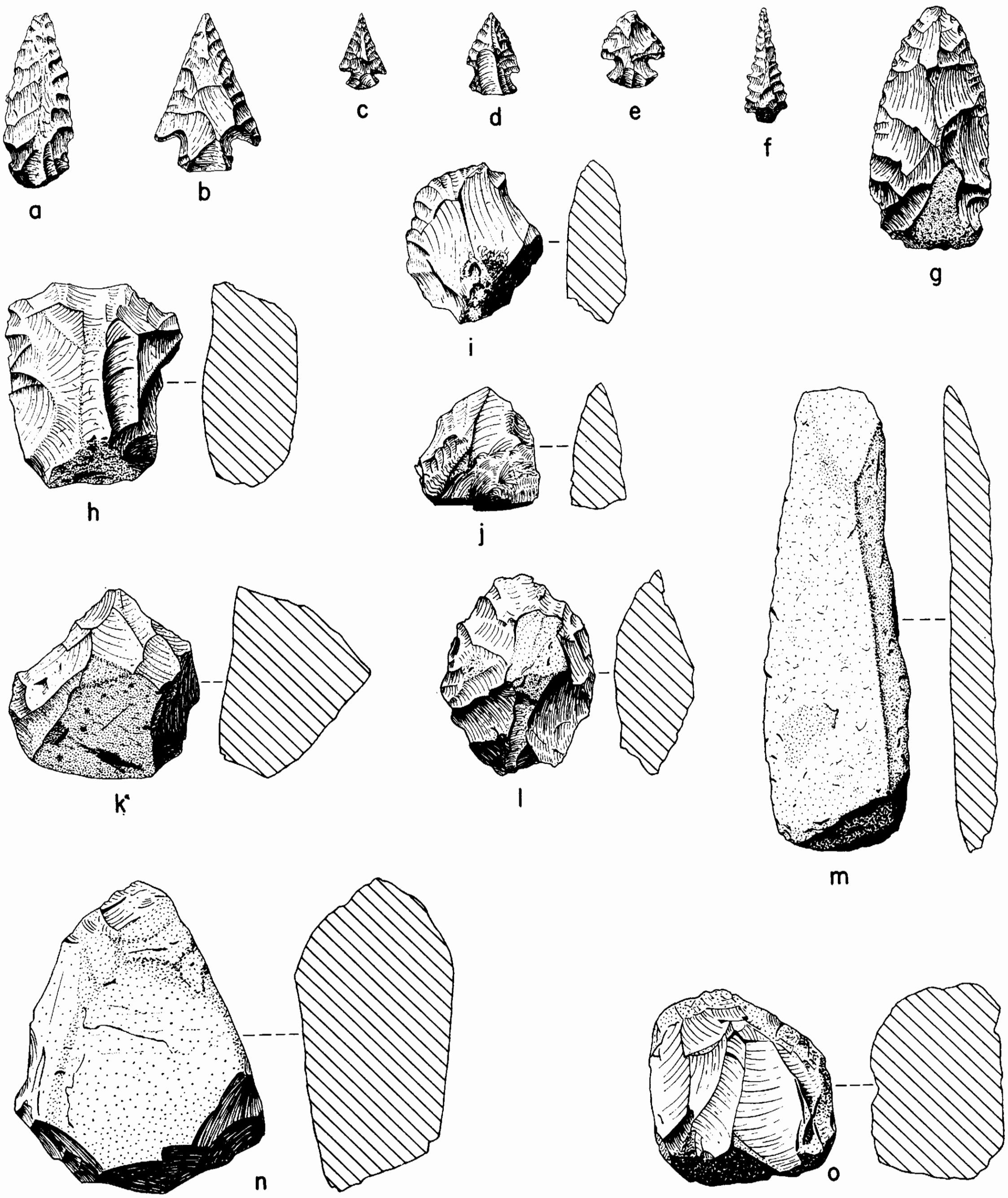


Figure 11.3

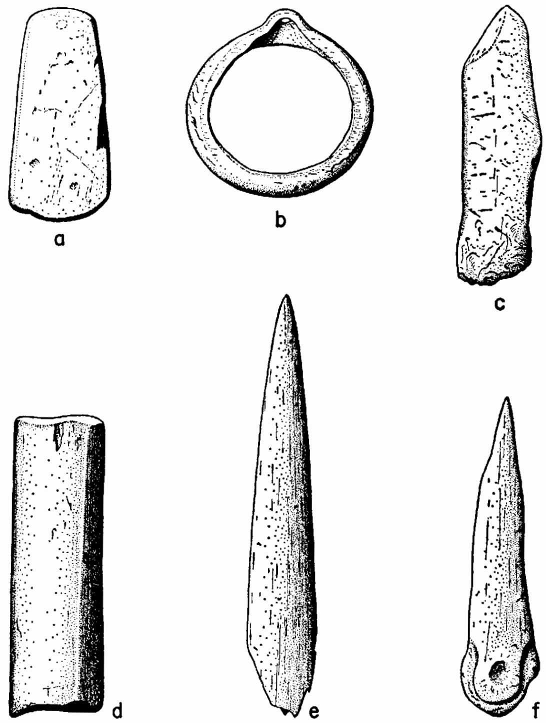


Fig. 11.4. Miscellaneous artifacts of the Early Pottery horizon: a, flat stone pendant fashioned from a quartzite pebble (Pl. 48g; this and following figure references are to Sayles 1945); b, small *glycymeris* shell bracelet (Pl. 51d); c, quartz crystal with facets and surface smoothed from use, possibly as a reamer (Pl. 56a); d, bone tube, deer ulna (Pl. 54h); e, splinter awl, deer bone; f, awl made of split deer metatarsus. Length of a, 6 cm.

which Cochise deposits occur consists of plain ware sherds, often extensively weathered and not typologically datable.

Agriculture was generally known and probably practiced earlier than pottery making. The presence of agricultural products at Bat Cave (Dick 1965), the Tularosa caves (Martin and others 1952), Cienega Creek at Point of Pines (Haury 1947), and Cienega Creek in the Empire Valley (Martin 1963b), along with houses and storage and cooking pits in the San Pedro stage indicate agriculture preceded pottery in southern Arizona.

The termination of the Cochise culture by the establishment of agricultural, pottery-making cultures of the Southwest has been outlined. The beginning of the Cochise culture is less well known and can only be sought by a review of the earlier hunting traditions.

Fig. 11.3. Chipped stone implements of the Early Pottery horizon. a-f, projectile points: a, long, leaf-shaped blade with shallow side notches and round base, thick in cross section (Pl. 42l; this and following figure references from Sayles 1945); b, triangular blade with deep lateral notches, long barbs, and straight base, thin in cross section (Pl. 42m); c-e, "arrowpoints," short blades with deep notches and round bases; (c, d, Pl. 42c, d); f, long, narrow "arrowpoint" with straight stem and serrated edges (Pl. 42b); g, knife, bifacial blade with shallow side notches (Pl. 42n); h-l, scrapers: h, i, end scrapers; j, graver(?) combined with a scraping edge; k, rough, spall-like; l, thick bifacial form; m, knife or digging tool(?), long flake with secondary chipping on both faces that are ground to form a thin cutting edge; n, chopper, plano-convex, roughly chipped along three edges, fourth unaltered; o, spall hammerstone, battered around the edge. Length of a, 4.7 cm.

12. CORRELATION OF COCHISE GEOLOGICAL-ARCHAEOLOGICAL RECORDS WITH RADIOCARBON DATING-POLLEN RECORDS

E. B. Sayles

GEOLOGICAL SEDIMENTS AND ARCHAEOLOGICAL REMAINS

Identification of the Cazador stage at Locality 2 of the Double Adobe Area, described in Chapter 8, occurred in 1953. All sites previously identified with the Sulphur Spring stage in Whitewater Draw that had not been destroyed by erosion or concealed by stream bed alluvium were subsequently rechecked, including Localities 1 and 5 in the Double Adobe area.

Figures 12.2-12.6 show the changes in the Double Adobe area caused by excavation and erosion since the first discovery of the Cochise culture in 1926 (see ill., p. x; see Fig. 12.1 for key to Figs. 12.2-12.5). Locality 3 (excavated in 1937) and Locality 4 (the site of the mammoth skull excavated by Cummings in 1926), both of Sulphur Spring age, had been eroded to a depth of at least 25 feet from the 1937 face of the arroyo. The sand strata resting on the pink clay and the overlying laminated silts were pinched out or represented by a thin trace. Only the massive calichified deposit below the Cienega sites remained.

Locality 5 of the Double Adobe area (Figs. 7.1, Site 5; 12.2-12.5), directly east of the old bridge, extended approximately 100 feet to the east when first investigated in 1937 (reported in Sayles and Antevs 1941, Fig. 13). Based on the nature of the geological strata and their contents of fossil faunal remains, charcoal, hearthstones, and other artifacts, the location was assigned to the Sulphur Spring stage. Only the western portion of the site was excavated to base clay because of ground water in the trenches. The upper strata in the eastern portion of the site were exposed and the entire site was mapped (Sayles and Antevs 1941, Fig. 13).

When field work started in the early 1950s to bring the Cochise report up to date, Locality 5 was partially concealed by a gravel bar. With the discovery and excavation of Locality 2, revealing Cazador stage material, further work at Locality 5 was planned, including the use of power machinery to remove the overburden and to clear the gravel bar that had accumulated in the stream bed. This clearing was partly done in 1956 by the forces of nature when high flood waters eroded most of the upper strata from the site, but they also added fresh material to the gravel bar.

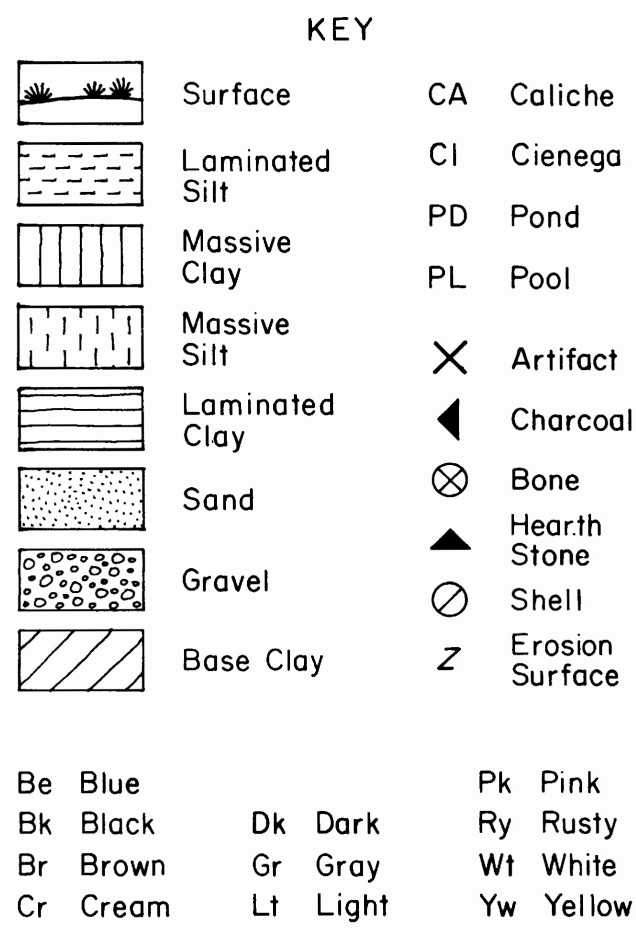


Fig. 12.1. Key to symbols used in geological sections (Figs. 12.2-12.5, 12.7, 12.8, 12.10, 12.11).

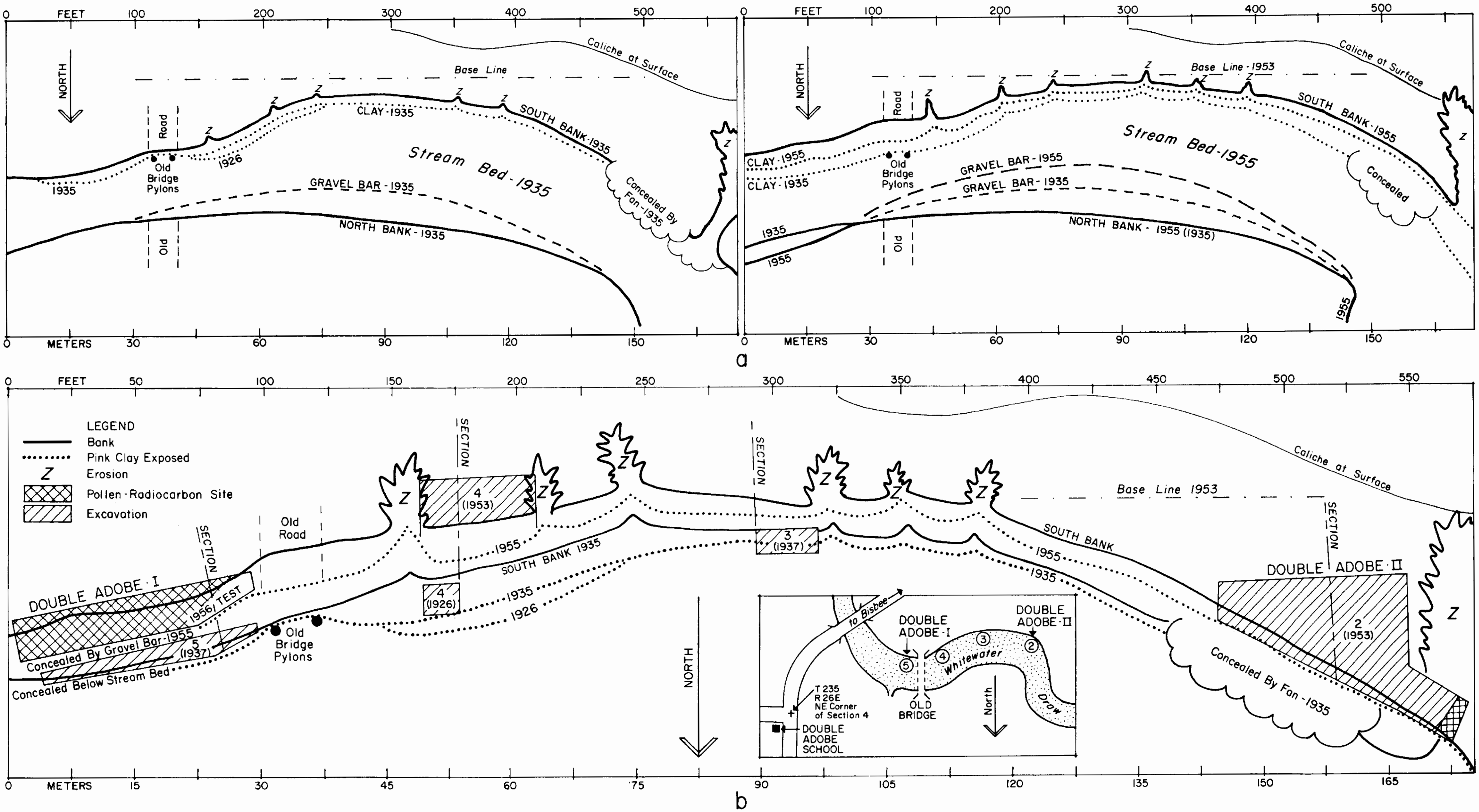


Fig. 12.2. Double Adobe area, Arizona FF:10:1 (GP Sonora F:10:1): a, Sulphur Spring and Cazador stage deposits in 1926, 1935, and 1955; b, relationship of Localities 2, 3, 4, 5, and Double Adobe I and II to the south bank of the arroyo (1926–1955). (See Fig. 12.1 for Key.)

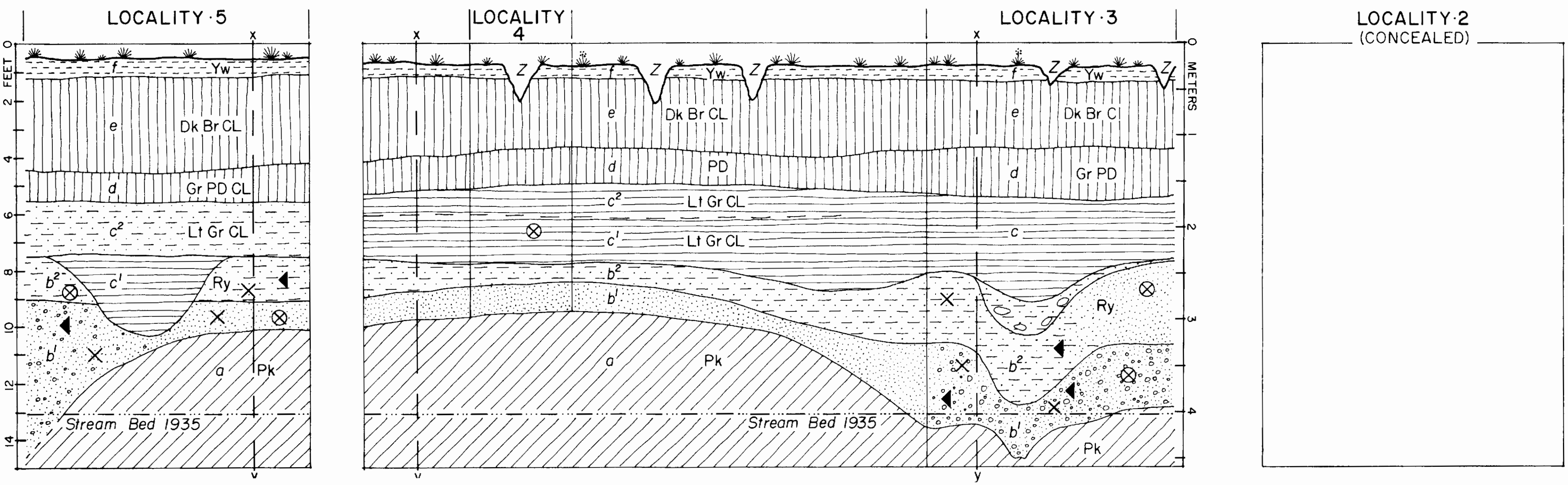


Fig. 12.3. Profiles of Localities 3, 4, and 5 (1935), Double Adobe area. (See Fig. 12.1 for Key.)

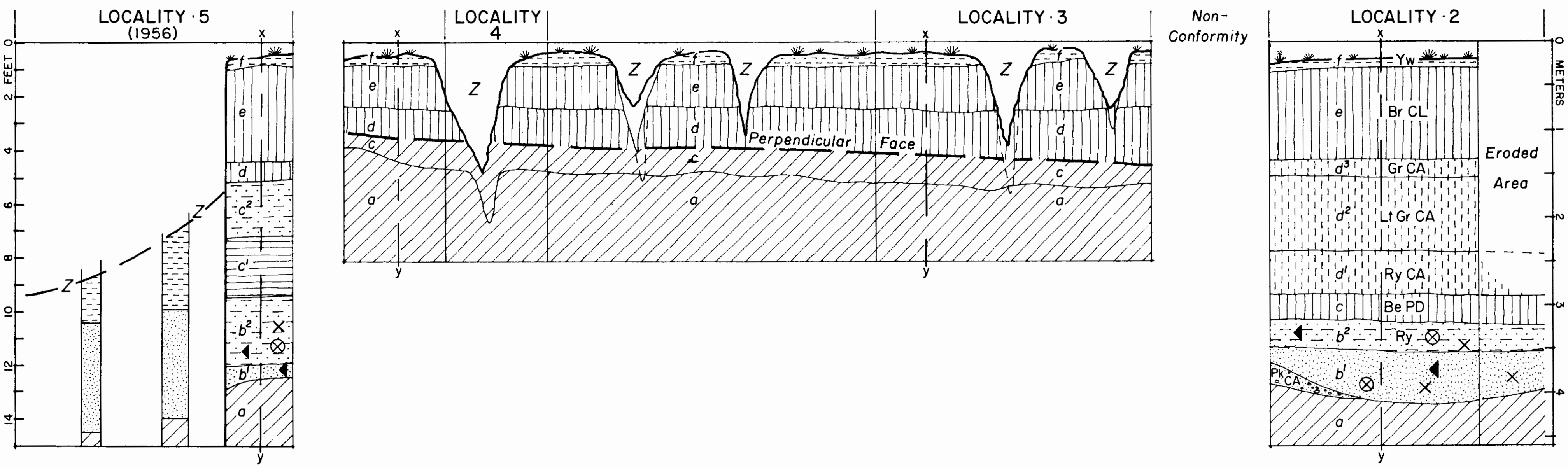


Fig. 12.4. Profiles of Localities 2, 3, 4 (1955) and Locality 5 (1956), Double Adobe area. (See Fig. 12.1 for Key.)

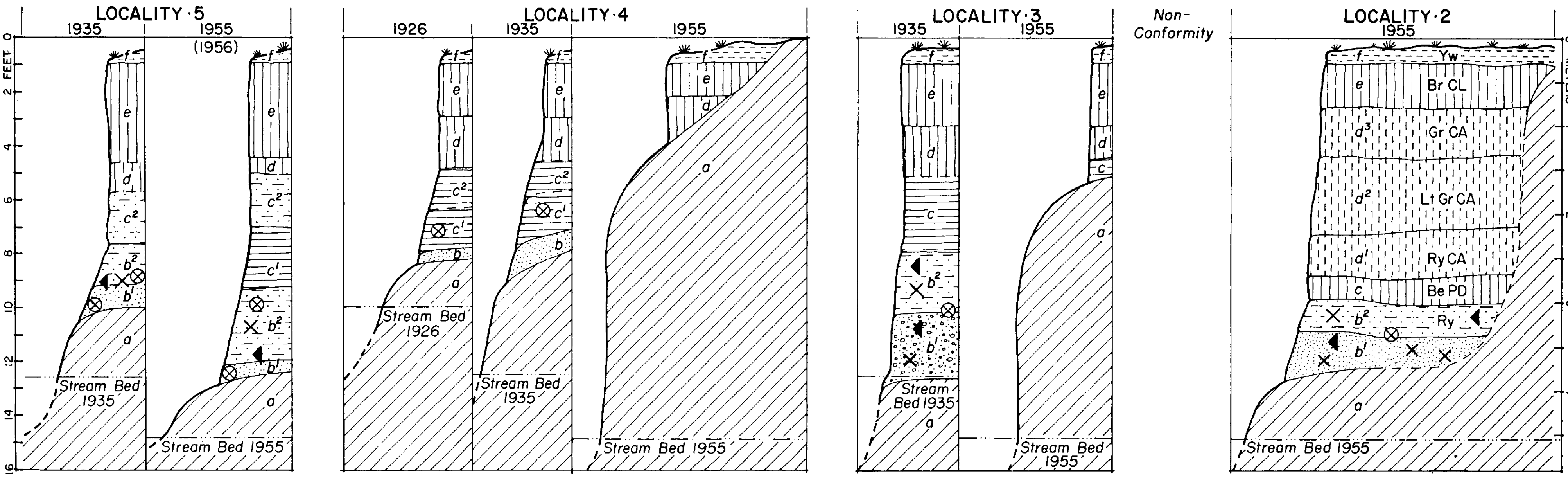


Fig. 12.5. Sections of Localities 2, 3, 4, and 5 (1926-1955), Double Adobe area. (See Fig. 12.1 for Key.)

Tests were made in 1956 exposing 25 feet of the face of the western portion of the site and pits were dug toward the east as shown in Figure 12.7a, b. The tests showed that the western section of the site (Test No. 3) could be correlated with the excavation made in 1937 (Sayles and Antevs 1941, Fig. 13). The test pits in the eastern part of the site (Nos. 1 and 2) indicated that complete excavation would be required to determine their relationship to Test 3, the western section. With the identification of the Cazador stage at Locality 2 and its assemblage of attributes that was recognized as different from that of the Sulphur Spring stage, the question arose as to whether or not the sites originally identified as Sulphur Spring were indeed of that stage or might instead have represented the Cazador stage. Since the Double Adobe site was not threatened by stream flow erosion in 1956, we felt there was no urgent need for excavation.

At this time, the Geochronology Committee of the University of Arizona was carrying on an extensive investigation in and adjacent to the Cochise culture area to collect samples for pollen identification and radiocarbon dating. Arrangements were made with Dr. Paul S. Martin, who was directing this field work, to collect samples from a series of sites that had been excavated and identified geologically and archaeologically with different stages of the Cochise culture. The Geochronology Committee arranged for the use of a bulldozer (from Cochise County) to aid in preparing Locality 5 for excavation. The samples for pollen and radiocarbon dating were to be collected while the excavation of the site was in progress. This field work by the Geochronology Committee to clear the gravel bar from the face of the site and to remove overburden to the depth exposed by erosion was not started until 1959. Through a misunderstanding, the bulldozer was used to remove the entire site, leaving only the profile shown in Figure 12.7c.

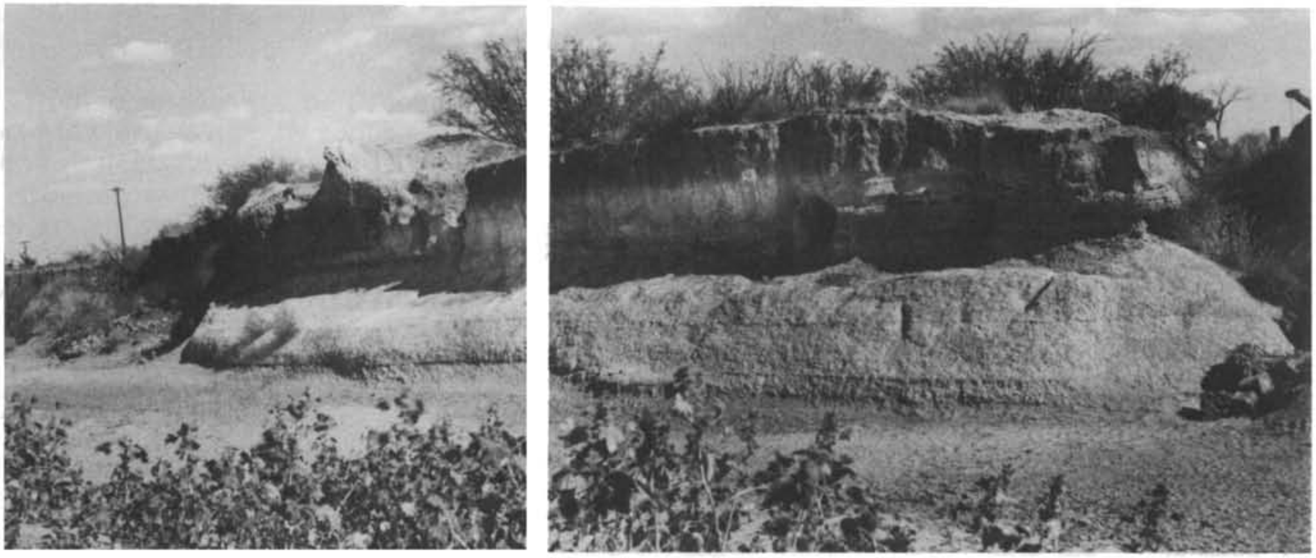
Identity of Geological Sediments

To further demonstrate the relationship of the geological sediments with which the Sulphur Spring and Cazador stages are associated, Figure 12.8 shows the sediments found at Locality 4 (Sulphur Spring stage), Double Adobe I (unidentified archaeologically), and Locality 2 (Cazador stage). The variation between the descriptions of some of the strata in Figure 12.8 and those shown in Figure 12.7c may be explained by differences in observation. In our investigations of the Cochise culture since 1935, it has been noted that the appearance of the same strata may differ, mainly in shades of color, when wet, dry, in sunlight, or in shadow. These characteristics and how the sediments were likely formed have been fully described by Antevs in Chapter 4. The seven erosion surfaces shown in Figure 12.7c, Double Adobe I, are shown in Figure 12.8 with their probable relationships to the stages of the Cochise culture.

The earliest erosion Z^1 at Double Adobe I may be the same as that at Localities 3, 4, and 5—erosion of pink clay a overlain by sand b^1, the artifact-fossil fauna strata identified with the Sulphur Spring stage. Since no artifacts or fossil fauna were found in situ in the excavation of Double Adobe I, no archaeological stage can be attributed to that locality. However, it is assumed from the occurrence of sizable pieces of charcoal in strata b^2 and c at Double Adobe I that man was present at the time the sediments were formed. While it is not uncommon for charcoal to be found in clay strata in Whitewater Draw, it is not considered of man-made origin unless there is evidence of archaeology in the same stratum. Unless the charcoal is larger than specks resembling plant stems, it is suspect.

The sequence of sediments at Double Adobe I and Locality 2 indicate that deposit b^1 at Locality 2 is equivalent to deposit b^3 at Double Adobe I. Erosion Z^3 at Double Adobe I and Z^1 at Locality 2 may be of comparable age. Although Locality 2 lacks any evidence of erosion similar to that at Double Adobe I, the variations in massive silts d^1, d^2, and d^3 at Locality 2 suggests drier periods during the deposition of the highly calichified massive silts represented by bed d at Double Adobe I. There is a close similarity in the sequence of sediments at Double Adobe I and Locality 2 following erosion Z^3 at Double Adobe I and erosion Z^1 at Locality 2.

There are marked dissimilarities between the early sediments at Double Adobe I and Locality 2 (sand followed by silt) and those at



a

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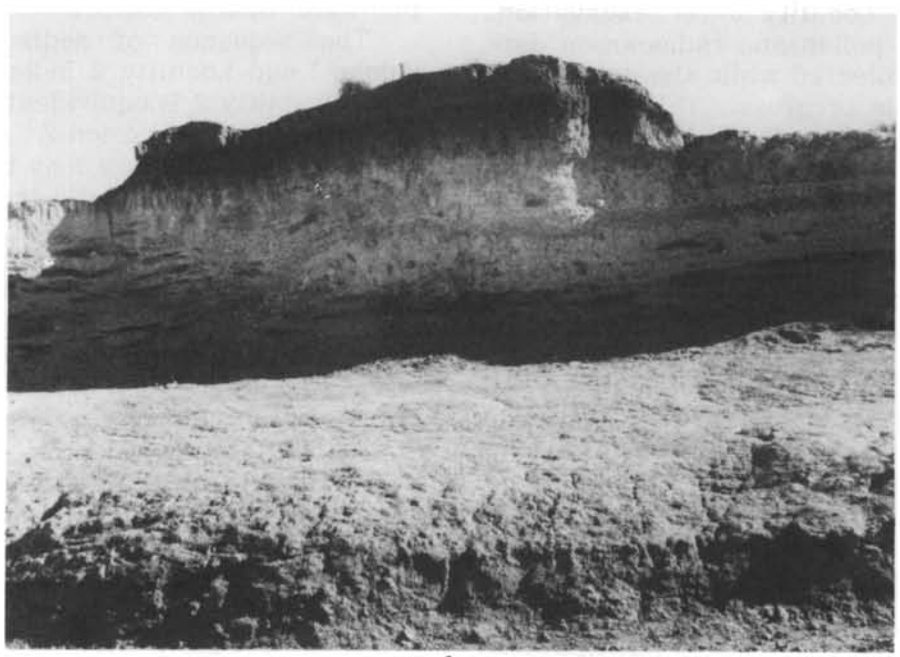

d

Figure 12.6

Locality 4. Erosion Z^1 at Locality 4 may correspond to either Z^1 or Z^2 at Double Adobe I, but the lack of fossil fauna and archaeological evidence in the overlying sands prohibits any identity of these sediments at Double Adobe I with any archaeological stage. All that can be implied is that erosions Z^1 and Z^2 at Double Adobe I represent erosions earlier than the one that immediately preceded the Cazador stage.

POLLEN RECORDS AND RADIOCARBON DATES

The objective of this correlation is to determine the natural environments (ecology) that existed at different periods during the span of the Cochise culture, and to identify their associated archaeological remains during the past 12,000 years in the area centering on the Whitewater Draw valley. Alluvial sediments and erosions, from the historic period extending into the past, indicate the climatic conditions under which they were formed as described in Chapter 4. "The fossil pollen record should reveal biotic and climatic conditions during deposition but it may not provide continuous evidence during the time of cutting..." (Martin 1963b: 3).

In this study, I propose that pollen types identified as noteworthy-rare by Martin (1963b) in Sulphur Spring and Cazador stage deposits are due to moist climatic conditions at that time, as indicated by our geological observations, and are not wind-blown from distant areas as Martin suggests. All pollen types recorded in each graph (Martin 1963b) are considered a source of information relating directly to the ecology at the site at the time the sediments were formed.

The higher relative percentages of fossil pollen types in all sites in Whitewater Draw are represented by *Compositae*, *Cheno-Ams*, and *Gramineae*, all dependent on summer rains. *Pinus* and *Quercus*, both prolific producers of wind-blown pollen, are generally present, along with other annual plants identified with the Desert Grasslands; some species of oak are found in all life zones.

The presence of plants dependent on perennial ground water such as walnut (*Juglans*), ash (*Fraxinus*), and willow (*Salix*), as well as pine and oak, indicate more moisture than from summer rains alone. In the correlation of the geological-archaeological records with the radiocarbon dating-pollen identification records, the presence of the noteworthy-rare types, associated with cooler, wetter life zones than the Desert Grassland, are

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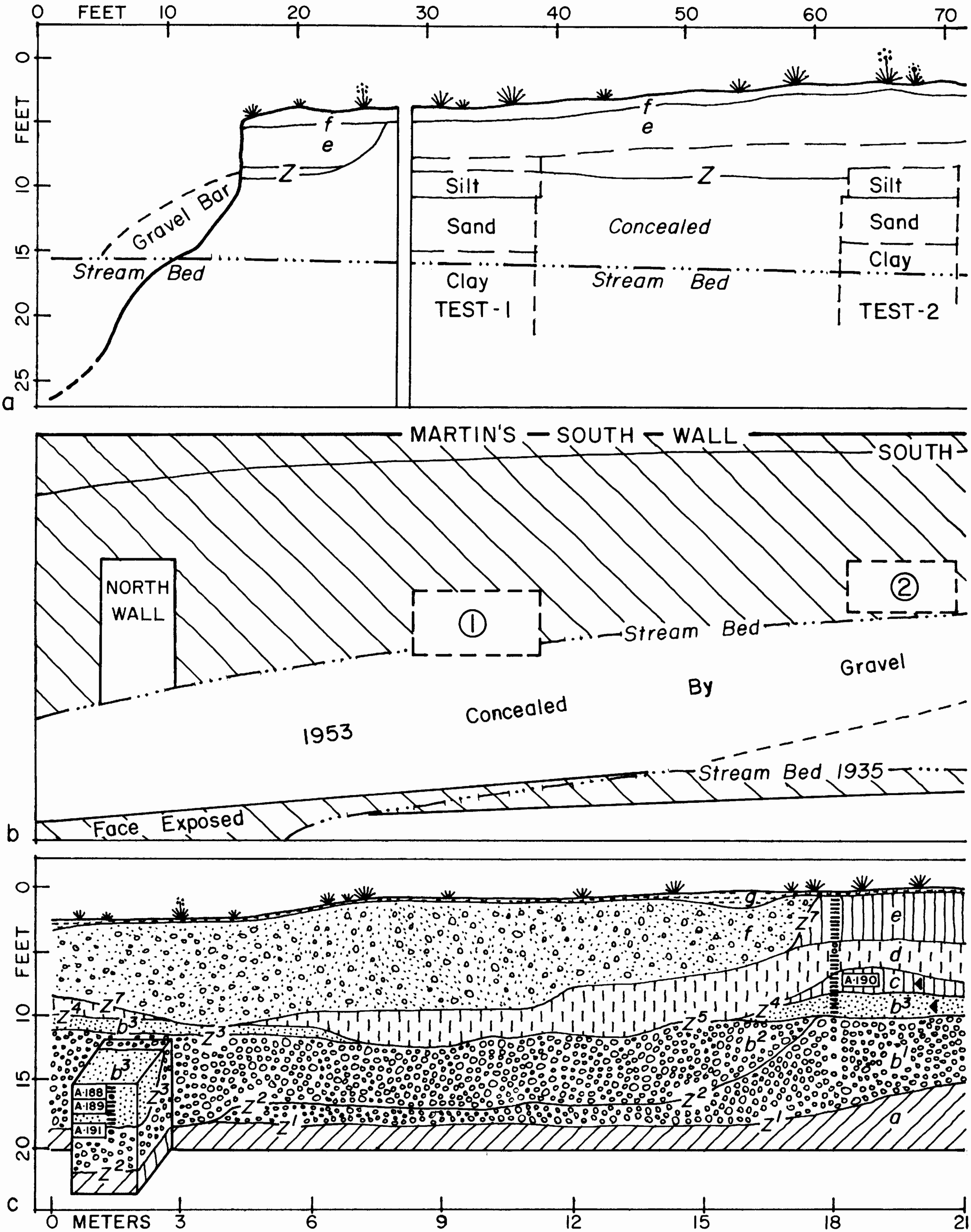
Fig. 12.6. South arroyo bank, facing north, of Double Adobe area (Arizona FF:10:1, GP Sonora F:10:1) showing relationship of Locality 2 (Cazador stage) and Localities 3, 4, and 5 (Sulphur Spring stage). a, area immediately east of Locality 4 (Loc. 5 and Double Adobe I, extreme left). In 1953 pink clay a was exposed high above the stream bed shown in foreground. The upper strata, in shadow, were thinned showing only the recent yellow silt, the underlying dark cienega clay overlying massive calichified silt. This overlay a thin band of laminated silt (clay). The sand-gravel strata were absent or showed only a trace. b, Locality 4, site of mammoth excavated by Cummings; shovel used to remove overburden for investigation of area to determine whether the mammoth bones had been deposited in an earlier stratum and later redeposited in clay bed c. Trenches were first hand dug from the face of the arroyo bank to determine the depth of the strata on clay bed a. Machinery was used to remove the dark brown cienega silt. The underlying strata were then thoroughly investigated, using a hoe and broom to expose pink clay a. The only bones discovered were some splinters of fossil bone, similar to those commonly found in the stream bed 30 years earlier, along with broken glass and tin cans that had accumulated in the shallow surface gullies. Nothing was found to indicate that the mammoth bones in clay bed c had originally been deposited in an older stratum and later redeposited. c, looking west toward Locality 2 (overburden removed for excavation of the site). d, section between Localities 3 and 2; only the upper sections, in shadow, remain, similar to those in b.



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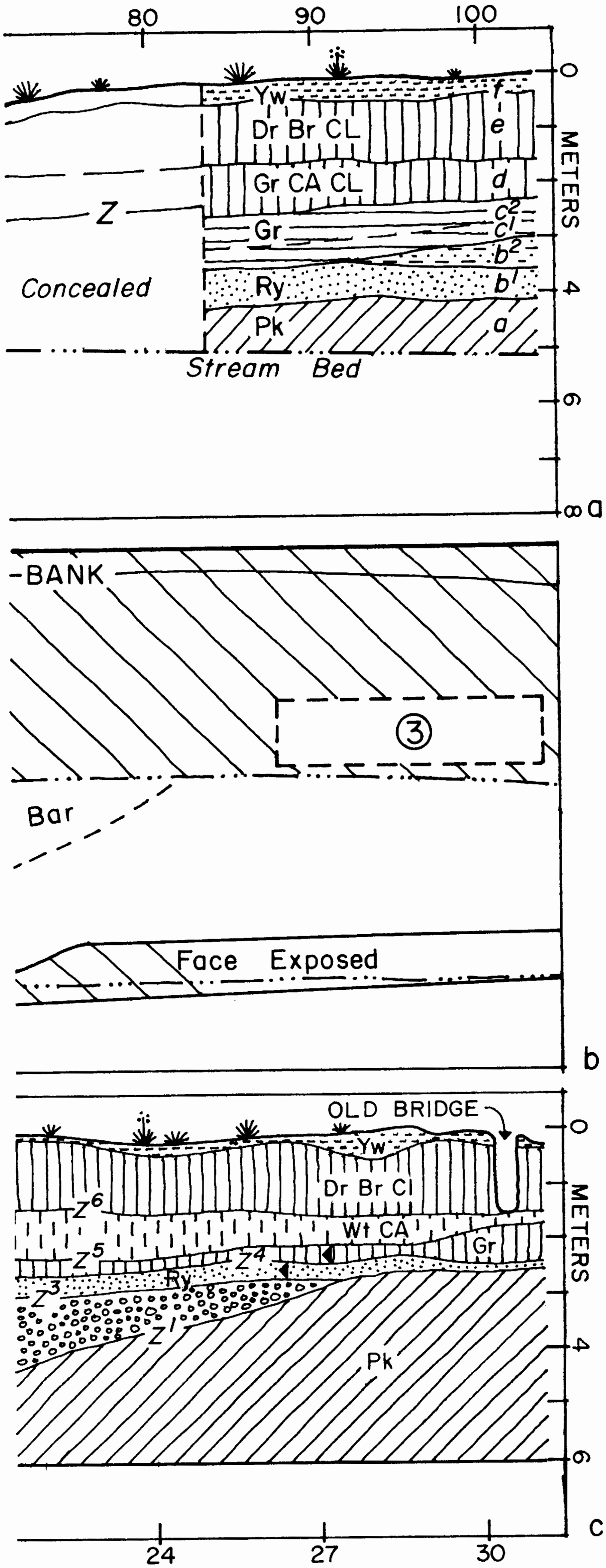
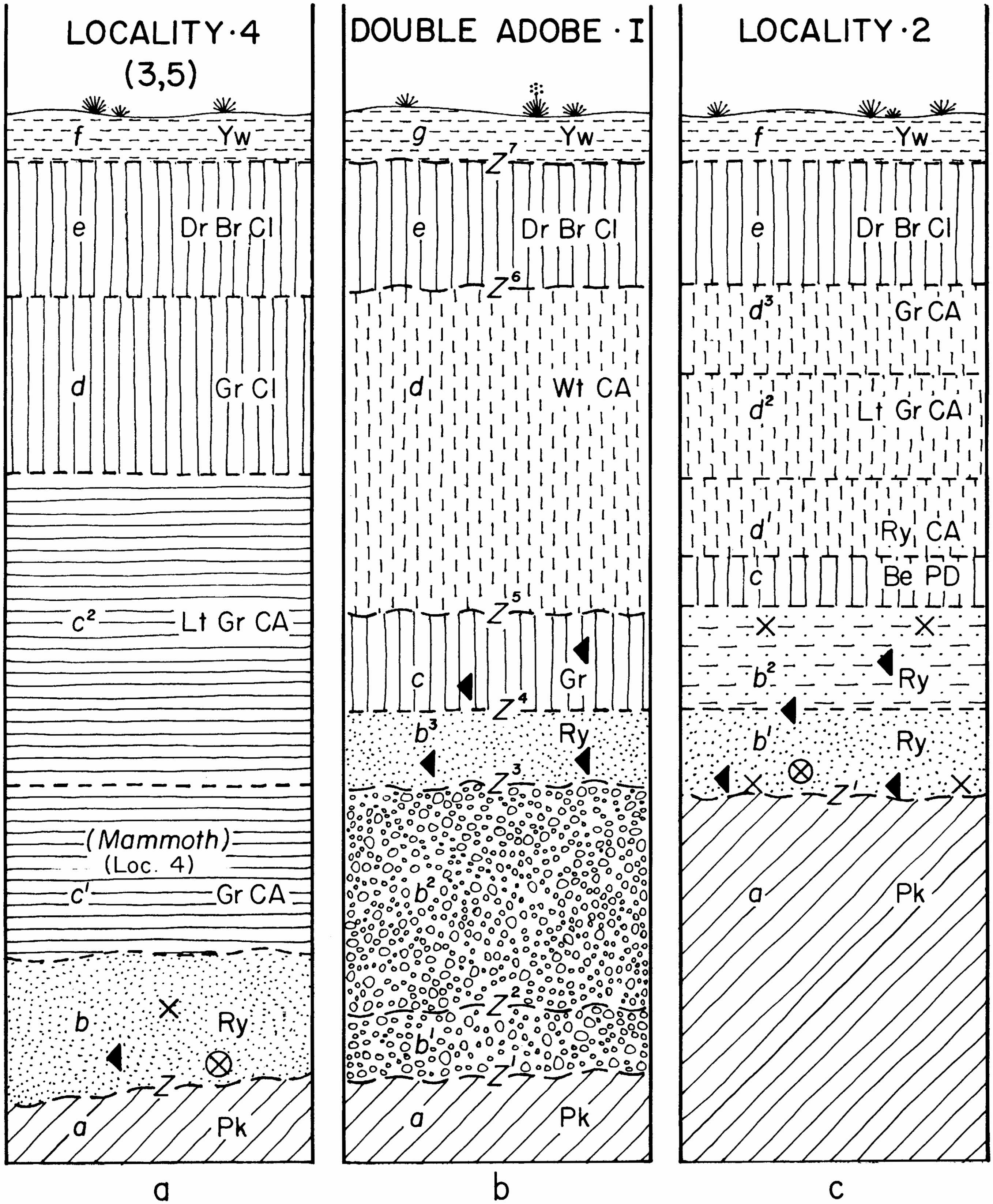


Fig. 12.7. Relationship of Locality 5 and Double Adobe I. a, profile of Locality 5, 1956. Tests 1 and 2, made by excavators from the Arizona State Museum in 1956, showed a series of strata that could not be correlated readily with those in Test 3 (see b), the western 25 feet of the site. Only this western section was comparable to strata excavated in 1937 that were identified with the Sulphur Spring stage (Sayles and Antevs 1941: 11-13, 46-48, Fig. 13). b, plan showing the relationship of Locality 5 and Double Adobe I. The south banks of the arroyo in 1935 and 1953 are shown with respect to the excavation of Locality 5 and Martin's excavation in 1959 showing the north and south walls of Double Adobe I. c, profile of Double Adobe I, redrawn from Figure 21 in Martin (1963b) with symbols added to show erosions (Z). Lettering of strata show sequence only and not identities of the strata of one sequence with that of another. Sediments in the south wall included "a loose silt" at the surface. "Below the silt is indurated clay resting on a conspicuous erosion surface at about 120 cm. From 120 to 190 cm is a white clay, highly calichified." This is underlain to a depth of 240 cm with clay and silt (RC-dated 7910 ± 200 B.P.) and below this, rusty sand, silt, and charcoal to a depth of 280 cm. "Sediment between levels 280 and 500 on the south wall was cross-bedded sand. Extraction of five levels from the sand indicated poor preservation or no pollen, and further analysis of them was not attempted" (Martin 1963b: 36). The eroded surface of the pink clay occurred at 550 cm. Facsimile of Figure 21 in Martin (1963b) is reproduced with permission of the University of Arizona Press, Tucson. (See Fig. 12.1 for Key.)



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Gr CA
d²
Lt Gr CA
d'
Ry CA
c
Be PD
b²
Ry
b'
Ry
Z'
a
Pk
c

Figure 12.8

considered indications of climatic conditions (moisture and temperature) comparable to that of the life zone with which these types are presently identified.

Life zones occurring at different elevations, their dominant vegetation, together with the climatic type indicated by rainfall and temperature, are presented in Figure 2.4. The dominant plants found in the various life zones of southeastern Arizona are fully described in Martin 1963b: 1-8). There exist at different altitudes and in different environmental areas life zones that may be comparable to those that existed in the region during the past 12,000 years or more. The Empire Valley (Fig. 2.5e) may be a present-day example of the appearance of the Desert Grassland before it was invaded by brush and denuded of grass. The valley floor and adjoining slopes (bajadas, 3000 to 5000 feet) are areas with which the Cochise culture has been identified. Characteristic of this Desert Grassland are the cienegas and streams that, in earlier times, may have originated in the mountains and flowed into the lower valley floors providing along their courses moisture for plants that could not have survived otherwise (Fig. 2.8).

Pollen Zones I-IV were established from the pollen and radiocarbon records (Martin 1963b: 56) based on the higher relative percentages of *Cheno-Ams*, *Compositae*, and *Gramineae*, and secondarily by *Pinus* and *Quercus*, in archaeological associations and in other locales mainly in the Desert Grassland.

Noteworthy-rare Pollen

The occurrences of certain fossil pollen in the Desert Grassland pollen graphs were designated as noteworthy because they indicated an ecological condition inconsistent with that of the dominant pollen with which they were associated. They were assumed to have been wind-blown from higher elevations within the Cochise area. Martin (1963b: 54-55) identified the occurrence of fossil pollen types now associated with the cool-wet conifer forest of the highest mountains within the Desert Grassland: spruce (*Picea*), maple (*Acer*), alder (*Alnus*), and birch (*Betula*). Pollen from trees requiring permanent or high level ground water included walnut (*Juglans*), ash (*Fraxinus*), and willow (*Salix*). Sage (*Artemisia*) is now limited to higher areas of the Desert Grassland. Three trees, elm, hickory, and linden, were not native to the Southwest; they also indicate the existence of a wet environment.

In summary, the earliest pollen records within the Cochise area indicate that the modern types (with limitation) were represented along with the higher relative percentages of pollens identified with Zone V, a cool-wet environment found at present within the Cochise area only in the higher altitudes and in the larger mountain areas; only elm (*Ulmus*) and hickory (*Carya*) of the rare types were represented in lower frequencies than in the Desert Grassland, and none of the strictly desert types (cacti, yuccas) were present. At the maximum of the Pluvial, 15,000 to 20,000 years ago, the conifers represented by *Pinus* and *Juniperus* were lowered at least 3000 feet and were living on the valley floor, with a corresponding lowering of spruce, fir, and Douglas fir now growing in limited areas at higher elevations. There is no continuous radiocarbon-pollen record connecting the latest Pluvial dates with the earliest dates associated with man in the Southwest, 12,000 years ago.

Willcox Playa Pollen Record

The only locale within the Cochise area proper that has provided a pollen record from a time earlier than the Sulphur Spring stage of the Cochise culture is the Willcox Playa. Martin (1963b, Fig. 28) has interpreted the

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Fig. 12.8. Identity of the geological sediments of the Sulphur Spring and Cazador stages: a, Locality 4, Sulphur Spring stage; b, Double Adobe I, unidentified archaeologically; c, Locality 2, Cazador stage. The sediments following the erosions shown in the profile of Double Adobe I may represent sediments contemporaneous with stages of the Cochise culture: Z^1, Z^2, Sulphur Spring stage; Z^3, Cazador stage; Z^4, Z^5, Chiricahua stage; Z^6, San Pedro stage; Z^7, recent or ceramic period(?). (See Fig. 12.1 for Key.)

pollen graph of the Willcox Playa as a record that extends through the Wisconsin into the Sangamon, commencing 20,000 years ago.

In 1935 the surface of the Playa to the east of the break in the beach shown in Figure 4.2 was three m or more below a calichelike formation adjoining the slope of the beach strand. Now the bare surface of the playa, where it is not covered by vegetation, appears level and it has been observed covered with water following a rain. The sand dunes on the northeastern side of the Playa form a series: the eastern dunes are anchored by vegetation; the western dunes, within the lake bed, were formed before A.D. 1300 as indicated by potsherds on their surfaces; between the two are shifting dunes partly covered by vegetation. Erosion by wind, as evidenced by the sand dunes and the location of the present surface of the playa three m or more below the calichelike formation on the west, must have taken place in the past, removing the sediments formed during wetter periods and perhaps causing the discontinuity in the pollen record noted by Martin. Wind erosion may also have caused concentrations of the pollen, as shown in the high count of broken *Pinus* in the Willcox graph. This may have resulted in a greater relative abundance of *Pinus*, combined with spruce, fir, and sage (*Artemisia*), throughout the depth of the pollen sample, than actually existed at any fixed time. A comparable "concentration" has been observed in the archaeological record in sand dune areas where the erosion by wind has left the artifacts of several ages exposed in "blowouts."

The geological records show there were lagoons, probably of fresh water, on both the east and west sides of the lake beyond the "beaches." Those on the western side, in particular, were extensive as shown by the erosions in the beach material that formed a retaining dam. The lake (playa) water must have been alkaline throughout its history as it had no outlet. From the archaeological evidence, these lagoons must have been the main attraction of man to the area in his search of game and plants for food and materials.

Sulphur Spring and Cazador Stages

The pollen sequences identified with three zones associated with four units of strata exposed in the excavations of Double Adobe I are presented in Figure 12.9 (facsimile of Martin 1963b, Fig. 20). The relative percentages of pollen types from the north and south walls are given, along with relative percentages taken from one of the mammoth teeth excavated by Cummings in Locality 4 in the Double Adobe area. Percentages of modern pollen records from a cow chip and a dirt tank are included.

As shown in Figure 12.8, the entire geological span of the Cochise culture may be represented at Double Adobe I by the seven *erosion surfaces* with sediments representing all stages except the Sulphur Spring. A comparable sequence of sediments occurs at the Cazador site (Locality 2) but with a single erosion surface. The radiocarbon dates and the pollen records at each locale may be comparable since Martin (1963b: 39) has pointed out "that these sediments are of the same age." No archaeological identity has been established with any of the strata represented at Double Adobe I, but as shown in Figure 12.7, they may be correlated with the south wall as follows: surface to 40 cm, *silt*, modern to recent; 40 to 115 cm, *indurated clay*, resting on a conspicuous erosion surface, San Pedro stage; 120 to 190 cm, *white clay*, highly calichified, Chiricahua stage; 195 to 240 cm, *clay and silt*, with marked changes in relative percentages of dominant pollen types; 240 to 280 cm, *rusty sand, silt, charcoal*, Cazador stage; 280 to 500 cm, *gravel or cross-bedded sand*, no pollen or poor preservation, analysis not attempted. A clay ball from a depth of 500 cm contained a "high frequency of sedge and grass pollen" (Martin 1963b: 38) and indicated the presence of cattail (*Typha*) corresponding to spectra of the lowest levels of overlying strata.

The pollen record from the north wall is comparable to that described above from levels 200 to 280 cm, but it included a higher relative percentage of both willow (*Salix*) and ash (*Fraxinus*).

The pollen record from the mammoth tooth excavated by Cummings in 1926 at Locality 4, Double Adobe area, "agrees quite closely with the average of the south wall spectra at 190-200 cm" (Martin 1963b: 38). However, there appears to be quite a difference in the pollen record from the outside of the tooth and that from within, perhaps because the mammoth skull had been exposed by erosion at the time it was exca-

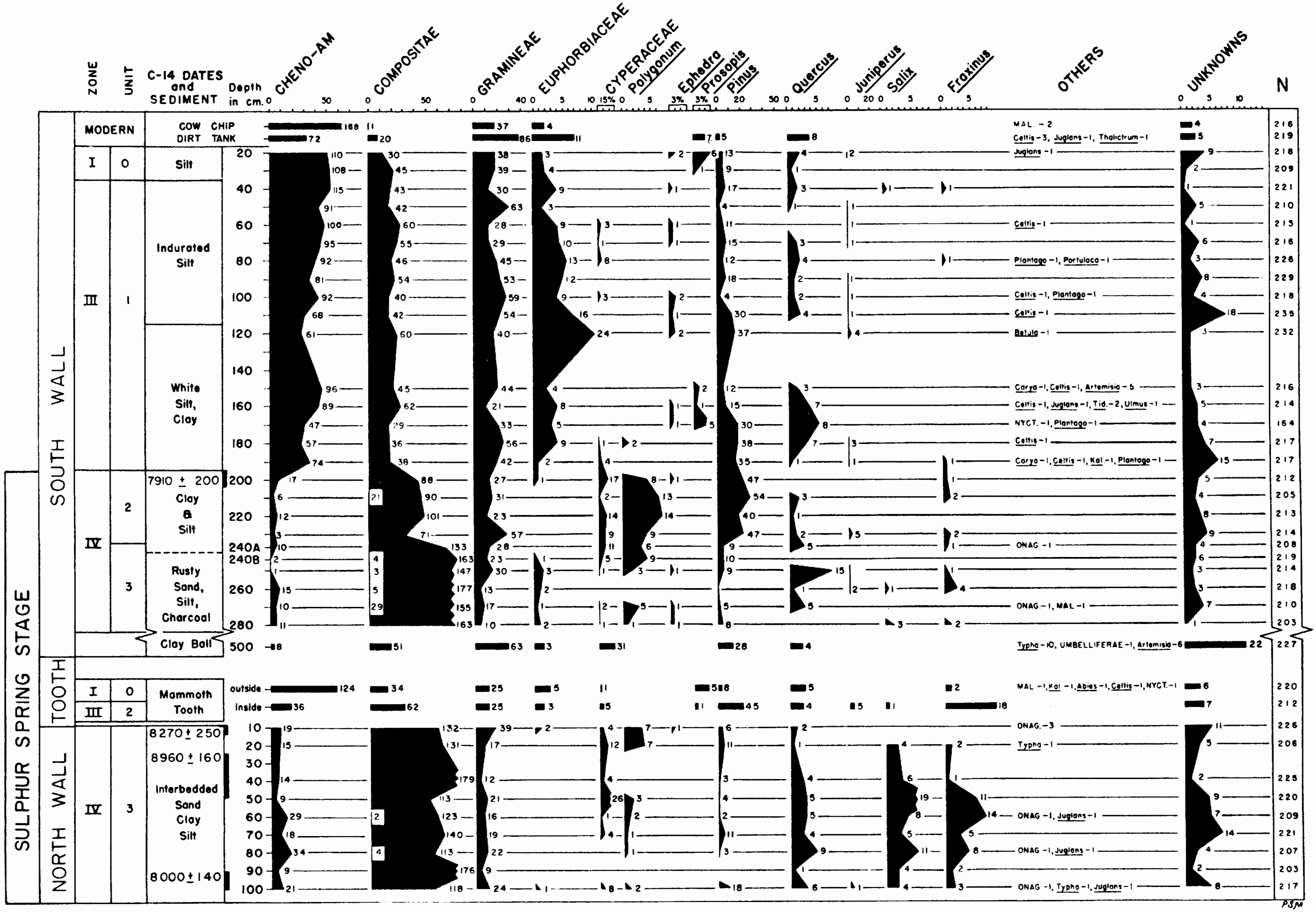

Fig. 12.9. Pollen diagram of Double Adobe I, Arizona FF:10:1. (Reprinted by permission from *The Last 10,000 Years* by Paul S. Martin, Fig. 20, University of Arizona Press, Tucson: copyright 1963.)

vated and continued to be exposed while on display and in storage at the Arizona State Museum.

The pollen count from a cow chip and dirt tank are also shown in Figure 12.9, both recording the types representing the highest relative percentages that determined the respective pollen zones: *Cheno-Am*, *Compositae*, *Gramineae*, *Euphorbriaceae*, *Pinus*, and *Quercus*.

Represented at various levels throughout the graph are pollens normally associated with Zone V, the Pluvial: fir (*Abies*), birch (*Betula*), and two of the notable types indicative of a permanent water table--walnut (*Juglans*) and hackberry (*Celtis*). Two of the three trees not native to Arizona are also present--hickory (*Carya*) and elm (*Ulmus*), both now growing in environments of greater moisture than presently occurs in the Desert Grassland.

The presence of these noteworthy-rare types at Double Adobe I and the sand-gravel strata on pink clay, indicating a permanent stream, are further support of the inference that the sediments at Double Adobe I and Locality 2 are comparable, and that the noteworthy-rare pollen types represent a part of the contemporary plant life when the earliest sediments were formed.

Radiocarbon dates for Double Adobe I and Locality 2 are also comparable. In the south wall, Unit 2, of Double Adobe I, from the clay and silt strata at a depth of 200 cm, one sample (A-190) was dated 7910 ± 200 B.P., from carbonaceous alluvium. Three dates came from the north wall, Unit 3, from the interbedded sand, clay, and silts: 10 cm, A-188C, 8270 ± 250 B.P., from charcoal, and A-188E, 8260 ± 160 B.P., from carbonaceous alluvium; 30 to 50 cm, A-189, 8960 ± 100 B.P., from charcoal, and 8680 ± 100 B.P., from charcoal and organic material; and 90 to 100 cm, A-191, 8000 ± 60 B.P., from carbonaceous alluvium.

Samples A-190 and A-189 came from sources close to erosion surfaces and might have been contaminated. However, these dates and those listed below from Locality 2 are consistent, falling within the range of approximately 8000 to 9000 years ago.

Two dates from the same sample were obtained from Locality 2: A-184C, 8240 ± 960 B.P., from handpicked charcoal, and A-184E, 7030 ± 260 B.P., from total soil with specks of charcoal. Two additional samples from the stratum identified with the Cazador stage are C-216, 7756 ± 370 B.P. (Libby 1955) and A-67, 8200 ± 260 B.P. (Wise and Shutler 1958) and A-67 bis, 9350 ± 160 B.P. (Damon and Long 1962).

These samples were collected and delivered to the Geochronology Committee at the University of Arizona and to Libby at the University of Chicago from 1950 to 1953 during our search for charcoal that might date the Sulphur Spring stage. At that time, the site of the sampling in the Double Adobe area was believed to represent an extension to the west of the original Sulphur Spring stage excavation of 1937 and was given the same site number of Arizona FF:10:1 (GP Sonora F:10:1). When the site was later excavated in October of 1953 and identified as representing the Cazador stage, it was designated as Locality 2, but the map showing the five locations in the Double Adobe area was not prepared until 1955. Unfortunately, when the dates were released they were designated as from the Double Adobe area, originally identified with the Sulphur Spring stage, and not specifically from Locality 2, identified with the Cazador stage.

As shown by the geological-archaeological record in the Cochise area (as represented in Whitewater Draw), the environment during the Sulphur Spring stage (11,000 to 12,500 years ago) was cool and wet and lakelets were present. Lithic tools were found in association with fossil faunal remains. During the Cazador stage (geologically dated from 8000 to 11,000 years ago) perennial streams and ponds formed. The faunal sample collected from Cazador deposits (Table 3.1) was inadequate for comparison with the faunal remains from other stages, and the presence or absence of extinct fauna associated with Cazador artifacts remains unclear. Bifacial projectile points and blades occurred in Cazador deposits that were not found in Sulphur Spring deposits; bifacial chipping is the principle difference between these two tool assemblages. The presence of the perennial stream and of pollen from plants now growing only in the highest altitudes in the region, along with pollen from plants requiring permanent water, indicate that the Cazador stage existed during a period of greater humidity than that which followed. Subsequently, the environment became semiarid, and the artifactual inventories of the Chiricahua and San Pedro stages were both diverse and representative of the plants and animals existing today.

Chiricahua Stage

Double Adobe III (Arizona FF:10:4, GP Sonora F:10:31) was identified by excavations in 1937 as representing the Chiricahua stage both geologically and archaeologically. The site was briefly described by Sayles and Antevs (1941: 52). As shown in Figure 12.10, Chiricahua stage artifacts occur in beds d and e together with hearthstones, charcoal, and the bones of deer, rabbit, and tortoise. Artifacts were most numerous directly on erosion surface Z of a channel cut.

Blue charco clay d (Fig. 12.10) developed in a pool holding water after the stream ran dry, and later the channel was filled with massive pond clays e and f with intervals of flooding and erosion; during one of these intervals a minor channel (Fig. 12.10, *left*) was cut. It, too, filled with pond clay. Further erosion took place followed by the formation of the massive cienega clay g that filled the former grass-covered floodplains with mud flats and temporary pools, containing patches of annual growths of weeds (*Amaranth*). [Measurements in the profile (Fig. 12.10) differ slightly from those shown in Martin's pollen graph (Martin 1963b, Fig. 23). E. B. S.]

Laminated clay c, overlying laminated sand b and sand a, represents sediments deposited by a perennial stream in which the later channel was cut. Artifacts in pool-clays of channel fills cut into earlier sediments are characteristic of the Chiricahua stage in the Whitewater arroyo. Channel-filled sediments are usually compact, filled with caliche nodules, and of light color, cream or gray, as compared with the overlying cienega dark brown massive silt.

From his study of the pollen Martin concluded (1963b: 39):

> High percentages of grass and composites occur throughout the profile (Fig. 23, D.A. III). No other pollen section yielded as high a frequency of grass pollen. Changes in pollen elsewhere seldom involve a change in abundance of grass. The high value at Double Adobe III probably reflects local abundance of Sacaton (*Sporobolus*). The abundance of composites suggests *Ambrosia* (ragweed) or its relatives.

The geological sediments and archaeological materials indicate that the larger main channel at Double Adobe III was eroded into older sediments containing pollen of different ages. The minor channel, from 0 to 180 cm, may represent the least mixed pollens; it appears to have been cut through an early pond clay and later filled with sediments similar to those in the larger channel. From the similarity of the fill in the small channel and that of the upper part of the larger channel overlying the blue pool clay, it is assumed that these sediments contained pollen representative of the time of the cutting and filling.

The larger channel, 140 or 180 to 300 cm, may represent an earlier period. Blue clay d may contain a concentration of pollen from the three older strata, a, b, and c, with most of it coming from the laminated clay c, along with pollen from contemporary plants that fell into the water-filled pool. The source of blue clay d was most likely from the bank of the stream itself, the laminated clay c, and not from the settling of sediments carried by the stream from a flash summer shower. The erosion of earlier sediments containing pollen of an earlier period would account for the occurrence of that pollen in later sediments.

A sample of carbonaceous alluvium taken at 250-260 cm produced a radiocarbon dating of 4960 ± 300 B.P. (A-192B, Martin 1963b). Another sample of inorganic carbonate from the same level gave a date of 7560 ± 260 B.P. (A-192A, Martin 1963b). Both of these dates fall within the range of the geological period with which the Chiricahua stage is associated, 3500-8000 years ago. Either date may be correct depending on the exact level from which the samples were taken. The younger date (A-192B) could represent the time of the formation of the clay (charco) in the channel; the older date (A-192A) may represent the older sediments a, b, and c in which the channel was cut.

In summary, a correlation of the geologi-

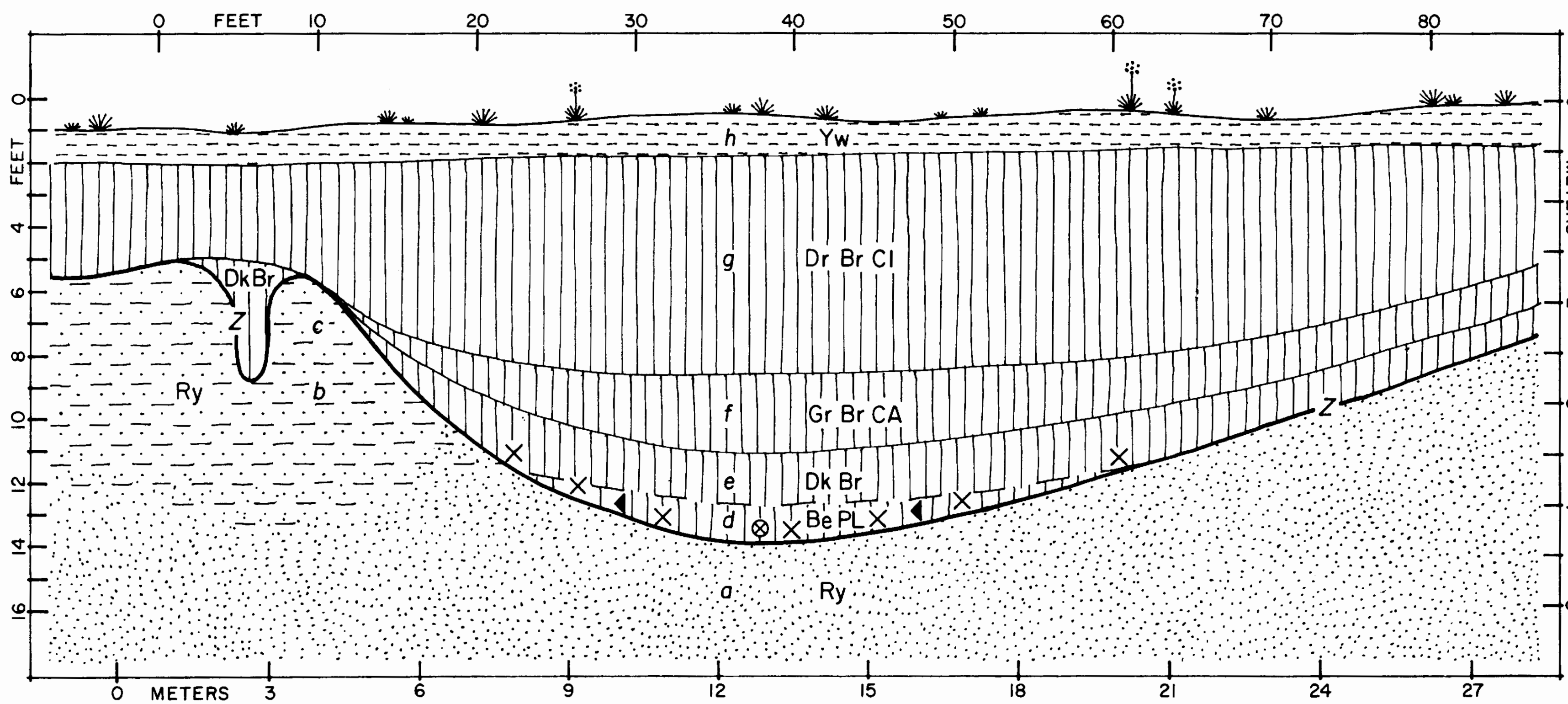

Fig. 12.10. Profile of Double Adobe III (Arizona FF:10:4, GP Sonora F:10:31), located 1.25 miles north and 0.50 mile west of the Double Adobe area. Profile based on observations made in 1937 (Sayles and Antevs 1951, Fig. 16). The site is of Chiricahua age of the middle post-pluvial period. (See Fig. 12.1 for Key.)

cal, archaeological, radiocarbon dating, and pollen evidence suggests that Double Adobe III was used by a small group of people gathering plant foods, possibly women and children, while the men hunted during the early fall of the year. The site was adjacent to a water hole in a meander of Whitewater Draw where grasses and other edible plants, particularly amaranth, were plentiful. The small seeds gathered from these plants required preparation with grinding tools. Deep basin (nether) grinding stones and pestles, handstones showing use along edges resulting from pounding, cobble mortars, and "nut crackers" all made their first appearance in the Chiracahua stage. Hunting activities are represented in a few sites outside of the Whitewater Draw area. All Chiracahua sites appear to have been used for a short time by a small group of people.

The correlation of all evidence from Double Adobe III supports the assumption that the presence of the noteworthy-rare pollen types originated in the earlier sediments deposited when Whitewater Draw was a perennial stream. They occur in later strata in the same area because of fill from adjacent sources.

San Pedro Stage

Double Adobe IV was selected for sampling for radiocarbon dating and pollen identification because it was the best known site representative of the San Pedro stage in the Whitewater Draw area. It contained a house feature below a pottery site and it was located within the area of other sites previously identified with the San Pedro stage. To the west was a sand dune region where both ceramic and nonceramic occupations were exposed in blowouts. Testing uncovered middens composed of dark gray (humus-charcoal) sand filled with hearthstones, specks of charcoal, and artifacts below deposits containing pottery or sterile sand.

A small house floor was excavated in the area designated GP Pearce 8:4 (see Fig. 10.1, *lower right*; shown in Sayles 1945, Pl. II). The floor was ovoid, approximately 2 by 3 m, and contained a fire pit and holes, probably for roof supports. At one end a pit 1.5 m in diameter and 1 m in depth was cut into the wall. Similar house floors are also indicated at other San Pedro sites (Fig. 12.11).

The profile shown in Figure 12.11, compiled from observations made before the feature was excavated for sampling, corresponds to the pollen graph by Martin (1963b, Fig. 19): sandy silt 0-15 cm, laminated yellow silt d consists of hummocks around vegetation, leaving the underlying surface c^2 exposed in some places; silty clay 15-55 cm, dark gray-brown silt c^2 contains hearthstones, artifacts, and late pottery (about A.D. 1300) overlying c^1 that contained no artifacts; pit house fill 55-225 cm is dark brown clay-caliche, brown massive sandy silt b with charcoal contained hearthstones; sand, clay, charcoal 225-240 cm, lower part of house fill on floor not differentiated from upper section when observed before excavation; indurated dark brown clay 240-320 cm, dark brown massive silt a with sand and gravel. The relationship of the compact massive silt and gravel a to the pink base clay exposed farther south in Whitewater Draw has not been determined.

No archaeological observations were reported in connection with the sampling of this site for radiocarbon-pollen identification, but from observations made before the feature was excavated, it seems likely that it represented a house similar to other San Pedro houses and that it was rapidly filled after being abandoned. A single flooding of the area may have filled it as there were no marked signs indicating that it was filled over a long interval. Since no pottery was in the fill, which must have come from the surface close by, the filling probably took place before the area was occupied by pottery users.

The pollen graph (see Martin 1963b, Fig. 19) is divided into three units. Unit O, 0-60 cm, was considered inconsistent with the pollen record of the past 1000 years. Unit 1 considered the pollen from 60-120 cm. Unit 2, 125-320 cm, contained a high relative frequency of pine and grass and a maximum of summer annuals as "evidence of a warm, wet, sub-pluvial climate in what should be the Altithermal" (Martin 1963b: 36).

The geological-archaeological interpretations of the sediments identified with the pollen units indicate that man's presence in the area may account for the inconsistencies in the pollen record. Unit O, 0-60 cm, represents the sediments of the pottery site overlying the preceramic San Pedro stage, a

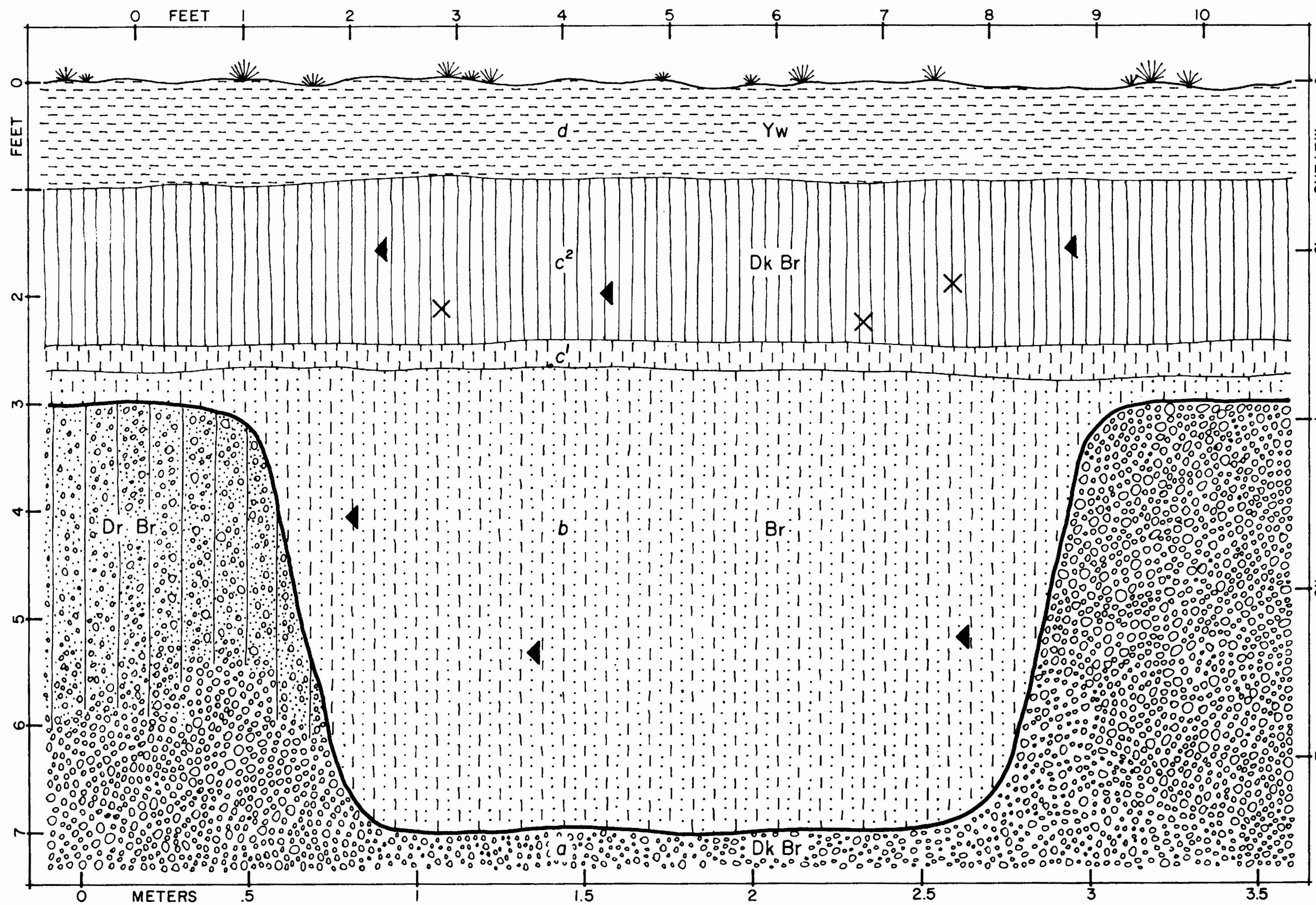

Fig. 12.11. Profile of Double Adobe IV (GP Pearce 8:9), located 4.5 miles north and 1.5 miles west of Double Adobe. Bed a, dark brown compact sandy massive clay, gravel, calichified; bed b, house fill, similar to bed a but with charcoal and hearthstones (lower surface ashy and flat, suggesting a house floor); bed c, brown cienega silt with upper 0.50 m containing charcoal, hearthstones, artifacts, and late pottery (dating about A.D. 1200); bed d, laminated yellow silt in hummocks around vegetation, elsewhere bed c surface is exposed by sheet erosion. (See Fig. 12.1 for Key.)

period when the area was used by groups gathering plant products somewhat similar to those of the earlier Chiricahua stage. However, the presence of houses in the area and the accumulation of the midden along with the later appearance of pottery, indicate that the region identified with Double Adobe IV was occupied semipermanently during a long interval. This may account for the high relative percentage of the *Cheno-Ams* (*Amaranth* +). Semipermanent residence also suggests that water was more stable in this area than in the earlier Chiracahua period, when the only source of water along Whitewater Draw was in the intermittent pools. The period identified with the San Pedro stage, followed by pottery users, is the Medithermal.

The upper part of Unit 1, 60-120 cm, representing the upper part of the house fill, could have come from an area in which there was a high percentage of pollen of a much earlier period. Sediments containing both the earlier pollen types and those contemporaneous with the occupation of the house would have been washed first into the lower part of the fill (125-200 cm), followed by sediments representing the earlier pollen with a preponderance of pollen of the earlier period. The level immediately above the floor should represent the change in the pollen graph from the mixed pollen to that of an earlier period.

The floor area (235-245 cm) contained sand, clay, and charcoal. From this a radiocarbon dating of charcoal of 2860 ± 440 B.P. (A-194) was obtained. This date should represent the time at which the house was occupied, and it is consistent with the range of dates for the San Pedro stage (2000-3500 B.P.). Another date of 3860 ± 200 B.P. (A-193) came from a sample of carbonaceous alluvium at a higher level in the fill at a depth of 100 cm below the surface, near where the house fill came in contact with the overlying dark gray silt that covered the house fill and adjoining area. This older date overlying the younger one is not inconsistent with the archaeological-geological evidence of a manmade feature dug into an earlier deposit and later refilled. The carbonaceous alluvium from which the older date was obtained may have originated in an older exposed stratum that was washed into the house fill, or it may represent selected material used by the house builders in plastering the roof or walls that became a part of the fill. It is probable that the older date could represent some period in the accumulation of the massive dark brown silt in which the house was dug and the younger date that of the house itself; the later date is consistent with the range of the San Pedro stage and the older is within the range of the earlier period identified with the Chiricahua stage (3500-8000 B.P.).

In the use of pollen as an indicator of past climate, the question lingers as to whether or not pollens accurately reflect the plant life at the time sediments were laid down or whether they might also include washed in pollen grains derived from older geologic contexts. None of the pollen profiles reported by Martin (1963b) showing only sediments formed during the past four to five thousand years record noteworthy-rare pollen types comparable to their occurrence in sediments indicating deposition by perennial streams. It is concluded that these types originated from plants associated with a wet-cool climate contemporaneous with the early sediments and that they are not haphazard wind-blown pollens from distant areas of high altitude where they are restricted today. The number of associations of pollen in the earliest sediments with which the Cochise culture has been identified are limited, and only additional research in the Cochise area will clarify questions unanswered.

POTENTIAL OF FURTHER WORK IN THE COCHISE AREA

There are indications in Whitewater Draw of a perennial stream even earlier than that with which the Sulphur Spring stage has become identified. The base clay of both Localities 1 and 5 in the Double Adobe area have never been explored because of ground water in the early excavations. In the later work done at Double Adobe I at least two erosions, filled with stream bed gravels, are recorded before that which was filled by sands, overlying gravel (dated at 7910 ± 200 B.P. to 8960 ± 100 B.P.).

When we first excavated in the Double Adobe area, workmen engaged in the construction of the present highway bridge reported that animal bones were found at a depth of more than 35 feet. We also learned of bones recovered from wells dug in the area. The depth of the sands overlying the base clay was demonstrated in excavations at the Fairchild site (Arizona FF:10:2, GP Sonora F:10:15) located approximately one-third mile south of the Double Adobe area. Here the partial bones of a mammoth were found in a sand bed 10 to 13 feet below the surface, overlying more sand of approximately the same thickness (Huckell 1972), indicating that the sediments overlying the base clay to the south of Double Adobe are at a greater depth than those to the north.

In 1955 stream bed erosion of Whitewater Draw south of the Double Adobe area had exposed a blue clay, frequently showing charcoal, at depths of more than 25 to 30 feet below the old ground level bordering the flood plain. The relationship of that blue clay to the deposits containing Sulphur Spring stage materials and to the basal pink clay at Double Adobe have not been established. Its presence, however, hints at the possible existence of sediments that predate the Sulphur Spring deposits.

The relationship between the Sulphur Spring stage and the archaeological complexes spanning the period from 10,000 to 12,000 years ago as recorded at Ventana Cave and with the Llano complex in the San Pedro valley, is still to be determined. The earliest geological period represented in the San Pedro valley with which the Llano complex is associated (according to Heming and Haynes 1969: 186-87) was one in which small tributaries of the San Pedro river had cut channels across flats left by a former lake. Dates of 21,000 B.P. and 30,000 B.P. indicated that there was a large lake in the valley during the last Pluvial. Comparable data have not been obtained within the Whitewater Draw area, although the Willcox Playa 40 miles to the north is of Pluvial age. Like the San Pedro valley, there is a gap in the radiocarbon dating of the Willcox Playa between the earliest archaeological records and the latest geological sediments identified with the maximum Pluvial within the Cochise culture region.

The "Barrier" area (Fig. 4.1) three miles northwest of Douglas, Arizona, with exposures of both geological and archaeological profiles, has never been thoroughly investigated. It may provide much information covering the entire span of the presence of man in the Whitewater Draw valley. But like all other archaeological sites on privately owned land in the Southwest, it could be threatened by the rapid growth in population.

In 1935, when research started on the Cochise culture, southeastern Arizona was largely ranching and mining country, with limited farming by irrigation. By 1974 the use of the land for homes and the increasing demand for its products, threatened the existence of all archaeological sites. Within the Cochise culture area alone, sites have already been destroyed by the use of beach material from the Willcox Playa for highway construction and by cultivation of land. The area of the Chiricahua stage type site in Cave Creek valley in the Chiricahua Mountains has been bulldozed. Large stone artifacts were first gathered by early white settlers to adorn gardens and walks, and were built into fences, fireplaces, and buildings. In the 1930s the Civilian Conservation Corps in the San Simon valley used the surface rock from prehistoric house sites to build diversion dams in an endeavor to control erosion.

Whitewater Draw is one area where nature is preserving, unknowingly assisted by man, some of the sites previously exposed. However, others may be uncovered by erosion and destroyed as more intensive use is made of the land. Locality 1 in the Double Adobe area, when excavated, may prove as productive as Localities 2, 3, 4, 5, and Double Adobe I, sites that have now been destroyed by erosion and excavations. While Locality 1 was not being eroded in 1973, a change in the stream course, by nature or by man, would threaten its destruction.

The variety of fossil bones excavated from the site, when it was first tested in 1937, led the late Chester Stock of the California Institute of Technology, who identified the materials, to plan a joint investigation of it with Gila Pueblo. His death and World War II stopped further work. But tests made at the site when research on the Cochise culture was resumed by personnel from the Arizona State Museum confirmed the earlier results. The bone in Figure 12.12, possibly a tool, was collected in 1954 from the surface, not in situ, but its location along with that of other fossil bones previously collected indicated that it may have come from the area where fossil bones and

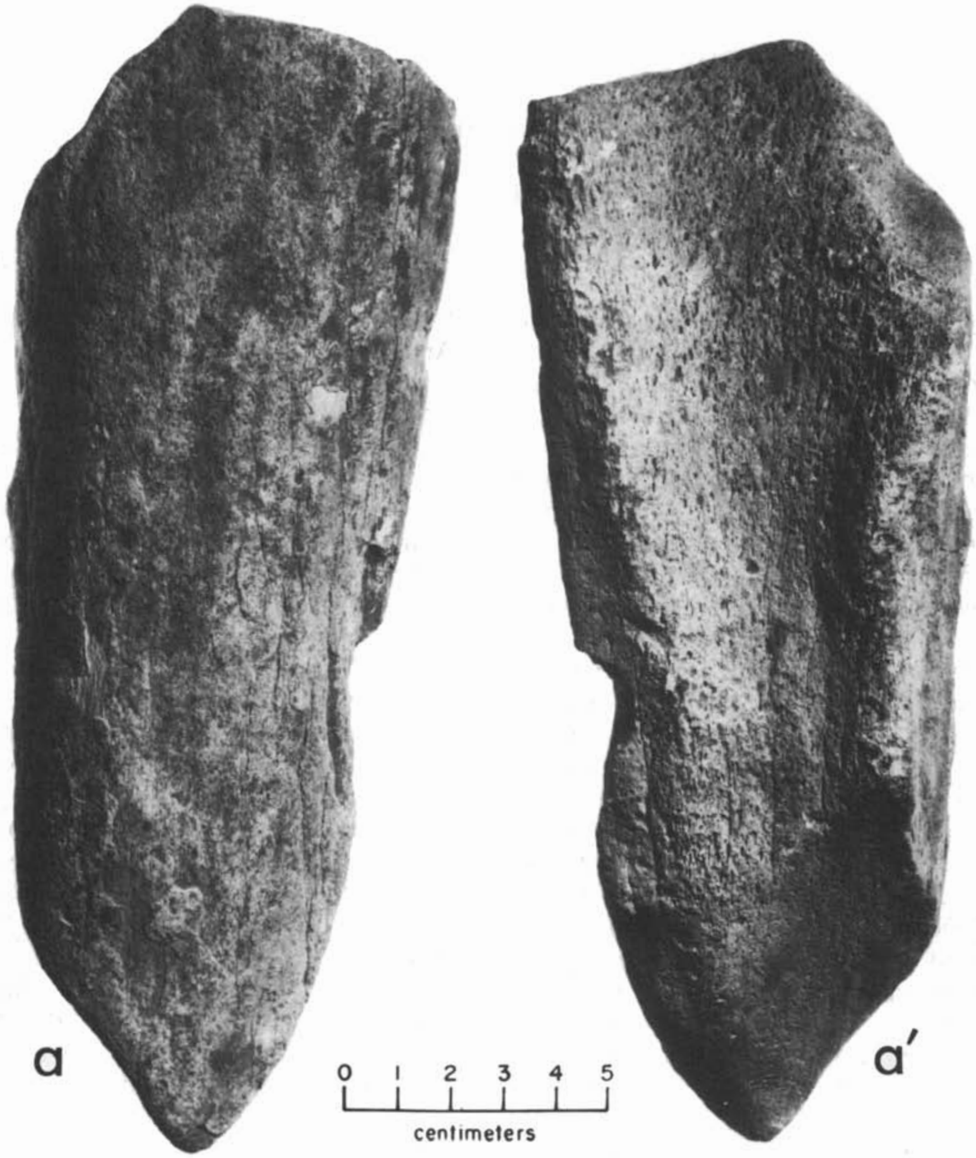

Fig. 12.12. Bone tool(?) fashioned from fragment of mineralized long bone of mammoth, found on the surface of Locality 1, Double Adobe area (Arizona F:10:1, GP Sonora F:10:1). The entire surface is smoothed, sand polished by running water; pointed end is not rounded off as occurs in water-rolled bones. Surface is ivory (off-white), bone is firm (solid), unlike mineralized bones usually found in the Cochise area that shatter when exposed.

artifacts were found. It is included here as a matter of record; other tools of fossil bone have been discovered in association with the Llano (Clovis) culture in the San Pedro valley and elsewhere (Haury, Sayles, and Wasley 1959, Fig. 15; Murray Springs).

No intensive survey has been made of the many tributaries of the main streams in the valleys in southeastern Arizona where late archaeological sites have been found. Many of the old sites exposed in the arroyo banks may have been eroded away or concealed by recent aggrading within the present stream bed, as the arroyo banks are constantly changing.

In retrospect, the work done in defining the Cochise culture was carried on without benefit of precedents. Future work demands the cooperation of several disciplines and the use of many new analytical techniques that have been developed since Cummings dug the mammoth remains at Double Adobe in 1926.

13. CONCLUDING REMARKS

Emil W. Haury

The curiosity of school children and their teacher about the nature of chalky white material found during recess in the bank of Whitewater Draw, the inquisitiveness of a Mexican-American about large bones flushed out of the ground by the waters of Greenbush Draw, and the searching mind of a rancher eager to know more about bones being exposed by erosion on his land, were the essential ingredients leading to a fascinating story of early man in southeastern Arizona. After many years of investigations in Anasazi remains of the plateau country of Arizona, New Mexico, Utah, and Colorado, these incidents opened a new chapter in southwestern archaeological studies.

In 1926 Byron Cummings led a small group of observers to the Double Adobe schoolhouse in Cochise County, 21 km (13 miles) airline northwest of Douglas, Arizona. It was there that children at play found fossil ivory protruding from an arroyo bank. The identification of the ivory as mammoth tusk by Cummings convinced him the site should be further investigated. Probings by his students quickly exposed a fragmentary mammoth skull in a geologically old marl deposit. But what astonished the group was the fact that the deposit in which the mammoth skull lay was stratigraphically above, and therefore younger, than a sandy layer containing grinding tools made by man along with the bones of extinct animals. This was the first inkling archaeologists had of the possible coexistence of man and extinct animals in the southeastern part of Arizona. Unexpected also was the fact that the people of that vaguely distant time had the specialized equipment to process plant foods by grinding.

As a member of the original "discovery" team, I welcome the opportunity now, in 1976, and 50 years after that momentous event, to jot down a few observations and comments as a historical footnote to Sayles' resumé (and his, Antevs', and other studies) of the early hunters and gatherers of southern Arizona.

Although the initial Double Adobe discovery elicited considerable interest, it must be remembered that this was one of the early instances of artifact-extinct animal bone association in a geological context. Up to this time archaeologists were accustomed to studying the remains of villages of sedentary people occurring at ground level. The buried evidence clearly called for technical help from the geologist and the development of a new set of procedures and controls to analyze it. In the 1920s few geologists had concerned themselves with late Pleistocene and Holocene stratigraphy and were generally not disposed to think in units of time small enough to encompass the story of man. It was a time for breaking new ground.

Gila Pueblo's interest in the Paleo-Indian emerged after Sayles had done extensive probing in artifact-producing geological deposits in Texas (1935) and after it became evident that Cummings was not actively pursuing the southeastern Arizona problem for the University of Arizona. It was in the mid 1930s, therefore, that Sayles and I began to search the arroyos of southeastern Arizona for further and supportive evidence of the Double Adobe station.

By now, the names of two people interested in Pleistocene and Holocene climatic history recoverable from the geological record, as well as in early man, were becoming known. One was Kirk Bryan of Harvard. The other was Ernst Antevs, a research associate of the Carnegie Institute of Washington. His well-known studies in the Great Basin of the western United States, notably Utah and Nevada, were a natural prelude for extending his interests into the lower reaches of the Southwest.

In 1934, a tour of early man localities in New Mexico, Oklahoma, Colorado, and Texas brought Antevs and Sayles together. Two years later, at the invitation of H. S. Gladwin, Dr. and Mrs. Antevs spent a winter at Gila Pueblo in Globe, where they ultimately established residence. In 1936, Sayles and Antevs began joint systematic studies in southeastern Arizona which culminated in their well-known report on the Cochise culture in 1941. During the next decade, little new information came to light to advance our knowledge of the region's early inhabitants.

Then, in 1951, the keen eyes of Marc Navarette and his father of Naco, Arizona, led them to the discovery of Naco I, the mammoth that met its death at the hands of Llano hunters (Haury, Antevs, and Lance 1953) as witnessed by the associated Clovis projectile points with which it was brought to earth.

That discovery was quickly followed by Ed Lehner's report of bones on his property, which ultimately became known as the Lehner Ranch Kill Site (Haury, Sayles, and Wasley 1959). Work started on that site in 1955 and has been continued at intervals since then by Haynes. The investigations revealed that periodic hunting of large game animals terminated the lives of at least 12 mammoths, and one or more each of bison, horse, camel, tapir, bear, and smaller animals. The implements for killing, butchering, and the traces of fires for roasting were present in the immediate environs, but where the hunters camped has not been established. Prolonged investigations at Murray Springs not far from Lehner between the years 1966 and 1971 (Haynes, in press) have further advanced our knowledge of the big game hunters and their way of life.

What had been learned then, in the early and mid-decades of the twentieth century, is that nine to eleven millennia ago southeastern Arizona was the homeland of people with two subsistence styles as revealed by artifactual remains: (1) dependence on the last of the Ice Age animals for food by employing an advanced hunting technology, and (2) heavy reliance on native food plants requiring stone processing equipment. The stage was thus set by these fundamental determinations for provocative discussions of problems dealing with the relationship of the two modes of existence early in the record of man in the southwestern United States.

THE COCHISE CULTURE CONTINUUM

The continuity of the three Cochise culture stages--Sulphur Spring, Chiricahua, and San Pedro--spanning at least 7,000 years from before 9000 B.P. to about A.D. 1 was greeted in 1941 with some skepticism. The time intervals were long, and the typological evolution in the tool assemblages, except for the introduction of projectile points in Chiricahua times, was not revolutionary or dramatic. Chipped tool types increasing in both frequency and complexity from Chiricahua to San Pedro, were taken to reflect increasing dependence on hunting. The best substantiation for the sequences, in fact the basis for it in the first place, came in the geomorphological positions of the tool assemblages and the related indicators of shifts in climate. The change in animal populations from the late Pleistocene megafauna to the modern fauna at the Sulphur Spring-Chiricahua interface was also important. All of these factors have been reviewed in detail in this report.

Ancillary support for the long, slowly evolving pattern of plant food processing came in 1950 with the publication of the Ventana Cave findings (Haury 1950). There the stratigraphic order of the Cochise stages, at least the last two, and the relative measure of great time depth were verified. Ventana Cave did, however, manifest a higher ratio of chipped-to-ground stone tools than was true for the Cochise proper. This difference was attributed to an adaptation to varying regional food sources and perhaps to greater proximity of the Ventana Cave people to contemporary California desert populations where food processing by grinding was further deemphasized. These relationships and attendant problems of cultural connections constitute a topic of no concern here. Ventana Cave did strengthen our understanding of a slowly unfolding preagricultural, foraging people as originally came to light in southeastern Arizona.

While the stage intervals were long, the Cochise culture continuum provided an important and needed set of links between the late Pleistocene hunters and the food-producing village people of the Christian era. Prospects of firmly establishing and understanding an uninterrupted succession of human occupance of over a dozen millennia in the arid southwest were bright.

THE CLOVIS-SULPHUR SPRING RELATIONSHIP

During the original work at the Double Adobe site in 1926 and in subsequent investigations, there was no question in the minds of the investigators, that is, Cummings, Sayles, Antevs, and myself, about the contemporaneity of man and mammoth. That gargantuan animal was seen as a component of the faunal complex associated with the Sulphur Spring assemblage. The geological superposition of the Double Adobe mammoth skull over culture-bearing sands and the repeated association of artifacts and mammoth bones in the sandy layer, appeared to verify the belief.

Not until the early 1950s with the discovery of the Naco and Lehner kill sites, and the enrichment of dating controls by the development of the radiocarbon technique, was doubt cast on the early assumptions. Dates in the 11,000 years B.P. range for Clovis, associated with an advanced lithic tool kit of lanceolate projectile points and butchering tools, and C-14 dates in the 9000 year B.P. range for the Cazador grinding tool and projectile point assemblage, were responsible for a reassessment of the old position. Other investigators favored the view that the mammoth became extinct soon after 11,000 B.P. and therefore was no longer a part of the natural scene when the Sulphur Spring food processors dominated the land.

I took exception to this view (Haury 1960) and still hold to the position that total mammoth extinction did not take place until after plant food gathering was established as a dominant activity. Otherwise, there are difficulties in relegating the stratigraphic and associated records, repetitive in nature, to the vagaries of nature. I cannot believe that natural forces would have selectively placed mammoth bones and Sulphur Spring artifacts in association so consistently in the same geological bed over a wide horizontal distance. To doubt the mammoth association means also that we must question the presence of the other elements in the extinct fauna--horse, bison, camel, and dire wolf.

Fresh data, either in support of or against the late extinction time, are slow in coming. It is worth noting, however, that a 1971 radiocarbon date on charcoal (U. of A. Geochron. Lab. #A-1152) from the "Rusty Sand" layer at Double Adobe (Arizona FF:10:2) was 10,420 ± 100 B.P. (Long, letter to Windmiller, 16 April 1971; see also Windmiller 1970). The "Rusty Sand" also produced a number of mammoth bones and, elsewhere, artifacts of the Sulphur Spring stage. In this excavation artifacts were not recovered; but it should be stated that because of funding shortages work came to a halt before the deposit was thoroughly explored. The possibility of recovering associated artifacts was thereby negated.

The date of 10,420 ± 100 B.P., applicable to the Sulphur Spring stage by extension, is consistent with the stratigraphic record, for it will be recalled that the Sulphur Spring assemblage lies below Cazador material dated at about 9000 B.P. The temporal distance between Clovis and Sulphur Spring would thus appear to be less than 1000 years, pointing to the reasonableness of believing that the Sulphur Spring people knew the mammoth. Mehringer (1967: 249) is undoubtedly correct when he states "...that the cause or causes [of extinction] predate 10,000 B.P." But this does not rule out the survival of small enclaves of mammoths into the tenth millennium B.P.

Tangential evidence bearing on the problem comes from Ventana Cave. A radiocarbon date of 11,300 ± 1200 B.P. has been established for the volcanic debris layer which produced extinct fauna and artifactual remains (Haury and Hayden 1975: v). Elements of the mammoth were not recovered, due perhaps to the cave setting, though the other associated life forms were well represented. In retrospect, and using new data since the excavation of the cave in the early 1940s, the lithic complex from the volcanic debris layer should be identified as Clovis rather than Folsom as was suggested on the basis of a single point (Haury 1950: 198). Of importance was the inclusion in the lithic materials of a bifaced, circular handstone (Haury 1950: 187-88), reasonably certain evidence of a plant-processing activity along with hunting. The coexistence of the two economies at about 11,000 years ago appears acceptable. At least in New Mexico at Clovis and in Arizona, grinding tools were known to the people who hunted the late Pleistocene fauna.

The foregoing thoughts introduce the single most discussed problem involving the Clovis hunters and Sulphur Spring gatherers, namely, did the Clovis hunting economy precede the Sulphur Spring gathering and food-grinding economy lineally? Were they the same people who changed their economic base when the big game was lost due to climatic change? Or, were hunting and food processing facies of a single people, the "kill" sites and the food-processing sites being contemporaneous special activity areas?

Let me digress for a moment to recognize what I believe to have been an undesirable side-effect of our taxonomic system. In our attempts to classify people, the dominant activity or pursuit is often selected as the basis for the identifying label. Hence, the big game "kill" sites led to the rubric "Clovis hunter." Similarly, the great abundance of grinding tools in early as well as later stages of Cochise was responsible for seeing them essentially as "food gatherers." These labels have been cast in a kind of puristic context suggesting that the two economies were mutually exclusive, thereby warping our understanding of what people really did.

Within the time range of concern here, the last dozen millennia, surely the Clovis hunter did not spurn plant foods and the Cochise gatherer depended on game that he himself took for his protein intake. Certainly the emphasis on these pursuits fluctuated within any calendar year in response to seasonal availability of the resources. In short, hunting did not preclude gathering, and plant food dependence did not preclude hunting. A "kill" site, either where a single animal was dispatched as a chance encounter of hunter and prey, or the repetitive killing of game animals around a water source, as at Lehner and Murray Springs, would not likely provide much evidence of plant food processing. At the same time, camps established near plant food resources might not show much, if any, large game hunting gear.

Nevertheless, if this hypothetical situation had been a reality, it would appear that by now some evidence of coexistence of the two pursuits would have emerged in southeastern Arizona. Since it has not, a firm decision must be held in abeyance. We must either believe the negative evidence reflects separateness or that at best it is misleading.

The radiocarbon dates we now have support the idea of a shift from animal to plant dependence but the stratigraphic record does not yet fully support this view. A tenuous hint of this succession is seen in the Lehner site where hearthstones and crude broken rock, but no grinding tools, occurred on top of the black mat that lay stratigraphically over the Clovis Complex layer (Haynes, in press), but the lithic materials were both so few in number and so undiagnostic in form that no definitive inferences may be drawn.

The absence of stone projectile points in the known sites of the Sulphur Spring stage cannot be taken at face value. The Clovis Complex with highly sophisticated projectiles has been repeatedly documented as having existed at about 11,000 B.P. The somewhat younger age, an estimated 10,000 B.P. for Sulphur Spring, without projectiles, appears at the present time to be acceptable. Then, in the Cazador assemblage, at about 8000-9000 B.P., stratigraphically later than Sulphur Spring and associated with modern fauna, projectile points once again are present.

It is highly unlikely that any people, exploiting the animal resources of the southwestern United States, or anywhere for that matter, should not have had some form of projectile point. This is all the likelier since stone-tipped weapons were known immediately earlier and later than Sulphur Spring time. The use of wood- or bone-tipped projectiles was also a possibility.

In principle, therefore, I favor tempering the negative evidence, or the lack of projectiles in the Sulphur Spring stage, as a manifestation of a specialized activity site, namely, plant processing, by people who had a well-rounded tool kit suitable to meet their dependency on plants and animals. The inference from this statement is that at no time in the cultural stages under discussion was the projectile point a foreign element. The stratigraphic records in Ventana Cave support this contention. Sayles recognized this possibility, but held to the position that the problem had not been solved.

THE CAZADOR STAGE

I now come to the question of the credibility of the Cazador stage. Sayles herein clearly provides data that establish the tool assemblage as stratigraphically later than Sulphur Spring and typologically transitional between the Sulphur Spring and Chiricahua stages. The associated fauna was too sparse to be helpful, and in Antevs' climatic history the Cazador time interval was transitional, correlating with the Anathermal, between the Pluvial and the Altithermal. Radiometric dates place the assemblage at about 8000-9000 B.P. and thus only shortly after the time of the Sulphur Spring stage.

Unfortunately, the Cazador stage concept has met with less than enthusiastic acceptance. This derives from the fact that judgments about it have been made without the benefit of the full data as presented herein. Whalen, for example (1971: 68-91), believes that Sulphur Spring and Cazador are one and the same in spite of the evident discreteness of the geological record. Others have expressed skepticism as well. The destruction of the type site removes it from possible further testing, but the existence of two other sites, GP Pearce 8:21 and GP Pearce 8:10 (Arizona FF:10:5), provides opportunities for further exploration and that should be done.

If the Cochise culture as now seen, ranging through three gross stages from about 9000 B.P. to about A.D. 1, was indeed a bona fide cultural continuum, then we should expect to find manifestations of life along the spectrum of time as studies proceed. The Cazador data would appear to be one of these "nodes" and a step toward forging the links in the chain of human events, chronological and typological, that now has gaps in it.

In verbal discussions one occasionally hears references to the Volcanic Debris assemblage in Ventana Cave and its relationship to the Cazador assemblage of the Cochise or to the Clovis industry. In my opinion, the Ventana and Cazador samples are too small to derive a satisfactory answer of relationship. The most diagnostic tool types, notably the few projectile points, scrapers, and other tool forms, do show similarities, but Cazador is unique in possessing a high incidence of grinding tools in the assemblage. Charcoal from the Volcanic Debris layer dated at 11,300 ± 1200 B.P., at least two millennia earlier than Cazador, as well as the lithic industry, convince me that the Ventana assemblage should now be equated with the Clovis culture (Haury and Hayden 1975: v). It would then be introductory to subsequent chipped tool industries that exhibit more variability in projectile point types and varying amounts of grinding tools. The lack of uniformity in these complexes may represent differences in seasonal aspects of food exploitation. This line of reasoning would once more lead to the inference that a chipped tool assemblage, similar to Cazador, but older, was indeed a part of the Sulphur Spring stage and that a Clovis-to-Sulphur Spring-to-Cazador sequence is a strong possibility. The increasing frequency in grinding tools could then be seen more easily as a shift in emphasis from animal to plant foods as the megafauna of the late Pleistocene disappeared and adaptation to an increasingly arid environment took place.

The preceding statement squarely contradicts a view strongly expressed by Haury, Sayles, and Wasley (1959: 26-27), namely, that the Sulphur Spring stage was not derived from the Clovis culture but rather from a generalized food-gathering base. My own stand on the issue has been softened somewhat, and the several alternatives now available have about equal chance of being proven the more believable.

THE RISE OF AGRICULTURE

An impediment to the easy acceptance of an early, full dependence on plant foods was the thought, held especially by archaeologists in the southwest, that grinding tools did not appear until the cultigens, notably maize, arrived on the scene. The shock of finding formalized grinding tools in a geologic context presumed to be as old as or older than mammoth remains is still with us--witness the reluctance to accept the evidence for so many years.

The metate-mano-maize complex is valid; but the grinding basin-handstone-native plant triad is equally valid as an antecedent complex. The chronological information we now have places the time of appearance (or invention) of the latter perhaps as much as 6000 to 7000 years before the metate-mano-maize complex.

The first appearance of the formal metate, meaning an externally shaped nether stone, may be placed at about 300 B.C. among the Hohokam. It can be further demonstrated that agriculture by irrigation was initiated by them at that time as well. Elsewhere in the southwest, evidence for the shaped metate cannot be carried as far back as 300 B.C. Inferentially, though incipient cultivation of maize and other cultigens may have been practiced in the late centuries of the first millennium B.C., agriculture in the fullest sense had not yet become firmly established. Dependence on native foods still dominated and the significant production of food was just beginning.

The podcorn of Bat Cave dated at 2500 B.C. and maize pollen in the Cienega site at Point of Pines (Martin, Schoenwetter, and Arms 1961: 63) I regard as evidence of an incidental augmentation of native food plants which left no measurable impact on the people. It was not until improved races of maize were acquired shortly before the time of Christ that a significant change in cultural behavior took place.

There is, however, a question that lingers in the mind. What is the probability that intensive plant cultivation was earlier than can now be demonstrated? The Chenopod-Amaranthus complex of plants was native to the region. Pollen records suggest these plants were nurtured by man millennia ago as they also were in more recent times. Other native food plants may also have been helped along by tending them. The following points would seem to support early plant culture.

First, the apparent quick and widespread acceptance of the maize complex, that is, the plant itself, the basic techniques of cultivation, methods for its preparation before consumption, the tools needed to grow and process it, the recipes of its use and related ceremonialism, suggest prior experience in these activities and tool uses.

Second, the frequency of grinding tools, particularly in the Sulphur Spring and Chiricahua stages of the Cochise culture, is impressively high. Scores of handstones may be picked up in a freshly eroding site of these culture horizons, far too many, it would seem, where processing of naturally dispersed plants only took place. Either natural plant stands were revisited over long periods of time to account for the vast number of grinding tools, or plant processing was heightened by the intentional growing of foodstuffs in the same locality. Expansion of the typological range of grinding tools possibly hints at a move toward plant-tending.

Third, the implement frequency noted above is due to either continuous or repetitive use of the locality. I have the impression that the sites might represent an incipient village existence, and that we are seeing a developmental stage of stable community residence. If this idea has merit, then an early effort at food production might be postulated. The Cochise people may, in fact, have reached the level of native plant cultivation demonstrated for the Paiute of Owens Valley, California (Lawton and others 1976: 19-20). Otherwise, immediately local resources would have quickly been used up, forcing the group to move on. This idea will fall by the wayside if seasonality of use can be demonstrated. Formal house-living and the presence of storage pits in San Pedro stage times are reflective of an increasingly stable existence.

In 1962, I postulated that long after podcorn had reached Bat Cave in 2500 B.C., improved races of maize flowed northward through the Sierra Madre corridor to initially stimulate the resident food gatherers to adopt settled living and become the incipient farming Mogollon people. That took place in the centuries immediately before the time of Christ. From the mountain environment, maize then was dispersed northward to the Anasazi and westward to the Hohokam where cultivation skills geared to local environmental dictates were learned (Haury 1962: 113-18). Not until then did stable farming communities become a reality.

Now, about two decades later, my position must be altered. The first part of the script is still viable. Podcorn in the highlands of New Mexico at 2500 B.C. seems certain. But its acquisition there, and doubtless elsewhere, by the Cochise foragers left no appreciable stamp on their life style. For a little more than 2000 years life continued much as before. Then, evolutionary improvement in Mesoamerica led to new races of maize. These, adapted to highland cultivation, moved north through the mountain corridor, and were the prime moving force in the establishment of the oldest Mogollon communities. At this point I now see a change in the events.

Highland maize in Mexico was matched by evolving races suited for lowland cultivation. I would assume this took place somewhere in western Mexico where a great cultural time depth is now being demonstrated (Kelly 1980). From there, within the first millennium B.C., both maize and the technology to grow it under arid conditions by irrigation, moved into the northwestern frontiers of the higher Mesoamerican societies. From this reservoir we must draw the immigrant Hohokam who introduced not only maize but the hydraulic controls to produce it into the Sonoran Desert as a quick and near-instantaneous take-over of an arid country (Haury 1976). The experimentation to develop successful farming techniques in the desert did not take place there. And while late Cochise foragers were in the region, they played no role in the initial transformation. Their territory was along the mountain threshold better suited to their exploitive skills. They were not to taste the full fruits of planting until somewhat later.

So, a two-pronged introduction of agriculture from the south is envisioned. One arm, through the mountains shortly before the time of Christ, needed the older substratum of plant-oriented people, the Cochise, as a seed bed; these became the Mogollon. The other arm was a transit by people through the desert west of the Sierras in search of the right combination of land and water where their learned skills and an already established agrarian system could be transplanted; these people were the Hohokam. This also took place by about 300 B.C.

Not until the time of Christ or later did the Cochise of southeastern Arizona feel the effects of Hohokam planting. These Cochise survivors, as incipient mountain farmers, acquired Mogollon and Hohokam attributes to form a cultural amalgam, as seen in the San Simon village.

The role of the Cochise people was thus an important one but they must be seen as willing recipients of cultural advances made elsewhere. They were not innovators. Their acceptance of agriculture was made easy by a long acquaintance with the basic milling and handstone tools, which became the metate and mano, needed to convert maize into its most useful form as a human food.

POTTERY

At the present writing, 1976, the story of pottery in the southwestern United States may be elaborated somewhat over what was thought about it in preceding years. We can be certain that pottery was not invented here. If that is so, then the idea and the skills to make pottery were introduced from outside the area. The virtual absence of pottery in the lands bordering the Southwest to the west, north, and east, and the long ceramic tradition to the south in Mexico immediately persuade us to look there for the origin. Since the cultigens and certain arts in growing them, notably irrigation, were of southern genesis, the derivation of pottery from the same source seems acceptable.

Pottery and agriculture have long been linked but it can be documented that the two elements did not always uniformly "belong" together or that they were always accepted as twin advantages by receptor people. The Cochise people I believe to be a case in point.

The acquisition of pottery and improved cultigens by Cochise people in the sierras of the Arizona-New Mexico area appears to have inaugurated the Mogollon tradition. This evidently took place by 300 to 200 B.C. The pottery at that time and place was both technically poor and not much of it was produced. It appears to have been a newly learned art by the people who became the Mogollon, and not until some centuries later was the production of pottery a natural part of their way of life.

To the west, the story was different. There, the immigrant Hohokam brought a developed ceramic industry with them. They not only had by 300 B.C. a technically good pottery with an impressive array of vessel forms, but also quantities of it were produced. While decorated pottery was unknown at the start, red-slipped vessels were made as a prelude to painting. One gains the impression that the knowledge of pottery was of long standing among the Hohokam, consistent with their mastery over irrigated agriculture. In this respect, the contrast with the simple and freshly acquired skills in agriculture and pottery-making by the Mogollon is abrupt.

In southeastern Arizona, the heartland of the Cochise, acquisition of pottery represented a blend of Hohokam and Mogollon ceramic traditions. This seems not to have taken place until the early centuries of the Christian Era, a lag consistent with the intermediate geographical position in relation to Mogollon and Hohokam "centers."

To the north, the picture among the Basketmakers is different once again. As late practitioners of the Great Basin gathering tradition, they appear to have acquired agricultural skills and domesticates in the centuries immediately preceding the time of Christ. This they followed with some success, leading to the establishment of settled villages. But, for some inexplicable reason, pottery was late in coming to them, or they were sluggish in accepting it. They must have had some contact with Hohokam and Mogollon potters, yet the idea was long in being accepted. Not until A.D. 400-500 do we see the first attempts at producing fired pottery among the Anasazi. But once that hurdle was passed, the art burgeoned and flourished impressively.

Elsewhere, the foragers of the western desert and the Great Basin found neither agriculture nor pottery acceptable. In those areas subsistence enforced by environmental limitations remained virtually unchanged for centuries unending.

While these disparities reveal something about natural limits imposed on what man does, they also say that the modes of dispersal were uneven and that acceptance of new ideas varied with the receptor people. In this respect, while the Cochise people lacked homogeneity, they were nevertheless vital links in the progression of the economic base from food collection to food production.

THE WILLCOX PLAYA

Sometimes it is not what we have done but what has not been done that challenges the mind. In all of the studies of the Paleo-Indian in southeastern Arizona, the Willcox Playa has not received its full share of attention. This land-locked basin--a dry playa today, a lake 11 millennia ago with a shore line of about 48 km (30 miles)--holds in bottom sediments and in its topographic features the key to past climatic fluctuations. These are seen in beach gravels representing several generations of high lake stands and sand dunes of several generations of dry inter-lake periods. Preliminary studies of cores from the lake floor sediments have documented these climatic fluctuations as well as other kinds of information.

Almost anywhere in the beach strand and adjacent to the fossil lagoons bordering them, traces of human activity are evident. These have appeared most emphatically during the exploitation of beach materials for highway road ballast. I refer to sites Arizona CC:13:1 and 2 (Arizona State Museum Survey) off the Kansas settlement road; Arizona CC:13:5 on the southwest shore; and others. Some of these materials appear to be linked with the times of beach formation, that is during a high lake strand (Haury, Antevs, and Lance 1953: 11-12). A hard and heavily mineralized head of a human femur from Arizona CC:13:3 hints at a long burial in the soil. A Clovis point from the sand dunes to the northeast (Di Peso 1953) suggests the lake's perimeter was searched by Clovis man. Croton Spring on the west side begs attention. The occurrence of a few pottery-bearing sites on the beach lines complicates the problem of separating cultural materials, but intelligent field scrutiny should lead to a clear distinction of the complexes.

Yet, no systematic work and only cursory surveying has been done to assess and understand the archaeological resources. It seems to me that the vexing question of the contemporaneity of grinding stones and hunting tools at the earliest time level, the 11,000 to 12,000 year range, could be settled by dedicated work in the Willcox Playa area. Here would be the place where both tool kits might have been simultaneously employed--the Clovis hunter stalking game and the Cochise gatherer reaping the plant foods at the lake edge or along the lagoons at the same time. The projectile points and grinding tools in the same beach context of Arizona CC:13:5 is a signal that this idea has merit.

If this association can be verified by other instances, and if the dating can be established as coincident with the last maximum lake level in the order of 11,000 years B.P., then contemporaneity would appear to be clear. We would then need to ascertain whether we are dealing with subsistence economies followed by two different people or whether the two economies were the ways a single people met food needs. What I have seen reflects the latter probability.

Viewing the problem in another way, the occurrence of a number of bulky nether stones in beach material buried to a depth of 1.5 m means people may have been on the beach at the time the beach aggregates were forming. The stones could not have been rolled or displaced by wave action, being essentially out of the range of constant water movement. Another alternative would be that collectors camped on the beach subsequent to lake maximum and somehow their artifacts became deeply lodged in beach matrix, not a likely possibility. Hence, I would hypothesize that all tools seen are essentially from the same time and that time most likely coincided with lake maximum at 11,000 B.P. from which the inference could be drawn that the oldest gathering and hunting tool kits were contemporaneous. Needed, of course, is further typological verification that the artifacts are indeed affiliated with the Sulphur Spring and Clovis complexes and the accurate determination of their age. I believe, to reiterate, that the opportunity to do so is there.

In the preceding pages I have reflected on a number of questions stimulated by Sayles' review of the Cochise culture as it is seen today. Sentimental attachments to this subject of long standing aside, it seems to me that an important segment of Southwestern prehistory has been clarified by his consolidation of what we know. He has provided us with an outline--a framework on which may be further appended the details of human existence between the big game hunters and agriculturists. These investigations, stretching over a half-century, have been slow in producing results.

Questions of the origin of the Cochise people, their relationship to the Clovis culture and to other contemporary traditions, the detection precisely of the magnitude, rate, and kinds of responses by people to changing environmental factors, refinements in dating, and the transition from foraging to a settled food-producing life way will remain with us for a long time. At least now we have a notion where to look further and what to search for, and progress in the next half-century toward achieving some of these goals should be at a much improved rate.

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INDEX

Boldface page numbers refer to figure captions.