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PAINTED WOODEN PLAQUE FROM TSEH SO

Painted Wooden Plaque from Tree 80

The University of New Mexico Bulletin

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TSEH SO, A SMALL HOUSE RUIN
Chaco Canyon, New Mexico

(PRELIMINARY REPORT)

By DONALD D. BRAND, FLORENCE M. HAWLEY, FRANK C. HIBBEN, *et al.*

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ACKNOWLEDGMENT

The publication of this bulletin has been made possible through the interest and kindness of Mr. William Shirley Fulton, of Waterbury, Connecticut, and Dragoon, Arizona. Mr. Fulton has already demonstrated, through excavation and publication, his position as a worthy amateur of archaeology. The Department of Anthropology of the University of New Mexico herewith acknowledges its debt of gratitude to Mr. Fulton as a sympathetic and intelligent patron.

PREFACE

For an eight year period, 1928-1935, the Department of Anthropology of the University of New Mexico had co-operated with the School of American Research in maintaining a summer field session in the Jemez Canyon, New Mexico. This General Field Session (commonly known as the Jemez Field School), offering lower and upper division work in two courses graded for beginners and advanced students, provided lecture and field work in archaeology, ethnography, anthropo-geography, and natural history. Both students and faculty were recruited from colleges and universities throughout the United States.

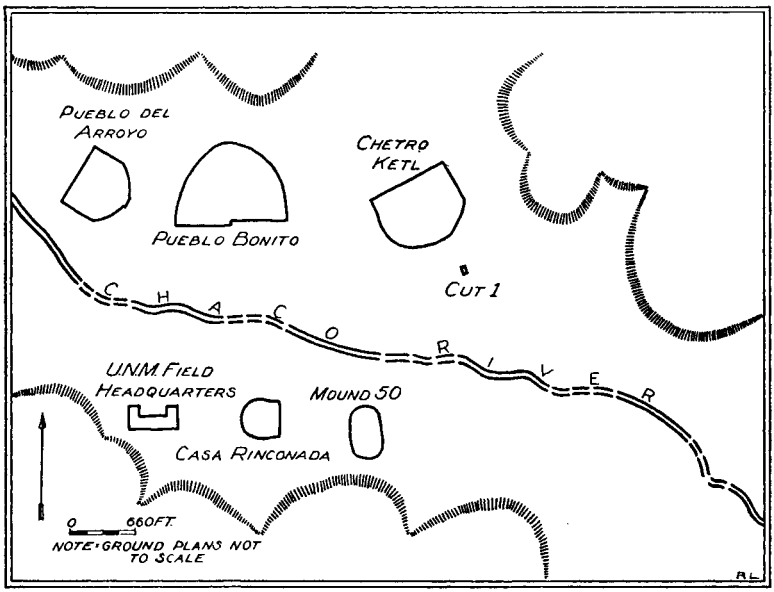
In August of 1936, for the first time, the General Field Session was held in the Chaco Canyon, northwestern New Mexico. This change to to the Chaco was made (1) In order to acquaint visiting students and faculty with the outstanding ruin area north of Mexico; (2) To test the thesis that young students in archaeology, if properly supervised, could profitably carry on an excavation under the supposedly more complex conditions obtaining in the Chaco; and (3) To accelerate the study of, and publication upon, Chaco archaeology.

The session was attended by forty-seven students (twelve men, thirty-five women), who represented seventeen institutions—University of New Mexico eighteen, University of Michigan four, Harvard University three, University of Southern California two, Leland Stanford Jr. University two, and one student each from Cornell University, Indiana University, Mount Holyoke College, Pennsylvania College for Women, Principia College, Princeton University, University of Rochester, Scripps College, Tennessee State Teachers College (Johnson City), Vassar College, Wabash College, and Wilson College. Six students were not enrolled in any other educational institution. Fifteen of the students studied the elementary course, twenty-five took the advanced course, and seven were auditors.

The staff comprised twenty-six individuals, in addition to the eight students who earned part of their expenses by waiting on tables, secretarial work, etc. This staff was composed of eight lecturers, two research associates, three supervisors of excavations, four camp physicians (each in camp for one week), one librarian, four camp boys, a camp hostess, and three cooks.

This field group (which, including spouses and children, totaled more than eighty) was housed in four blocks of tents which were disposed in a sinuous line along the foot of the cliffs on the south side of the Chaco arroyo, opposite Pueblo Bonito, and extended west for a furlong from Casa Rinconada. The Chaco Canyon Research Station,

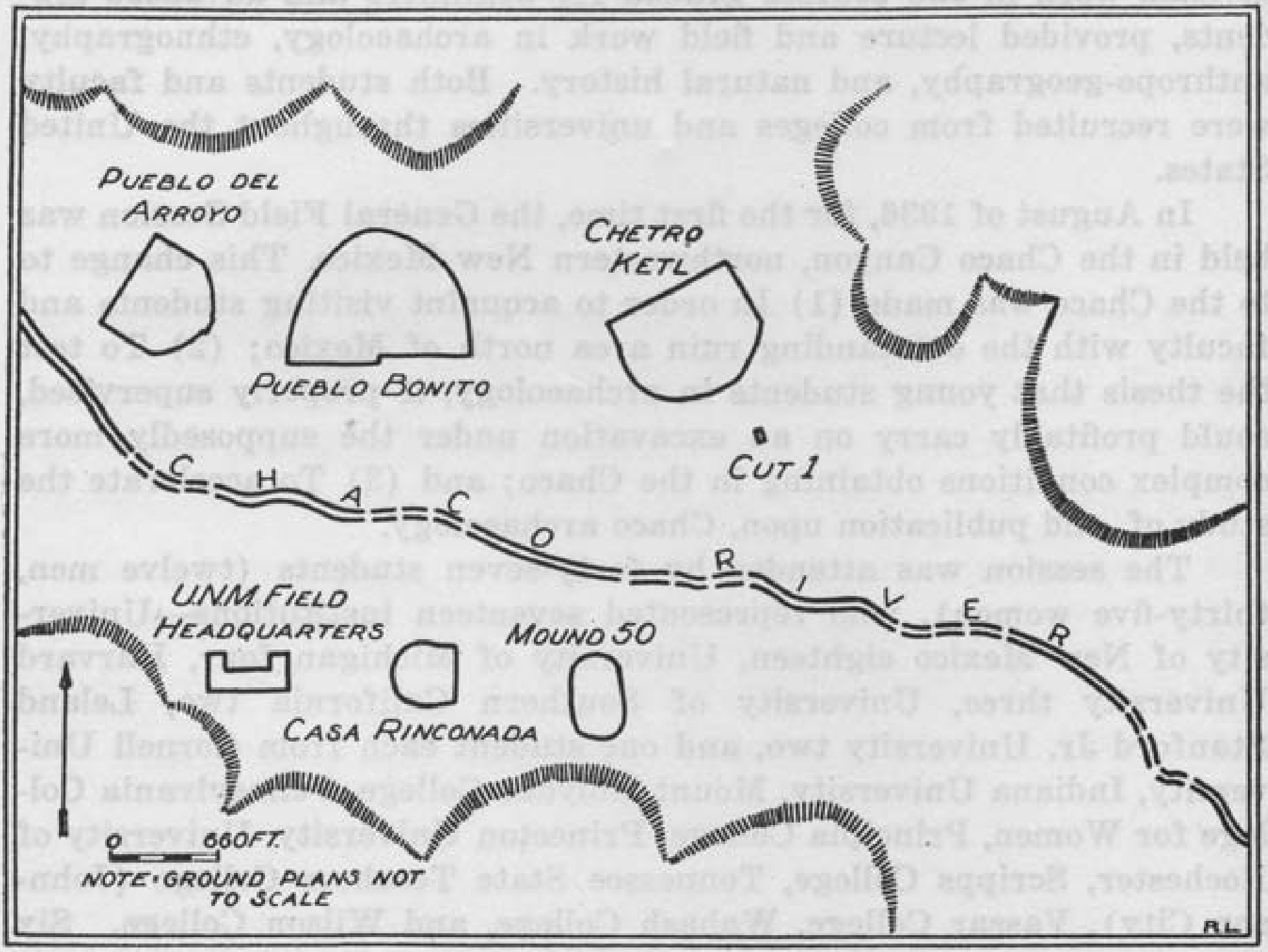
recently erected jointly by the University of New Mexico and the School of American Research, on University property, provided lecture hall (which was used also as dining room), kitchen, store rooms, library, toilets, and showers. Water for kitchen and showers was piped from a windmill and well on the edge of the Chaco arroyo. However, although there was always ample water for cooking, and for washing in the pail-basin-sponge fashion, the uncertain zephyrs of



MAP I—TSEH SO AND ITS ENVIRONS

August frequently necessitated cutting out the indoor showers and toilets. Vegetables, fresh fruits, eggs, meat, bread, ice, canned and packaged goods, gasoline, and miscellaneous supplies were hauled in, normally twice a week, from Gallup (100 miles distant) in a one-half ton Dodge truck. Coleman gas lanterns, coal oil lamps, candles, and flashlights, all contributed to the camp illumination. Fuel for the large kitchen range was soft coal from a nearby seam in the canyon wall, and juniper wood hauled in from an area several miles to the north of the canyon.

The work of the session was divided into four parts: excavation, museum, lecture, and problems. The principal excavation was that of a small rock, sand, and potsherd-covered mound (Bc50), located less



MAP I—TSEH SO AND ITS ENVIRONS

than a quarter of a mile east of the Research Station, and on the toe of a spur from the southern mesa. This small house ruin (as it turned out to be) was selected because of its proximity to camp, size estimated to be suitable for a month's work, situation protected from the full blast of wind storms by southern cliffs and the western Casa Rinconada ridge, surface profusion of potsherds of various types, and location near a refuse mound and a previously excavated pithouse. However, several other small sites were equally suitable; and it was a most pleasant but unmerited surprise to encounter the superposition of wall types, numerous burials, and wealth of artifacts, which are described in the body of the report.

All the students were divided into two sections of nearly equal size. Students in Section A excavated (under supervision of Hibben and Bliss) during the morning hours from 7:30 to 9:25, while Section B worked in the museum tent (just south of the Research Station) under the direction of Dr. Florence Hawley. The museum work consisted of cleaning, sorting, classifying, labeling, repairing, preserving, and packing the varied material (shards, restorable ceramic items, tree-ring specimens, stone artifacts, bones, shells, vegetable remains, etc.) which had been recovered from the previous period of excavation. In the afternoons, from 3:30 to 5:30, the sections reversed fields of operation—A going in to the museum technique class, and B carrying on with the excavations. Most of the actual pick-shovel-wheelbarrow work was done by a crew of Navajo workmen whose homes were in the vicinity. Excavation proceeded on from three to six days a week, according to the whimsies of weather and Navajo. At times, storms of wind or rain were so violent as to preclude any work in the open. Also, the numerous and often inopportune Navajo "sings" and "squaw dances" frequently depleted the ranks of the workmen. Thus it was that on many a "morning after," only three or four "Navvies" would put in appearance on time, and the sleepy and indolent remainder might not straggle in until afternoon or even the following day. As the students were present on the "digs" only four hours of the day, the Navajos were employed for the remaining four hours of the working day on the refuse mound, under the supervision of Mr. Wesley Bliss, and on the stratigraphic cut in the canyon floor near Chetro Ketl, under the direction of Mr. Donovan Senter (Map I). Sixteen different Navajos put in a total of 1,990 hours during the month, or 249 man days. This was the equivalent of 12½ Navajos working on each of the planned twenty days of excavation. The net results were: stratigraphy and refuse trenches as reported, and approximately 80 to 90 per cent of ruin Bc50.

The work of the students in the excavation consisted of sorting the fill dug out by the Navajos; exposing and removing burials and arti-

facts with trowel, brush, and geologist's hammer; sacking, labeling, and conveying archaeologic material to the museum tent; taking field notes on their individual work and observations, which notes were written up and handed in periodically; and filling out burial, tree-ring specimen, and room excavation blanks. Several of the students helped in surveying and mapping, and in advancing the stratigraphic trenches in the refuse mound immediately to the east of the house ruin. As much as possible, the same one, two, or three students were allowed to work out specific rooms and kivas to completion. The excavation of the small house ruin was under the immediate supervision of Mr. Frank Hibben, curator of the Museum of Anthropology, University of New Mexico. Mr. Wesley Bliss, graduate fellow in the University of New Mexico, supervised the trenching of the refuse mound, with advice from Dr. Florence Hawley, who had previously superintended the trenching of the Chetro Ketl east refuse mound. Other members of the staff, notably Dr. Leslie Spier and Dr. Stuart Adler, helped from time to time in the excavations. Whether or not the student excavators of 1936 did an acceptable job can be determined, in part, by a perusal of the excavation report.

Nine formal lectures, totaling 95 hours, were offered by the eight members of the lecturing staff. These lectures were:

1. Antevs: North American pàleo-climatology and pre-history. 12 hours.
2. Brand: Anthropo-geography of the Southwest. 12 hours.
3. Hammond: History of the Southwest. 8 hours.
4. Hawley: Archaeologic chronology and ceramics. 12 hours.
5. Hewett: Religion, symbolism, and art of the American Indians. 8 hours.
6. Spier: Southwestern ethnology and ethnography. 16 hours.
7. Tello: Andean archaeology—coastal Peru. 12 hours.
8. Tello: Andean archaeology—architecture. 12 hours.
9. Thompson: Maya archaeology. 3 hours.

Lower Division students were required to take courses 4, 6, and 7, and 11 to 12 additional hours (not including course 1). Upper Division students took courses 1, 2, 8, and 9, and 8 to 16 additional hours. All students were allowed to audit any course offered.

A special problem was assigned to each of the Upper Division students. This work was done under the director, Dr. Donald Brand. Among these problems were: The Masonry of Bc50 Compared With That of Shabik'eshchee and Chetro Ketl; Handicrafts of the Navajo Indians of the Chaco Region; Navajo Foods and Cooking Techniques;

Notes on Navajo Ceremonies; Trading Posts of the Chaco Canyon and Associated Area; Hogan Types and Comparisons; Transportation and Communication Among the Navajo Indians of Chaco Canyon; Design in Navajo Weaving; Research in Chaco Canyon Tree Rings; Geologic Cross Section of Chaco Canyon; Reproductions of Chaco Pottery (art work); Analysis of Chaco Manually Textured Wares; Survey of Pictograph and Petroglyph Material on Chaco Canyon Walls.

Normal program for each day (excepting Sunday) was: 5:40 a. m., rising gong; 6:00, breakfast; 7:30 to 9:25, excavations, and museum technique; 9:30 to 11:30, lectures; 12:00, noon lunch; 1:30 to 3:25, lectures; 3:30 to 5:30, excavations, and museum technique; 6:00, dinner; 10:30, lights out.

In addition to extemporaneous musical concerts and dances, horseshoe tournaments, and the nightly treks to the Chaco Canyon Trading Post (less than half a mile distant) for candies and soft drink refreshments, there were several campfires held in the yard of the Research Station. At these campfires the local talents in tall tales, singing, playing the various musical instruments, etc., were on display. The first campfire was devoted to brief speeches of self introduction from all members of the camp. It ended with the representatives of the various institutions singing their respective Alma Mater songs. The last campfire saw the students and faculty "squaw dancing" to a Navajo chorus and orchestra. On one occasion, a group of Navajo bucks presented portions of the Yei-bihchei dance. Sundays were devoted to "siestas," writing and reading, and to excursions to the various ruins in the canyon area. A number of outside trips also were taken by several members of the camp, including to Zuñi and El Morro, the Hopi snake dances, Aztec Ruins, and the Gallup Inter-tribal Ceremonial.

ROSTER OF THE 1936 CHACO GENERAL FIELD SESSION

STAFF

NAME—POSITION	HOME ADDRESS
Brand, Dr. Donald D., Director, and lecturer	University of New Mexico
Antevs, Dr. Ernst, Lecturer	Carnegie Institution of Washington
Hammond, Dr. G. P., Lecturer	University of New Mexico
Hawley, Dr. Florence M., Lecturer	University of New Mexico
Hewett, Dr. Edgar L., Lecturer	University of New Mexico
Spier, Dr. Leslie, Lecturer	Yale University
Tello, Dr. Julio, Lecturer	Univ. of San Marcos, Lima, Peru
Thompson, Mr. J. Eric, Lecturer	Carnegie Institution of Washington
Alexander, Dr. Hubert, Research associate	University of New Mexico
Fisher, Dr. Reginald, Research associate	University of New Mexico
Bliss, Mr. Wesley, Excavation supervisor	University of New Mexico
Hibben, Mr. Frank, Excavation supervisor	University of New Mexico
Senter, Mr. Donovan, Excavation supervisor	University of New Mexico
Adler, Dr. Stuart, Camp physician	Lovelace Clinic, Albuquerque
Fisher, Dr. Robert, Camp physician	Lovelace Clinic, Albuquerque

Johns, Dr. E. W., Camp physician	Lovelace Clinic, Albuquerque
Miles, Dr. L. M., Camp physician	Lovelace Clinic, Albuquerque
Bliss, Miss Margaret, Camp hostess	Albuquerque, New Mexico
Gentry, Mr. Jay, Camp librarian	University of New Mexico
Appel, Mr. William, Camp boy	University of New Mexico
Hayes, Mr. Alden, Camp boy	University of New Mexico
Lister, Mr. Robert, Camp boy	University of New Mexico
Sieglitz, Mr. Robert, Camp boy	University of New Mexico
Keith, Mrs. Florence, First cook	Chaco Canyon, New Mexico
Lee, Miss Anna, Second cook	Chaco Canyon, New Mexico
James, Miss Marjorie, Third cook	Berkeley, California

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Wellwood, Gail J., 1024 Grand Traverse St., Flint, Michigan.
Witkind, William, 505 N. University, Albuquerque, New Mexico.

"General utility boy," Robert Spier.
Camp mascot, Nezahualcoatl (a Oaxaca kit fox).
Camp attaches: Miss H. Adler, Mrs. Stuart Adler, Mrs. Robert Fisher, Mrs. Frank Hibben, Mrs. Erwin Johns and son, Mrs. Lee Miles and son, Mrs. J. Eric Thompson and son.

INTRODUCTION

By DONALD D. BRAND

SCHEME OF THE REPORT

This bulletin is made up of a Preface, which recounts the details of camp operation; Introduction, with History of Research in the Chaco Canyon; Report upon the actual excavation and results; and Appendices. As a number of authors are represented, it seems advisable to outline the various contributions.

Dr. Donald D. Brand (associate professor of anthropo-geography, and head of the Department of Anthropology, University of New Mexico) wrote the Preface; Introduction; Report, Part I, The Natural Landscape; summary on Subsistence; and compiled the Bibliography.

Dr. Florence M. Hawley (assistant professor of archaeology, University of New Mexico) wrote summaries and conclusions on Succession of Chaco Masonry Types; on Pottery; and on the Place of Tseh So in the Chaco Culture Pattern. Miss Hawley also wrote the appendix dealing with the Refuse Dump.

Mr. Frank C. Hibben (curator of the Museum of Anthropology, University of New Mexico) wrote Report, Part II, The Site and the Excavations; and summaries and conclusions on Vegetable Remains, on Stone and Other Artifacts, and on Mammal and Bird Remains.

Mr. Donovan C. Senter (graduate fellow in anthropology, University of New Mexico) wrote the appendices on Floor Deposition and Erosion in Chaco Canyon; and Burials from Mound 50 and Mound 51.

Mr. Wesley Bliss (graduate fellow in anthropology, University of New Mexico) did much of the surveying and mapping which contribute to the illustration of the report.

Most of the maps, charts, graphs, and other illustrations were composed by Robert Lister and James Spuhler, students in the department.

Identifications of materials were made or checked by experts in various fields. Dr. H. J. Boekelman, of the Louisiana State Museum, examined the shell material. Dr. E. F. Castetter, of the University of New Mexico, identified plant rests. Dr. Stuart Northrop, of the University of New Mexico, checked the mineral identifications. Dr. Alexander Wetmore, of the U. S. National Museum, identified the animal remains.

HISTORY OF RESEARCH IN THE CHACO CANYON

SPANISH AND MEXICAN PERIOD

The builders of the structures now constituting the ruins of the Chaco Canyon were long dead before documentary history entered New Mexico with the coming of the Spanish explorers and conquerors. Cabeza de Vaca barely touched southern New Mexico (if at all) in 1536; Fray Marcos de Niza probably never set foot in New Mexico during his journey of 1539; and Coronado and his followers (1540-1542) crossed the state at least fifty miles to the south of the Chaco Canyon. Possibly, as Morgan[1] and others have conjectured, the far-flung tale of the seven cities of Cibola may have been grounded not upon the Zuñi pueblos but upon a Zuñian report of the Chaco ruins, but no Spaniard ever searched for these fabled cities in the Chaco area. Exploratory and military expeditions of Spanish governors, from Oñate on, traversed the province from north to south and from east to west, but not one record indicates that even a single Chaco ruin was visited.

Despite the fact that the Chaco area was almost in the geographic center of the Navajo country (Provincia de Navajoó) of the eighteenth century, seemingly no Spanish punitive expedition ever dared pierce this land of the scourge of the northwestern frontier.[2] Spanish garrisons were located in the Laguna area; Spanish missionaries labored among the Jemez, Zuñi, and Hopi; and, for a brief period in the eighteenth century, Spanish ranchers colonized the San Mateo district; but normally the Rio Puerco of the East (Rio Grande drainage) and the lower San Jose marked the westernmost white settlements against the Navajo territory. It is true, however, that the terms of grants made in the 1760's[3] indicate a knowledge of the eastern Chaco area. One grant made by Governor Mendinueta to Joaquin Mestas in 1768[4] mentions the Mesa de Chaca as the western boundary of a tract of land. This Mesa de Chaca is apparently what is now termed the Chacra Mesa, immediately to the south of the upper Chaco Canyon.

Such a knowledge, however, was probably hearsay, based upon reports from Navajos who came into the Spanish villages to trade, from renegade mestizos who lived among the Navajos, and from the Pueblo Indians who hunted, raided, and occasionally traveled into or through the Provincia de Navajoó. It must be remembered that the Jemez, Zia, Laguna, Acoma, and Zuñi Indians were, perforce, in close contact (both friendly and hostile) with the Navajos at all times.

1. Morgan: *Houses and House-Life of the American Aborigines*, pp. 167-170.
2. See resume in Thomas: *Forgotten Frontiers*. There is a belief held by some historians that Pedro Ainza visited the Chaco in 1735. In this connection see Bloom and Brinton.
3. See Bloom and Twitchell.
4. Twitchell: *The Spanish Archives of New Mexico*, vol. 1, p. 159.

Furthermore, during the Pueblo Rebellion and Reconquest of the 1680's and 1690's there was a considerable movement of Pueblo Indians into and across the Navajo country.

The first map to present names and features at all in accord with reality in the Navajo country was that constructed by Don Bernardo Miera y Pacheco (captain of engineers, and one-time chief alcalde of Pecos and Galisteo), who accompanied the Franciscan brothers, Dominguez and Escalante, in 1776 on their trip in search of a feasible road from Santa Fe to Los Angeles.[5] This clerical party proceeded from Abiquiu, up the Chama, across what is now northern Rio Arriba County to the San Juan River, and continued north of the San Juan into Utah. Ruins were mentioned, but these were not of the Chaco area. One Miera map, dated January 3, 1777 (the final date of the "diario" made by Dominguez and Escalante), probably accompanied the report made by the friars. That Miera y Pacheco ever saw the Chaco area is contrary to the internal evidence provided by various copies (dated 1777 to 1779) available of this map.[6] Bandelier, without citing his authority, has stated[7] that Mier y Pacheco (sic) explored the Canyon de Chaca and measured the ruins. There is no known evidence for such a statement.

Other Spanish expeditions had sporadically crossed the northern Navajo country, especially between 1707 and 1743, when parties went out in search of a rumored mountain of silver. All of these went out from Jemez or Abiquiu, and none seemingly ventured anywhere near the Chaco. After the Dominguez and Escalante trip there developed a certain usage of the northern trail, and this became known as the Old Spanish Trail, but no ramification entered the Chaco.

Nothing more is known of the Chaco area until Gregg,[8] in 1844, published his Journal in which he mentioned "the ruins of Pueblo Bonito, in the direction of Navajo, on the borders of the Cordilleras." Gregg never claimed to have been to this Pueblo Bonito (which probably was the present Pueblo Pintado), gave no dates, and never mentioned the Chaco.[9] He probably had acquired a knowledge of this ruin at second hand, as he gave no details concerning the one ruin, and made no mention of other ruins in the area.

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5. "Diario y derrotero de los RR. PP. Fr. . . . Dominguez y Fr. . . . Escalante."

6. See Map 592, Library of Congress—section reproduced by Bloom, p. 30, *Art and Archaeology*, Vol. 11, 1921; and Map of Expedition of Fathers Dominguez and Escalante, National Archives of Mexico, reproduced by Amsden, plate 57A, *Navajo Weaving*, and Map II of this report. It will be noted that Chacat becomes Chaca, and the relative positions of Chusca and Chaca are changed.

7. Bandelier: *The Gilded Man*, p. 253.

8. Gregg: *Commerce of the Prairies*, pp. 188-189.

9. Winsor states that Gregg was at Pueblo Bonito in 1840. See footnote 2, p. 396, J. Winsor: *Aboriginal America*.

AMERICAN MILITARY PERIOD

Active investigation of the western terrain in New Mexico commenced with the American invasion in 1846. Colonel Doniphan was empowered to deal with the Navajos, and he sent parties under Captain Reid and Major Gilpin to treat with the Indians in the Tunicha (Chuska) area. Major Gilpin, in the fall of 1846[10] must have crossed the lower Chaco while going south from the San Juan to the Tunicha Mountains, but no mention is made either of the Chaco or of ruins.

In August of 1849, Lieut. Col. John M. Washington (governor of New Mexico) led troops in a military reconnaissance from Santa Fe, across the Continental Divide, down the Chaco, and on through the Navajo country. Lieut. James H. Simpson (later a general), who was a topographic engineer, and artist Richard H. Kern (brother of E. W. Kern, also an artist with the expedition), from the 26th to the 29th of August took notes and made sketches of the various ruins encountered. This material was incorporated in a publication[11] in 1852 which contained the first use of the word "Chaco," and described and gave names or numbers to all of the principal ruins in the immediate Chaco Canyon area with the exception of Pueblo Alto, which seemingly was overlooked. This journal also presented the first general archaeologic map of the Chaco Canyon. All of Simpson's ruin names have been retained, with an occasional modification in spelling.

The various parties of the 1850's which explored for feasible wagon and railroad routes across New Mexico and Colorado never approached the Chaco area.[12] Captain L. Sitgreaves, in 1851, followed the old Laguna-Zuñi road to attain the headwaters of the Little Colorado. Lieutenant Whipple's party, of 1853-1854, that explored a route near the thirty-fifth parallel, got no closer than Campbell's Pass and Fort Defiance. Captain J. N. Macomb and naturalist Newberry, in 1859, followed the Old Spanish Trail northwestward from Abiquiu across the Navajo and Blanco tributaries of the San Juan, and returned by Canyon Largo and Jemez. Apparently, however, in 1858, several members of Company E, RMR, left their record on the walls of Chaco Canyon.[13] This was Company E of the Mounted Riflemen which campaigned against the Navajos in October and November of 1858 (under Captain

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10. Hughes: *Doniphan's Expedition*, pp. 300-301, reprinted in Connelley: *Doniphan's Expedition.*

11. Simpson: *Journal of a Military Reconnaissance*, pp. 30-48, 131-133. Among others in Simpson's immediate party were Physician Hammond and a Mr. Collins of Santa Fe.

12. Sitgreaves: "Report of an Expedition down the Zuñi and Colorado Rivers." Whipple: "Report . . . upon the Route near the Thirty-Fifth Parallel." Newberry: *Report of the Exploring Expedition from Santa Fe . . . in 1859.*

13. Compare "Chaco Inscriptions," pp. 67-68, in *El Palacio*, vol. 33, and Bloom: *"The Emergence of Chaco Canyon in History,"* p. 35.

Thomas Duncan), and later became Company F of the 3rd. United States Cavalry.

At some time between 1850 and 1857 the Abbé Em. Domenech traversed northwestern New Mexico. Since Domenech gives an account of the Chaco ruins, Bloom believes that the Abbé probably traversed the Chaco Canyon; however, as Bancroft points out, the Domenech account is merely a badly garbled version of Simpson. Furthermore, no one who had actually been in the Chaco would have made the geographic blunders committed by the good Abbé.[14]

In the following decade the military energies of the United States were directed mainly toward waging the Civil War. However, Colonel Kit Carson (later brevet brigadier general) was commissioned to round up the Navajos and transfer them to Bosque Redondo—which he did in 1863-64. There is no record of any operations in the Chaco Canyon during this campaign.[15]

PERIOD OF GEOLOGIC AND GEOGRAPHIC SURVEYS

During the 1870's several government parties were making geologic and geographic surveys in New Mexican territory. These were the United States Geographical Surveys West of the One Hundredth Meridian, under Captain George M. Wheeler—especially expeditions 1873 to 1877;[16] the United States Geological and Geographical Survey of the Territories Embracing Colorado and Parts of Adjacent Territories, under Dr. F. V. Hayden;[17] and the United States Geological and Geographical Survey of the Rocky Mountain Region, under Major J. W. Powell.[18]

Parties from the Wheeler survey entered the Chaco area only in 1874 and 1875. Lieutenant R. Birnie and party, in September 1874, went from the Tuni-Cha villages (on eastern border of Chuska mountains) across to the middle Chaco and up the arroyo for some distance, but they headed north-northeastward for the upper Nacimiento (Puerco, near Cuba) before reaching the main Chaco Canyon ruin area.[19]

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14. Domenech: *Seven Years' Residence in the Great Deserts of North America*, Vol. I, pp. 199-200, 378-381, 419.

15. Sabin: *Kit Carson Days*, Vol. 2, pp. 712-722.

16. *Report* upon U. S. Geog. Sur. West of the One Hundredth Meridian, 7 vols., 1 sup., 2 atlases, Washington 1875-89, especially Vols. 1 and 7; and Annual Reports upon the Geographical and Geological Surveys and Explorations West of the One Hundredth Meridian, to be found in appendices to the Annual Reports of the Chief of Engineers, U. S. A., 1873-1878, especially for 1874-75, and 1875-76.

17. *Annual Reports* of the U. S. Geol. and Geog. Sur. of the Territories, especially the *Tenth Annual Report*.

18. *Contributions to American Ethnology*, Vol. 4, by Morgan, is the only publication of this survey which considers the Chaco area to any extent.

19. *Report* of Lieut. R. Birnie, Appendix C to Appendix LL of *Report* of the Chief of Engineers for 1875, pp. 961-963. See Wheeler: *Annual Report*.

Dr. Oscar Loew, also in September of 1874, entered the upper drainage of the Chaco from the east, but he saw only Pueblo Pintado (which he called Pueblo Bonito).[20] In 1874, Lieutenant Ruffner, of the United States Engineers, led a reconnaissance party from Ft. Garland in southern Colorado, across the Continental Divide to Ft. Wingate, but his route barely touched (if at all) the upper waters of the Chaco.[21] Lieutenant C. C. Morrison, in the summer of 1875, visited the Chaco ruins in connection with the survey of Topographic Sheet 69C.[22]

The Hayden survey, which concentrated on Colorado, sent parties into northwestern New Mexico in 1875 and 1877. Only the field party of May, 1877, led by photographer W. H. Jackson, entered the Chaco Canyon. Jackson devoted a number of days to exploring, mapping, sketching, photographing, and taking notes, the results of which are incorporated in his report of 1878.[23] This report (opp. p. 451) contains a detailed map of the Chaco Canyon ruin area, in which is included the Pueblo Alto ruin which was discovered and named by Jackson. Since the initial visit of 1877, Mr. Jackson has revisited the canyon in 1925 and again in 1936. Studies, made by the Hayden parties, of prehistoric ceramics in the Southwest were incorporated in a monograph by geological artist W. H. Holmes.[24].

The investigations of Major J. W. Powell (first head of the Bureau of American Ethnology) and his parties were confined mainly to Arizona, Utah, and Colorado. However, as one of the papers authorized by the Rocky Mountain Survey there appeared, in 1881, Morgan's monograph on American Indian house types, which contained a section on the Chaco ruins. This section was a compilation from the reports of Simpson and Jackson.[25]

BEGINNINGS OF MODERN RESEARCH 1888-1920[26]

By the close of the 1880's, not only the Smithsonian Institution and various other research and educational institutions in the United States had begun to take an active interest in the Chaco ruins, but also the

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20. Appendices G2, H2, and J2 to Appendix LL of *Report* of the Chief of Engineers for 1875, pp. 1017-1036, 1049-1059, 1094-1098. Also, articles and maps in *Petermann's Mittheilungen*, Vol. 21, 1875, and Vol. 22, 1876.

21. Ruffner: Report, in *House Exec. Doc.* 172, 44th Congress, 1st Sess.

22. Lieut. C. C. Morrison: Executive and descriptive report, Appendix E to Appendix JJ of *Report* of the Chief of Engineers for 1876, pp. 356-367.

23. Jackson: Ruins of the Chaco Cañon, examined in 1877, in *Tenth Annual Report* U. S. Geol. and Geog. Survey of the Terr., pp. 431-450. See also, Hoffman: *Report on the Chaco Cranium*, pp. 453-457. The party was made up of Jackson, Beaumont, Hosta (the Jemez Indian who had guided Washington and Simpson in 1849), and Hosta's grandson Victoriana. Jackson obtained no photographs because of poor films.

24. Holmes: "Pottery of the Ancient Pueblos," pp. 315-321, *Fourth Annual Report* of the Bureau of American Ethnology.

25. Morgan: *Houses and House-Life of the American Aborigines*, pp. 154-171. Although Morgan never was in the Chaco Canyon, he had visited the Aztec Ruins.

general public—represented by casual travelers and newspaper men—had begun to visit and publicize the ruins. Among the first of the latter group were Charles Lummis, who visited Pueblo Bonito in 1888, and F. T. Bickford, who spent some eight days exploring the Chaco Canyon ruins in 1890.[27] Victor Mindeleff, in connection with his comparative study of Pueblo architecture, had visited the Chaco briefly in 1888.[28]

The first excavation, other than the ignoble and unrecorded diggings of pot-hunters, in the main Chaco ruin area was that by the Hyde Expedition for Explorations in the Southwest. Mr. Richard Wetherill, who homesteaded and built in the canyon near Pueblo Bonito in 1896, brought an excavation project for Pueblo Bonito to the notice of Messrs. B. Talbot B. Hyde and Frederick E. Hyde, Jr. These gentlemen financed the project, which was placed under the direction of Professor F. W. Putnam, who was at that time Curator of Anthropology for the American Museum of Natural History. Professor Putnam had previously been an archaeologist for the Wheeler Surveys, and had written the volume on archaeology in the report series. As Professor Putnam was able to be in the Chaco only a small portion of the time contemplated for excavation, Mr. George H. Pepper was appointed field director. Actual excavation was commenced in the spring of 1896 and was continued in the summer field seasons of 1897, 1898, and 1899. A road was improved to Pueblo Bonito from a siding on the Santa Fe railroad (more than sixty miles distant) which became named Thoreau. At Pueblo Bonito was established a great trading center for the Navajos, and a post office named Putnam. Between Putnam and Thoreau wended long wagon trains, taking out Navajo blankets and wool, and artifacts from the excavations, and bringing in excavation equipment, supplies, and trade goods.

A large crew of Navajo and Zuñi workmen, supervised by a few white men, were able to accomplish the excavation of somewhat less than half the pueblo rooms (198 rooms were excavated, mainly in the northern central section). About a score of burials, more than fifty thousand pieces of turquoise, and thousands of artifacts of clay, wood, stone, bone, shell, and metal were uncovered. Most of this material now reposes in the American Museum of Natural History. Besides excavation in Pueblo Bonito, test trenches and pits, and exploratory excavations were made in other portions of the canyon. Also, geologic, geographic, somatologic, and ethnologic studies were carried on in the

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26. Among the outstanding anthropologists, noted for Southwestern work, who never worked in the Chaco Canyon are: Adolph Bandelier, Frank Cushing, J. Walter Fewkes, F. W. Hodge, W. H. Holmes, Walter Hough, and J. W. Powell.

27. Bickford: "Prehistoric Cave-Dwellings," pp. 896-911, in *Century*, October, 1890.

28. Mindeleff: "A Study of Pueblo Architecture in Tusayan and Cibola," ***Eighth Annual Report*** of the Bureau of American Ethnology, pp. 70, 92, 140, 144, 145, 149, 159, 184, 195, 198, 226.

canyon area. In addition to Director Putnam, and Field Director Pepper, assisted by the five Wetherill brothers, such men as A. V. Hrdlicka, W. K. Moorehead, and R. E. Dodge carried on studies at Pueblo Bonito and throughout the Chaco Canyon during the period 1896 to 1900. Although a few articles by Pepper appeared in 1899, 1905, 1906, and 1909, no comprehensive report on the excavations was published until Pepper's field notes appeared in 1920.[29]

With the turn of the century, came T. Mitchell Prudden, who for several summers carried out a general reconnaissance of the upper San Juan drainage basin, with special attention to small house ruins.[30] In 1902, Dr. E. L. Hewett visited and mapped the ruins of the Chaco Canyon.[31] During the following eighteen years numerous visits were made by private individuals and government officials, but no formal excavations or other detailed studies were carried out.[32] In 1907, the Chaco Canyon National Monument was organized, but no resident custodian was employed for some twenty years. Dr. J. Walter Fewkes, in 1916, explored a number of ruins on the southern periphery of the Chaco basin in connection with a search for archaeologic mile posts of a legendary migration of a Hopi clan from Jemez to the eastern Hopi area.[33] In 1915, N. C. Nelson took rough notes on ruins in the Chaco area, and in 1916, he, assisted by Earl Morris, excavated refuse mounds at Pueblo Bonito, collected shards from various ruins, and studied the Threatening Rock behind Pueblo Bonito.[34] Also, in 1916, Dr. E. L. Hewett, of the School of American Research, conducted a reconnaissance of the main Chaco ruin area with a view toward initiating excavation in the following year. The entrance of the United States into the World War delayed this project until 1920.

MODERN PERIOD 1920—

The School of American Research inaugurated what might be called the Modern Period (with a lesser stress on the acquisition of museum specimens, and a greater attention to architectural features and excavation methods) in the Chaco Canyon, with its excavation at Chetro Ketl, May to October of 1920. This excavation was continued

29. Pepper: Pueblo Bonito, A. M. N. H. *Anthropological Papers.* See Bibilography, Pepper, for other titles.

30. Prudden: "The Prehistoric Ruins of the San Juan Watershed," pp. 277-279, *American Anthropologist,* n. s. Vol. 5, 1903. This contains a sketch map showing ruin locations.

31. Hewett: "Archaeology of New Mexico," pp. 429-433, in *Report of the Governor of New Mexico to the Secretary of Interior,* 1902.

32. See special section devoted to studies in geology, geography, and biology for resume of non-archaeologic history.

33. Fewkes: *Archaeological investigations in New Mexico, Colorado, and Utah,* pp. 13-21.

34. Nelson: "Notes on Pueblo Bonito," pp. 381-390, in Pepper: *Pueblo Bonito.*

in the summer of 1921, but further work was discontinued (at the recommendation of Wesley Bradfield) during the activity of the National Geographic Society at Pueblo Bonito.[35]

In 1920, Neil M. Judd (now Curator of Anthropology, National Museum) visited the Chaco Canyon for the Smithsonian Institution and the National Geographic Society, and a burial mound one hundred yards east of Casa Rinconada was trenched. In the following year the First National Geographic Society Expedition to Pueblo Bonito commenced excavation at Pueblo Bonito. These excavations were carried on for seven years, 1921 to 1927, under the direction of Neil M. Judd. Most of the pueblo was excavated, including the cleaning out of the rooms which had been filled in after excavation by the Hyde Expedition. A number of small sites near Pueblo Bonito were excavated also; several test pits were sunk in the vicinity; a topographic survey of the main ruin area was completed in 1922; a pit house one mile east of Pueblo Bonito, on the north bank of the arroyo, was excavated in 1922; Pueblo del Arroyo was excavated under the direction of Karl Ruppert, beginning in 1923; and trenches were run through dump heaps at Pueblo Alto and Peñasco Blanco in 1926 by Frank H. H. Roberts, Jr. During much of this time, Roberts had served as "potsherd expert" for the expedition, and upon this work was based his doctoral dissertation at Harvard University. Beginning in 1922, Dr. A. E. Douglass visited the Chaco Canyon from time to time, in connection with dendrochronologic studies, which culminated in dating and correlating chronologically Pueblo Bonito, Aztec, and numerous other ruins of the Pueblo area. For this chronologic work, Jeançon and Ricketson visited the Chaco in 1923 (on the First Beam Expedition) and obtained numerous wood specimens. Various brief progress reports, and short papers on various phases of investigation in the Chaco Canyon during the activity of the National Geographic Society expeditions have appeared, but no summary or final report has been published as yet.[36]

Growing out of his work in some pit houses and small house structures for the National Geographic Society in 1926, Roberts excavated a Basket Maker III site on the Chacra mesa in 1927 for the Smithsonian Institution. The report on this excavation constitutes the only complete report on a major excavation in the Chaco area to date.[37]

In the summer of 1929, the School of American Research (in cooperation with the University of New Mexico) renewed excavations in the Chaco Canyon under the general direction of Dr. E. L. Hewett. The

35. For reports on 1920-1921 School of American Research work see Bibliography—Bloom, Bradfield, Chapman, Hewett, and Walter.

36. See Bibliography—Douglass, Judd, Roberts.

37. Roberts: *Shabik'eshchee Village.*

season of 1929 saw work resumed in the eastern sector of Chetro Ketl, with a concentration on the East Tower, the Great Sanctuary, and the eastern refuse mound. The Great Sanctuary was cleaned out 1929 to 1931. Stratigraphic work on the large dump progressed for several years under Miss Anna Shepard (San Diego Museum; now at the Laboratory of Anthropology) and Miss Florence Hawley (from the University of Arizona; now on the University of New Mexico staff), and provided material (in conjunction with tree-ring and masonry studies) for Hawley's doctoral dissertation at the University of Chicago. Aerial views of the Chaco Canyon were taken in 1929 by Carlos Vierra, of Santa Fe. Also in 1929, Dr. John P. Harrington (of the Smithsonian Institution) carried out linguistic studies in the area. Working with Dr. Harrington was Miss Sara Goddard, whose studies in the Zuñi language are represented in a master's dissertation of 1930 at the University of New Mexico. In 1930, a test trench was run at Casa Rinconada, preparatory to excavation and restoration which have continued from 1931 to the present time under the supervision of Gordon Vivian. Also, in 1930, Richard Vann made paleontologic studies in the canyon for his master's dissertation in geology at the University of New Mexico.

During 1933, 1934, and 1935, one of the Talus units back of Chetro Ketl was excavated by Paul Walter, Jr., and Margaret Woods (of Bryn Mawr and Radcliffe colleges). In 1933, Hurst Julian (one time custodian of the monument) and Mrs. Dorothy Keur (of Hunter College) cleaned out a number of cliff cavities and cists in the north wall of the canyon, between Yellow House and Casa Chiquita. Also, in 1933, Dr. J. Keur (Long Island University) commenced a study of the Threatening Rock back of Pueblo Bonito in order to determine the amount of annual shift. Paul Reiter (now Curator of Archaeology of the Museum of New Mexico) assisted with much of the Chetro Ketl excavation from 1929 to 1933. In 1933, he presented a master's dissertation to the University of New Mexico, which stressed architectural elements in Chetro Ketl. In the same year, Mrs. Winifred Reiter submitted a master's dissertation concerning personal adornment of the ancient Pueblo Indians, which was based on a study of material from Cheto Ketl and the general San Juan area.

Besides the usual work on Chetro Ketl (under Dr. E. L. Hewett, Mr. William Postlethwaite, of Colorado College, Dr. Reginald Fisher, J. M. Miller, and Miss Janet Woods, of Bryn Mawr College), in 1934, work on Yellow House was commenced by Edwin Ferdon, small house sites No. 8, No. 21, and No. 26 were partially excavated by Charles Hutchinson, Marion Hollenbach, and Bertha Dutton, and an archaeologic survey of the Chaco Canyon area was completed by Dr. Reginald Fisher. This archaeologic survey, the maps of which will be published

in the near future, will constitute the Upper San Juan Sub-Quadrangle A: Ancient Chaco Province, Vol. 1, No. 2, in the University of New Mexico Survey Series. Excavation at Site No. 26 (a small house on the south side of the arroyo, upstream from Casa Rinconada) was continued into November of 1936 by Miss Bertha Dutton; and the preliminary report on this site (termed Leyit Kin) constituted her master's dissertation submitted in 1937 to the University of New Mexico. In 1934, Miss Alice Leinau presented a master's dissertation to the University upon the sanctuaries of Chetro Ketl. Based upon erosion control experiments made to safeguard Yellow House in 1934, William Chauvenet submitted a master's dissertation to the University of New Mexico in 1935.

The field session of 1935, under the direction of Fisher and Brand, did not excavate in Chetro Ketl, but work on the talus unit was continued by Margaret Woods; a large isolated kiva (Kin Nasbas) near Una Vida was excavated by Dorothy Luhrs; a survey of possible prehistoric irrigation ditches was made by John Corbett (Princeton University); a comparative study of Chaco Canyon kivas was carried out by Stanley Milford; and a study of Navajo ethnobotany, based on Chaco Canyon plants, was made by Francis Elmore, which served as a master's dissertation in botany at the University of Southern California. In June and July of 1936, various research projects were carried out in the Chaco area under the direction of Fisher. These included the excavation of several pit houses near Rinconada by J. Maloney (Stanford University).

During the period of University of New Mexico co-operation with the School of American Research (1929-1936) in the Chaco Canyon Advanced Field Session, University credit was given to advanced and graduate students from New Mexico and other institutions of higher learning. To date, no complete report has been published on any School of American Research excavation in the Chaco Canyon, although various phases of excavation and research have been reported upon in a number of dissertations, School of American Research Annual Reports, articles in *El Palacio*, and *Southwestern Monuments*, and in two books by Dr. Hewett.[38] Many students not mentioned above also turned in term and report papers which are filed at Santa Fe along with the bulk of recovered artifacts.

38. See Bibliography—Chauvenet, Dutton, Elmore, Fisher, Goddard, Hawley, Hewett, Julian, D. Keur, J. Keur, Leinau, P. Reiter, W. Reiter, Vann, Vivian, and M. Woods.

CHRONOLOGIC OUTLINE

1540-1542	Coronado's party passed well to the south of the Chaco, along the old Zuñi-Acoma trail.
(1735)	Pedro de Ainza possibly explored Chaco ruins.
1776	Miera y Pacheco, with Dominguez and Escalante party, passed from Abiquiu into Utah to the north of the Chaco.
1777-1779	Miera y Pacheco maps having names "Chaca" and "Chacat."
(1831-1840)	Bare possibility of visit by Gregg to the Chaco.
1844	Gregg's *Commerce of the Prairies* published, with mention of a Pueblo Bonito.
1846	Captain Reid, from the Rio San Jose, and Major Gilpin, from the Rio San Juan, across to the eastern base of the Tunicha (Chuska) mountains.
1849	Simpson and Kern explored ruins of the Chaco Canyon.
(1850-1857)	Unlikely possibility that Domenech visited the Chaco.
1851	Sitgreaves passed, to the south.
1852	Simpson's Journal published, with first mention of "Chaco" and detailed description of various ruins from Pueblo Pintado to Peñasco Blanco.
1853	Whipple's party outlined the present Santa Fe railroad route, to the south.
1858	Members of Company E, R.M.R., in the Chaco Canyon.
1859	Captain Macomb and party followed Old Spanish Trail, to the north.
1860	Domenech's garbled account of the Chaco published.
1863-1864	Kit Carson rounded up Navajos, but seemingly did not enter Chaco Canyon.
1874	Lieut. R. Birnie on the middle Chaco.
1874	Dr. Oscar Loew at Pueblo Pintado.
1874	Lieut. Ruffner along the Continental Divide, to the east of Chaco.
1875	Lieut. C. C. Morrison visited Chaco ruins.
1875	Publication of *Report* of Chief of Engineers with appendices by Wheeler, Loew, Cope, Birnie, et al.
1877	Jackson explored the Chaco ruins.
1888	V. Mindeleff examined Chaco architecture. Charles Lummis visited the Chaco for the first time.
1890	Bickford spent eight days in the Chaco.
1893	Scott N. Morris (father of Earl Morris) trenched refuse mounds at Pueblo Bonito.
1896	R. Wetherill homesteaded at Pueblo Bonito.
1896-1899	Hyde Expedition excavations at Pueblo Bonito under Putnam and Pepper. Moorehead, Hrdlicka, Dodge, et al., worked sporadically with the expedition.
1900-1903	Prudden's small house explorations in the upper San Juan basin. Visited the Chaco several times.

1901	W. C. Farabee examined ruins in the Chaco area for Peabody Museum.
1902	E. L. Hewett visited the Chacó Canyon for the New Mexico Normal University. Mapped ruins.
1907	Chaco Canyon National Monument organized.
1915-1916	N. C. Nelson investigated refuse mounds and collected shards for the American Museum of Natural History.
1916	Fewkes explored the Crownpoint area.
1916	Reconnaissance by Hewett and Bradfield.
1920-1921	School of American Research excavation at Chetro Ketl.
1920	Judd visited Chaco Canyon.
1921-1927	National Geographic Society excavated Pueblo Bonito, under Judd. Bryan, Morris, Roberts, Ruppert, et al., were associated with this work.
1926-1927	Robert excavated Shabik'eshchee and other nearby sites.
1929-1937	School of American Research and University of New Mexico excavated sites and carried out various studies in the Chaco Canyon.

STUDIES IN GEOLOGY, GEOGRAPHY, AND BIOLOGY

Mention has been made already of the various military and scientific reconnaissances into the Chaco area up to 1902. Along nonarchaeologic lines the scientific studies were chiefly for details of terrain and structural geology. No collections of botanical, zoologic, or paleontologic materials were made in the Chaco Canyon area until 1902.[39] Professor R. E. Dodge, at the turn of the century, carried on geologic and geographic investigations around Pueblo Bonito for the Hyde Expedition during three field sessions. In 1902, George Pepper sent to the American Museum some dinosaur bones from the vicinity of Ojo Alamo, to the northwest of Pueblo Bonito. In 1904, Barnum Brown, of the American Museum of Natural History, made the first extensive paleontologic collections in the Ojo Alamo area and formation. By 1907, F. C. Schrader, James H. Gardner, and M. K. Shaler had made several paleontologic and economic reconnaissances of the western Chaco drainage basin. A search for commercial deposits of coal has been the mainspring of geologic investigations in this area ever since the presence of coal was verified by the Wheeler, Hayden, and other government expeditions of the nineteenth century. Some prospecting has been carried out also for petroleum, which occurs in various portions of the San Juan basin near Farmington, Shiprock, and Seven Lakes (on the Chaco Plateau). Noteworthy among the later paleontologic and geologic collecting and mapping parties were those of: Gardner and Gidley, in 1908 and 1909; H. E. Gregory and J. E.

39. Cope had collections made in the Puerco and Torrejon beds, to the north of the Chaco arroyo, by D. Baldwin in 1881 and 1882, and by Dr. J. L. Wortman in 1892. This included work on Coal Creek.

Pogue, in 1911; W. J. Sinclair and W. Granger, in 1912 and 1913; C. M. Bauer, J. B. Reeside, Jr., and H. R. Bennett, in 1915; Reeside and F. R. Clark, in 1916; Reeside and H. Bassler, in 1917; Reeside and C. E. Dobbin, in 1920; C. H. Sternberg, in 1921; Reeside, in 1923; C. H. Dane, J. D. Sears, and C. B. Hunt, 1928-1931; and C. W. Gilmore, in 1929.[40]

Physiographic and hydrographic studies in the Chaco Canyon area began with Professor Dodge (associated with the Hyde Expedition) who noted evidence of changes in erosion and sedimentation near Pueblo del Arroyo and elsewhere in the canyon area.[41] James Gardner, in 1906 and 1907, observed the formation of mud and sand concretions in the Chaco arroyo. Herbert Gregory studied the water supply of the southwestern Chaco area in 1911. During the National Geographic Society excavations in the canyon, 1921-1927, trenches were dug which revealed former channels and denudational surfaces. At this same period, Dr. Kirk Bryan, of Harvard University, studied the history of denudation, sedimentation, and erosion in the canyon. In 1927, New Mexico State Engineer Herbert W. Yeo commenced investigations in the San Juan Basin, including the Chaco drainage. Beginning in 1928, Dr. Reginald Fisher has devoted much time to meteorologic and hydrologic studies in the Chaco area. In 1934, William Chauvenet experimented in erosion control for the protection of several archaeologic sites.[42] Dr. Ernst Antevs, Dr. Malcolm Bissell, and Dr. Donald Brand studied recent sedimentation and erosion in the canyon in connection with the University of New Mexico Field Sessions of 1936. Possible movement of the Threatening Rock, back of Pueblo Bonito, is being observed (since 1933) by Dr. J. Keur, of Long Island University.[43]

Practically no investigations have been made of the weather and climate, soils, vegetation, and fauna of the Chaco Canyon area. Only broken meteorologic records are available up to June of 1932. Since then, reports on maxima and minima temperatures, precipitation and wind direction, have been sent in monthly to the Weather Bureau Office at Albuquerque by the Monument custodian. Flow in the Chaco arroyo has been gaged at the Pueblo Bonito bridge for the last few years also.

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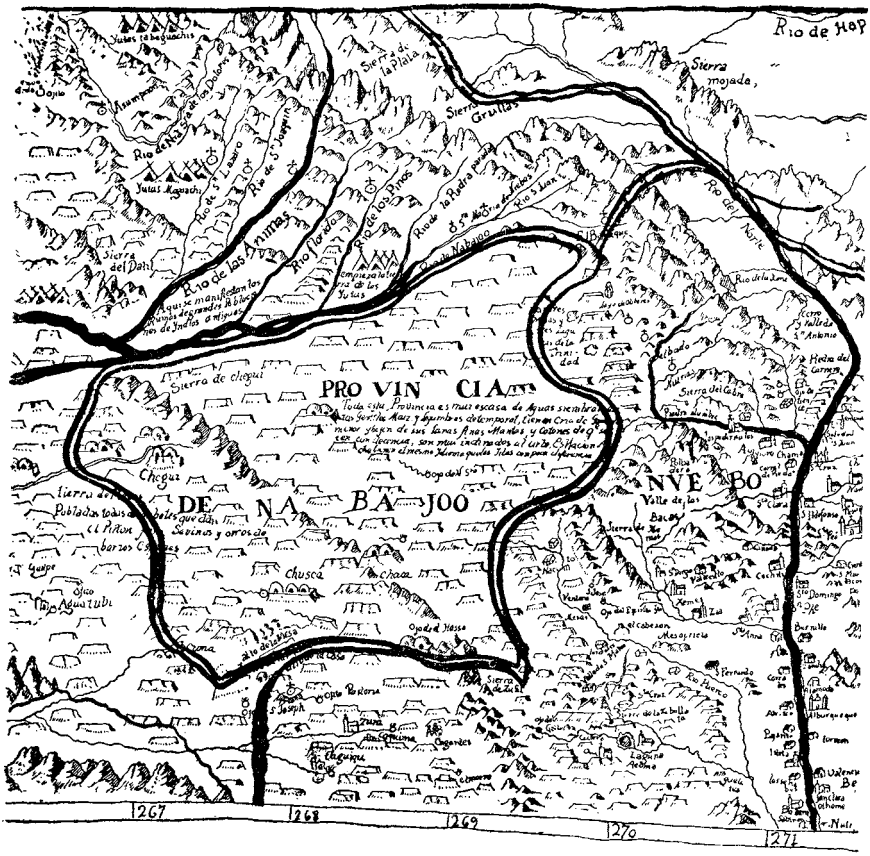
40. See Bibliography—Bauer, Brown, Dane, Darton, Foster, Gardner, Gilmore, Granger, Gregory, Hunt, Knowlton, W. D. Matthew, Reeside, Schrader, Sears, Shaler, Sinclair, Stanton, Sternberg, Vann, Winchester, and Wootton.

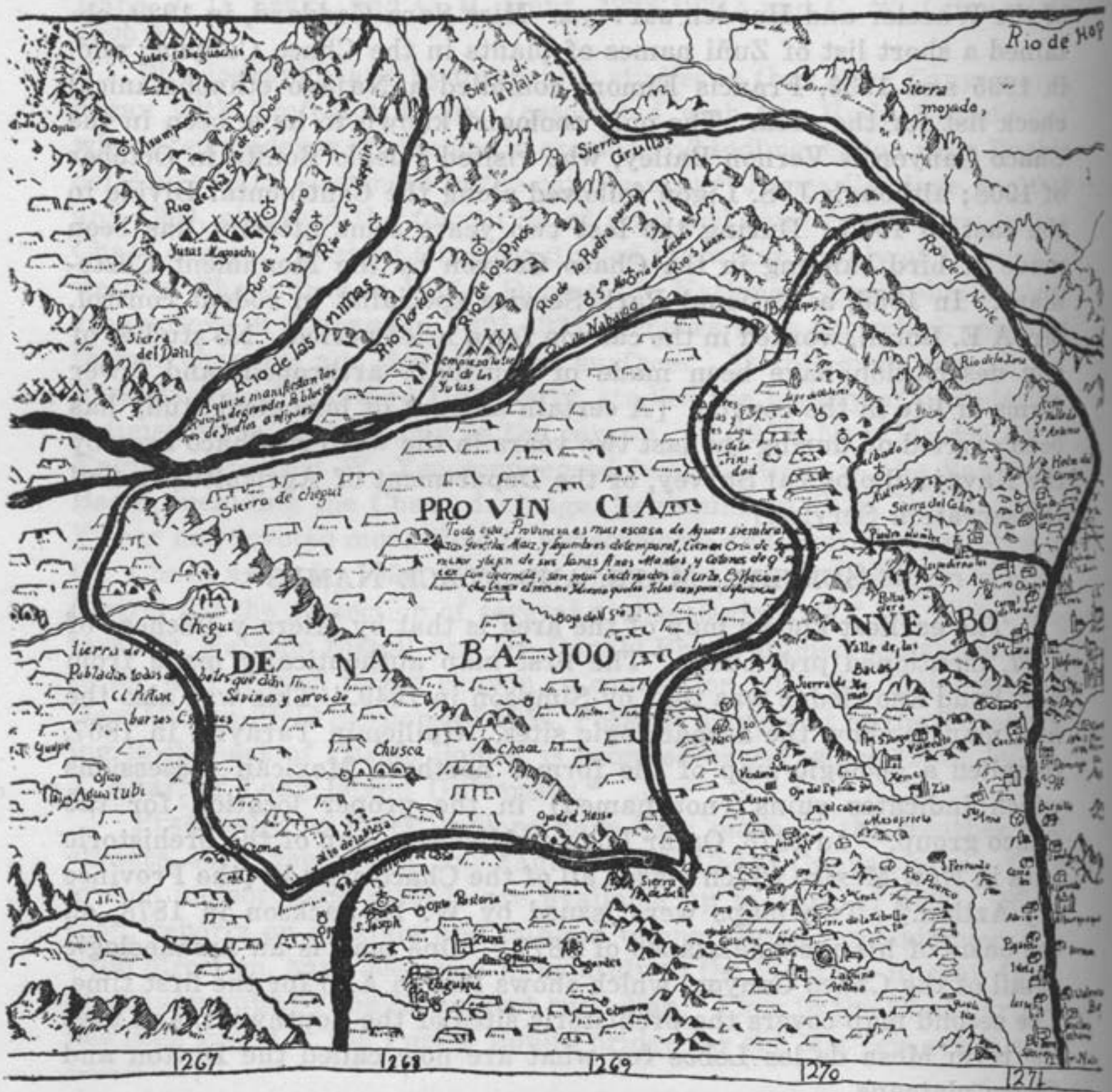
41. In Pepper: *Pueblo Bonito*, pp. 23-25. Brief earlier sidelights will be found in Simpson, p. 37; Jackson; and Loew.

42. During the last several years the Soil Conservation Service has been working in the Chaco area, both on the Navajo Reservation and on the Chaco Canyon National Monument.

43. Nelson made some observations in July, 1916. More recently, in addition to Keur, A. E. Clark, of the National Park Service, has been studying the rate of outward movement, which has been more than one inch in less than two years. However, there seems to be a retrograde movement under way during this year.



MAP II—SECTION OF MIERA Y PACHECO MAP



MAP II—SECTION OF MIERA Y PACHECO MAP

quadrangle, surveyed in 1927-1928, was issued in 1932. This map shows a sector within the old Chaco sheet on a scale 1:125,000, contour interval of fifty feet.

Surveyors, working for individuals, the old Atlantic and Pacific Railroad (now a part of the Santa Fe system), petroleum and coal companies, the Bureau of Mines, the General Land Office, the United States Geological Survey, the Indian Office, the American Museum of Natural History, and the School of American Research, have run numerous lines and set up a few corner posts and bench marks during the last fifty years. However, little of their work has been incorporated in usable maps of the Chaco area. This is especially true for a four hundred square mile area centering at Pueblo Bonito. Despite the archaeologic-topographic surveys made by the Hyde Expedition in the 1890's, Dr. E. L. Hewett in 1902, the National Geographic Society in 1922, and Dr. R. G. Fisher during the last few years, no decent archaeologic or topographic map has yet been published for the ruin area.

The archaeologist, wishing a field map, is confronted by the following:

General topography: N. H. Darton's Topographic Map of New Mexico (1:500,000; 100-meter contour) published in 1925; supplemented by the very poor Chaco, Largo, Ft. Wingate, and Mount Taylor sheets, and the fairly accurate Kirtland quadrangle. The Kroeger and Ritter (Durango, Colo.) Map of San Juan County, New Mexico, 1923, might be used also.

Geology: N. H. Darton's Geologic Map of New Mexico (1:500,000; 100-meter contour) published in 1928; with Reeside's map for the *Western Part of the San Juan Basin* (U. S. G. S. Prof. Paper 134) east to Pueblo Bonito and Alamo Arroyo, and Dane's *Geologic Map of the La Ventana-Chacra Mesa Coal Field* (U. S. G. S. Bulletin 860-C) west to Gallo Arroyo and Alamo Arroyo.

Archaeology: Jackson's map mentioned above, or Hewett's map in the *Chaco Canyon and its Monuments.* Better maps have been compiled but they are in manuscript form.

Various: The Indian Office, National Park Service, and Soil Conservation Service have an aerial photograph mosaic map of the Navajo Indian Reservation which is quite valuable to anyone who is familiar with aerial photographic maps. The Chaco Canyon National Monument is outside of any national forest. The Navajo Indian Reservation takes in only the western portion of the Chaco drainage basin.

Many changes have occurred in the place names of the Chaco area, even during just the last sixty years. In order to aid in the understanding of various earlier reports and maps, the following list has been

48. These were on a scale 1:250,000, contour interval of two hundred feet. Chaco Sheet, surveyed 1887, issued 1892; Wingate Sheet, surveyed 1882-1883, issued 1892; Largo Sheet, surveyed 1887, issued 1895; Mount Taylor quadrangle, surveyed 1883, issued 1899. The Mount Taylor quadrangle shows Chacra Mesa (sic).

compiled. It is merely a check list of the more important localities in and near the Chaco, or those that have changed most in name, and does not pretend to any degree of completeness.

Alamo Arroyo (Choukai Wash), enters Escavada Wash from the southeast.

Bennett Peak (Peaks of the Ojos Calientes), igneous plug south of the Shiprock.

Bisti Trading Company (Hunter's Store), on Bisti Wash (Hunter's Wash) just east of Navajo Indian Reservation east line.

Bluewater (Ojo Agua Azul), station on Santa Fe northwest of Grants.

Campbell's Pass (Navajo Pass), across Continental Divide west of Thoreau.

Casa Chiquita (Ruin No. 9 of Simpson).

Casa Morena, east of Crown Point and Heart Butte.

Casa Rinconada, large kiva south of Chaco River nearly opposite Pueblo Bonito.

Chaco Canyon (Cañon de Chaco, Cañon de Chusca).

Chaco River (Chaco Arroyo, Chaco Wash, Tsegilini).

Chacra Mesa (Mesa de Chaca as late as 1899, Chaco Mesa), mesa south and east of upper Chaco river.

Chetro Ketl (Rain Pueblo, Chettro Kettle, Chetho Kette, Ketro Kete, Shining Pueblo), just east of Pueblo Bonito.

Chuska Mountains (Sierra de Chusca or Choiskai, plus Sierra de Tunicha or Tunitcha or Tumecha, plus Lukachukai mountains), main mountain chain along Arizona-New Mexico border west of the Chaco.

Chuska Valley, along eastern foot of the Chuska Mountains.

Coal Creek, about 15 miles below Meyers Creek, tributary of the Chaco.

Continental Divide (Cordilleras, Sierra de los Mimbres, Sierra Madre, Cejita Blanca), runs through Thoreau northeastward past Star Lake.

Cottonwood Arroyo (not to be confused with arroyo of same name entering lower Chaco), enters Chaco River from the north about two miles below Pueblo Pintado.

Crownpoint (formerly location of Pueblo Bonito Indian School, and headquarters for Pueblo Bonito Reservation.) Navajo agency, hospital, and school.

Delnazini (Tiznatzin), spring and ruins on Coal Creek about four miles above its mouth.

Escavada Wash, first main wash entering the Chaco from the north below Pueblo Bonito.

(New) Fort Wingate (old Fort Fauntleroy, Ft. Lyon, Ojo Hasso, Ojo del Oso, Bear Springs, Tshushbitgo).

Gallo Arroyo, north side of the Chaco, between Wijiji and Una Vida. This name is also applied to the arroyo coming in from the north about two miles above Shabik'eshchee.

Hosta Butte, south of Crown Point—a landmark for miles.

Hungo Pavi (Hungopavie, Crooked Nose), ruin east of Chetro Ketl.

Kimbetoh (Kinnebeto, Kinnebito), on Kimbetoh Arroyo, which enters Escavada Wash from the north.

Kin Biniola (Kin Binioli, Kin Bineola, Kinbiniyol, Kimenola, House of the Winds), large ruin some sixteen miles by road southwest of Pueblo Bonito.

Kin Kletso (Yellow House, Kinkletsoi, Kinklitso, Site No. 8 of Simpson), small ruin about one-half mile west of Pueblo Bonito.

Kin Klizhin (Black Wood, or Charcoal Place, Kinklizin), ruin southwest of Pueblo Bonito on road to Kin Biniola.

Kin Nasbas (Kin Nahasbaz, Kin Nahasbas), large isolated kiva northwest from Una Vida.

Kintyel (Kintail of Bickford, Broad Ruin), identified as Chetro Ketl by W. Matthews. More probably Pueblo Bonito.

Kin Ya-ah (Kin ya-a, Kinya-a, Kin Yai, High Pueblo House, probably Lummis' Pueblo Alto), ruin east of Crownpoint.

Mesa de los Lobos (Dutton and Chaco plateaus have replaced this term, excepting on a 1933 map of the Navajo country which places it north of the Navajo Church).

Mesa Fajada (Mesa Fachada, Mesa Fahada, Saydegil), landmark mesa near western point of the Chacra Mesa.

Meyers Creek, about eight miles below Pueblo Bonito.

Mockingbird Gap (Hungo Pavi Canyon), north side of the Chaco just east of Hungo Pavi. This name is also applied to the Gallo Arroyo.

Mockingbird Pass, from south toward Pueblo Pintado.

Mount Taylor (San Mateo, Tsadil, Dzotzil, Yodotlizhitzil), volcanic massif and landmark north of Acomita. Named Taylor by Simpson in 1849.

Ojo Alamo, near head of Ojo Alamo Arroyo which enters Coal Creek from the north.

Old Fort Wingate (Ojo del Gallo), near San Rafael south of Grants.

Otis Trading Post, where road to Pueblo Bonito leaves Farmington-Cuba highway.

Peñasco Blanco, large ruin south of Chaco River about three miles below Pueblo Bonito.

Pueblo Alto, ruin on mesa north of Pueblo Bonito. Not to be confused with Pueblo Alto (Trading Company) northeast of Pueblo Pintado.

Pueblo Bonito (abandoned postoffice of Putnam), main ruin in the Chaco Canyon. Location of monument headquarters. Perhaps Pueblo Grande of Loew's map. In Navajo, Sabaohnnai (place where rock is braced up).

Pueblo del Arroyo (Taba Kin), about one-fourth mile west of Pueblo Bonito. Location of Chaco Canyon Trading Post.

Pueblo Pintado (Pueblo Bonito of Gregg and Loew, Pueblo Colorado, Pueblo de Montezuma, Pueblo de Ratones, Pueblo Grande), most eastern Chaco River ruin. About 22 miles by road from Pueblo Bonito.

Raton Spring, nine miles east of Pueblo Pintado.

Rio Puerco—Rio Puerco of the East flows into the Rio Grande; Rio Puerco of the West flows into the Little Colorado.

San Jose River (Rio de la Laguna, Rio Gallo), main tributary of the Rio Puerco of the East.

Satan Pass (Devil's Pass, Cañon Infierno), from Dutton Plateau down into Chaco drainage.

Saydatoh (Pueblo Alto, Socorro, Ojo del Alto), four miles northeast of Pueblo Pintado.

Seven Lakes (Siete Lagunas, Faris Ranch), ephemeral lakes where Star Lake and Pueblo Bonito roads diverge.

Shabik'eshchee, Basket Maker site on Chacra mesa about two miles above Wijiji.

Shiprock (Winson Peak, the Needles, Tsebidai), igneous plug and landmark southwest of Chaco-San Juan juncture.

South Gap, entrance to the Chaco Canyon, from the south, opposite Pueblo del Arroyo.

Star Lake, just east of Continental Divide, and five miles east of Raton Spring.

Stinking Spring, two miles east of Chavez near Santa Fe Railroad.

Stony Butte, south of Chaco River about 16 miles west of Pueblo Bonito. White Rock Store is nearby.

Torreones Arroyo (Torrejon), east of Continental Divide from the Chaco River. Flows into Chico Arroyo which flows into the Rio Puerco of the East.

Tzin Kletzin (Tsin Kletsin, Tsinklitsin), ruin on mesa south of Casa Rinconada.

Tsaya, formerly post office; now a Navajo community north of the Chaco River some six miles northeast of Stony Butte.

Una Vida, ruin north of the Chaco River, nearly opposite Mesa Fajada.

Vicente Wash (Vacinte Wash, Fachada Chaco, Fahada Arroyo, Chacra Wash), south fork of the Chaco River which joins the main river just west of the Mesa Fajada. Not to be confused with two other washes or arroyos by this name in the same general area.

White Horse Trading Post (Buck's Store), on upper waters of south fork of the Chaco.

Wijiji (Turquoise House, Blue House, Kin Dotliz, Greasewood House, Wejegi, Weje-gi, Vetche-Tchi), ruin east of Una Vida.

The Chaco Canyon is within the San Juan Basin (a structural basin in northwestern New Mexico and southwestern Colorado, enclosed by outcrops of Cretaceous coal bearing formations, and with strata dipping toward a common center), and also extends into a portion of the Durango-Gallup Coal Field. The Chaco Plateau, together with the northern part of the Dutton Plateau, the Chuska Valley, and the eastern slope of the Chuska Mountains, comprise the Chaco drainage basin. These physiographic divisions constitute the eastern part of the Navajo section of the Colorado Plateaus province. Much of this area was once referred to as the Cretaceous Plateau.

Upper Cretaceous and lower Tertiary sedimentaries dominate the Chaco area. Terms in vogue are (from oldest to youngest):

Within the Mesaverde group (named by Holmes in 1877 from the Mesa Verde in Colorado):

Hosta sandstone (Sears 1934, from Hosta Butte), replaces Point Lookout sandstone (Collier 1919, in Mesa Verde area). It is not revealed in the Chaco area proper.

Allison member (Sears 1925, near Gallup), replaces Menafee formation (Collier 1919, in Mesa Verde area).

Chacra sandstone member (Dane 1936; earlier by Keyes; from Chacra Mesa), replaces Cliff House sandstone (Collier 1919, in the Mesa Verde).

Lewis shale (Cross 1899, near Ft. Lewis, Colorado).

Pictured Cliffs sandstone (Holmes 1877, one mile west of Fruitland).

Equivalent to the Laramie of Holmes:
Fruitland formation (Bauer 1916, Fruitland, N. M.).
Kirtland shale (Bauer 1916, Kirtland, N. M.)
Ojo Alamo sandstone (Brown 1910, Ojo Alamo Arroyo).

The Ojo Alamo sandstone may be Paleocene, along with the following Nacimiento group:
Puerco formation (Cope 1875, Rio Puerco of the East).
Torrejon formation (Wortman 1897, Torrejon [Torreones] Arroyo).

The Chaco drainage area is within the New Mexican counties of San Juan (formerly part of Rio Arriba), McKinley (formerly part of Valencia), Rio Arriba, and Sandoval (once part of Bernalillo). This area was, in Spanish times, termed the Provincia de Nabajoó. The Pueblo Bonito, Pueblo Alto (Pueblo Pintado), Kinnebeto, Lake Valley, and Stony Butte Navajo Chapters operate within the Chaco Canyon portion of the Eastern Navajo Jurisdiction.[49]

49. From Chapter Survey Notes, J. C. Kelley, 1936.

THE REPORT

PART I

THE NATURAL LANDSCAPE

By DONALD D. BRAND

Location and Setting:

The small house ruin of Tseh So (Bc50 survey number) is located approximately in the center of Section 13 (University of New Mexico property), Township 21 North, Range 11 West. This is about Latitude 36°3′ North, and Longitude 107°58′ West. The ruin is located on the gently inclined sandstone pediment of a sandstone and shale (Chacra sandstone and Allison members) spur that juts northward from the south mesa wall of the Chaco Canyon. The toe of this spur extends into a nearly level embayment of the south mesa, between the low Casa Rinconada ridge on the west and the high cliffs of an eastern promontory. Immediately south and east of Tseh So the cliffs are low, running from fifty to one hundred feet, but they ascend by a series of shelves and low scarps to the mesa top which is more than three hundred feet above the canyon floor.

The canyon floor is, at this point, nearly half a mile wide from north to south, and is nearly bisected by the channel of the Chaco River. From Tseh So to the bank of the present channel is a trifle more than one thousand feet. The banks are steep, between twenty-five and thirty feet high, and are being cut away rapidly by lateral erosion of the Chaco River and by the ephemeral torrents that cascade down the banks from southern draws after heavy precipitations on the south mesa. Reentrants of the south mesa, on both sides of Tseh So, are, at present, sandy bottomed draws that extend into the mesa front approximately a quarter of a mile. They have recently commenced to channel in their upper portions.

Over the Tseh So ruin and the adjacent canyon floor lands there is a sparse vegetation of chico or black greasewood *(Sarcobatus vermiculatus)*, tumble weed or Russian thistle *(Salsola pestifer)*, crownbeard or smelling sunflower *(Verbesina enceliodes exauriculata)*, and scattered grasses. Herbaceous forms dominate; there is no tree growth; and the chico is the only shrub in the immediate area. The soil is a grayerth, derived from the sandstones and shales of the vicinity. It is normally a transported sandy loam, of considerable depth, with some organic content from the carbonaceous shales, but practically lacking in potash, phosphates, and nitrates. Iron, sulfur, gypsum

(calcium sulphate), white alkalis (sodium chloride and sodium sulphate), and black alkali (sodium carbonate) are present in varying amounts. This soil is classified by the United States Bureau of Soils as a Brown Soil, but it is more properly to be classed with the desert gray soils.[1]

The Tseh So site is but one of several small house sites in this cove to the east of Casa Rinconada. There are also traces of numerous pit houses. From the upper edge of Tseh So can be seen most of the sites of the main ruin area, including Casa Rinconada, Pueblo Bonito, Chetro Ketl, Pueblo Alto, and Pueblo del Arroyo.

Geology, Landforms, and Drainage:

All of the rocks exposed in the Chaco Canyon are sedimentary in origin, ranging in age from the Allison member of the Mesaverde group, through the Chacra sandstone member, to the Lewis shale—all belonging to the Upper Cretaceous. The Chaco Canyon has been eroded mainly out of the Allison and Chacra members, as the Chaco River leaves the Lewis shale about five miles below Pueblo Pintado. Back of Pueblo Bonito, across the canyon from Tseh So, the canyon walls rise nearly sheer for 125 feet. Including the back slopes, the canyon at this point is more than 350 feet deep. The upper and greater portion of the cliff scarp is made up of the massive buff Chacra sandstone, whose counterpart the Cliff House sandstone forms imposing scarps in the Mesa Verde. Due to a dip of the beds down toward the north, more of the underlying Allison member is exposed in the southern cliffs than in the north wall. The Allison member is made up of interbedded sandstones and carbonaceous shales, with stringers of white clay, argillaceous shale, selenite, and coal. In the vicinity of Casa Rinconada the coal seams are thin, and the coal varies from lignite to subbituminous. Progressing westward the seams increase in thickness, and the quality of the coal improves. The characteristic profile of the Allison exposure is that of a concave talus slope, littered with fragments of shale and occasional large angular blocks of sandstone from the nearly vertical face of the superior Chacra sandstone. This may be seen best in the pediment of the Mesa Fajada, and along much of the southern cliff wall.

Few fossils are found in the walls of the Chaco Canyon. These are mainly casts of the giant fucoid alga *Halymenites major*, and shells of *Inoceramus barabini*. It is normally assumed that the Allison shales and sandstones were laid down during a period of oscillation of the Cretaceous seacoast, some of the sediments having been formed in fresh

1. Marbut: *Soils of the United States*, Plate 2. Plate 5, Section 6, shows the Chaco area soils as belonging to the Laurel, Otero, and Meeker series. The Chaco Canyon proper has not been surveyed by pedologists.

water, and others in coastal waters of the sea. The Chacra sandstone is definitely marine in origin. Some shark's teeth have been collected from the Chacra sandstone, in addition to the above mentioned algae and shells. Plant rests are fairly common in the coal beds.

Within fifteen miles of Pueblo Bonito, advancing northeastward, successive exposures of Lewis shale, Pictured Cliffs sandstone, Fruitland formation, Kirtland shale, Ojo Alamo sandstone, and Puerco and Torrejon formations are encountered. The Escavada Wash and its tributaries the Kimbetoh Arroyo and Alamo Arroyo pass across all of these formations. With the exceptions of the Kirtland and the Puerco and Torrejon, the exposures are narrow (though continuous), with an average width of less than two miles in the area to the north and east of the Chaco Canyon ruins. The Lewis shale is of marine origin, as is the succeeding Pictured Cliffs sandstone. Although calcareous rocks are rare in all this area, some thin layers of impure brown limestone are found in the Lewis shale. The Fruitland formation, of sandstones, shales, and clays, was laid down in waters that changed from brackish to fresh. Extensive badlands have been formed in the Fruitland, especially of the weird monumental type. Various fossils of Dinosauria, Chelonia, and Pisces have been obtained from the Fruitland formation.

The Kirtland shale, of fluviatile origin, is noted for its badlands which normally assume a rounded billowy form. In the strata of the Kirtland shale occur barite, gypsum, aragonite, siderite, petrified wood, and numerous remains of dinosaurs, turtles, crocodiles, and fish. Succeeding the Kirtland shale is the Ojo Alamo sandstone, whose geologic position has been given variously as terminal Cretaceous and basal Tertiary. The shale of the Ojo Alamo is fairly rich in remains of Reptilia; and the conglomeratic sandstone contains silicified logs (up to three feet in diameter), and pebbles (up to six inches in length) of red jaspery quartz, brown and grey chert, vein quartz, pink and white quartzite, rhyolite, andesite, felsite, porphyrite, granite, gneiss, schist, and obsidian. Also there are found pieces of lignitized wood, concretions of manganese, and limonitic concretions. The Puerco and Torrejon formations possess a large vertebrate fauna—mainly archaic placental mammals, and an abundance of turtles and crocodiles, but no dinosaurs. Calcite crystals are found in bedding planes in the Puerco; and pebbles of chert and quartz up to one inch in diameter are found in the Torrejon.

Upon the horizontal to gently dipping Cretaceous rocks of the area ephemeral torrents and prevailing winds have sculptured a landscape of alternating dales and swells, with here and there ridges, knolls, buttes, and mesas rising up to as much as a hundred feet above the general plateau level. Only the Chaco River, and the lower portions of its principal tributaries, has deeply incised the surface. Despite a

meager rainfall, the Chaco River collects enough water, during the torrential precipitations of late summer, from its drainage basin (estimated between 4,200 and 4,800 square miles) to maintain an ever-enlarging channel some 150 miles in length. (Estimated runoff about 65,000 cubic feet.) Although normally the upper Chaco River is only a sandy wash in the bottom of a narrow channel (70 to 150 feet in width), in the rainy season a swirling flood of ill-smelling chocolate colored water will fill its bed from bank to bank.[2] The load of the river is made up of mud and sand, with a few small sandstone pebbles carried in the train. No pebbles larger than one inch in diameter are to be found in the canyon sector of the river.

Between Shabik'eshchee and Peñasco Blanco (the main area of prehistoric settlement in the Chaco Canyon) the river describes a sinuous course which results in the cutting away of tons of bank fill with every rise of water. Although there is some deposition on the inner slack-water margins of the bends, each season sees a fairly complete evacuation of the material eroded from the banks. This was seemingly not the case during all of the past millenium, as there are traces of an older arroyo (now completely filled in) which wriggled its way across the canyon floor, intersecting the present arroyo in a number of places.[3] This filled arroyo, which was fifteen to eighteen feet deep, contains shards from the latest Chaco period. There have evidently been several cycles of filling and cutting in the Chaco Canyon since Basket Maker days (some twelve hundred years ago) as pithouses and hearths of the Basket Maker period have been revealed to a depth of more than thirteen feet in various places along the present Chaco River bank.[4]

The work of the wind, prevailingly from the west and southwest, is less spectacular than that of summer rains, but it has left its imprint on every portion of the landscape. Sand blasting of the cliffs and isolated rocks goes on continually, leaving polished or striated surfaces here, and niched or honeycombed rocks there. Sandstone blocks at the feet of southwest-facing cliffs are exposed to the greatest action of the wind, and frequently one finds such boulders converted into sponges of stone. Undercutting of cliffs, in the first three feet above the canyon floor, contributes in no small fashion to the downfall of huge masses of cliff rock. This is best observed between Kin Kletso and Chetro Ketl.

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2. Highest water marked during the last few years was nine feet, May 21, 1934, at the Pueblo Bonito bridge where the channel is 80 feet wide. This particular flood rose from 1.4 feet at 6:00 a. m. to 9 feet at 10 p. m., but was down to 2.75 feet by 5:00 a. m. the next morning. Chauvenet: *Erosion Control in Chaco Canyon*, p. 36.

3. For comments on sedimentation and erosion in the Chaco Canyon, see Bryan, Chauvenet, Dodge, Fisher, Judd, and Senter. Antevs, Brand, and Bissell are carrying on further study at the present time.

4. Such a site was noticed in August of 1936 when a large mass of bank, near Shabik'eshchee, fell into the river and exposed a nicely bisected pithouse.

Silt and sand, collected from hundreds of square miles of shale and sandstone, are harried by the wind—filling the air in the windy months of spring and summer, or piling up in drifts along the larger washes. One of the largest aggregations of sand dune and drift in the Chaco Canyon is in the ox-bow around the Peñasco Blanco.

Weather, Climate, and Water Supply:

A moot point among archaeologists working in the Chaco area is the possibility of climatic change during the past thousand years, and even during the last hundred years. At one time Gregg and Simpson were misquoted to prove that only three or four generations ago there was a perpetual stream flowing in the Chaco Canyon.[5] The droughts indicated by tree rings (for the period 750 to 1150 A. D.) did not cause the abandonment of the Chaco, nor were they more intense or more frequent than during the last four hundred years.[6] Undoubtedly there are cyclic fluctuations which affect agricultural populations, especially on marginal steppe areas as in the "dust bowl" of the United States, but these fluctuations do not constitute secular change. There does remain evidence, however, for a fuller and more diversified vegetation in the Chaco a thousand years ago. Without entering into a full discussion of possible factors, it will be sufficient at this time to mention the close relationship between ground water supply and vegetation, and the oscillations produced in physiographic processes and in areal distribution of vegetation before a balance is attained after any disturbance of the water supply-vegetation equilibrium. Any stream channeling will initiate a lowering of water level and a reduction of vegetation. Concommitantly, any reduction of vegetation (whether by disease, fire, man, or other agent) will induce an accelerated runoff, and this will initiate a cycle of erosion. On the basis of the evidence in hand, one might plausibly conclude that weather and climate are the same today as they were in 937 A. D., but the processes of denudation and erosion have become so greatly augmented that marked differences exist in landforms and vegetation. The change is physiographic and not necessarily climatic.

Weather records have been kept in the Chaco Canyon continuously only since June of 1932. A broken record extends back to May of 1922. These records comprise only precipitation, and maximal and minimal temperatures. Summarized for the Chaco Canyon National Monument station, these records are:[7]

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5. Simpson: Journal p. 37, states definitely that although the Chaco was running (in August, one of the two rainiest months), it carried water only in the wet season. Gregg makes no statement at all relative to water supply.

6. Hawley: "The Significance of the Dated Prehistory of Chetro Ketl," pp. 65-75.

7. Data from U. S. Weather Office, Albuquerque, and from Custodian of the Chaco Canyon National Monument. Despite the record, old inhabitants of the Chaco Canyon claim that July is the rainiest month of the year.

STATION: PUEBLO BONITO

Elevation: 6,000 feet. Length of record: 6 to 9 years

	Max. Temp.	Mean Max. Temp.	Min. Temp.	Mean Min. Temp.	Mean Temp.	Min. Precip.	Max. Precip.	Mean Precip.
Jan.	60°F.	40.7	—13	14.8	27.7	T	.67	.30
Feb.	70°	40.5	—15	18.7	29.6	T	2.34	.93
Mar.	80°	54.0	5	24.7	39.3	T	.94	.31
Apr.	84°	62.3	9	32.3	47.3	T	.47	.27
May	88°	73.6	24	41.3	57.4	.08	1.56	.60
June	99°	85.3	30	49.0	67.1	T	1.23	.27
July	100°	89.7	44	57.2	73.4	.66	2.11	1.19
Aug.	99°	86.7	42	55.6	71.1	.22	2.72	1.49
Sept.	102°	78.5	24	46.0	62.2	.32	2.42	1.02
Oct.	81°	66.6	10	37.0	51.8	T	2.62	.61
Nov.	71°	51.2	1	22.3	36.7	0	1.38	.70
Dec.	60°	40.9	—24	16.9	28.9	0	.89	.49
Annual	102°	64.2	—24	34.6	49.4	7.86	11.72	8.18

Greatest precipitations in 24 hours: 1.14 inches October 27, 1935; and .90 inches August 4, 1936.

Modal date last killing frost: second week in May.

Modal date first killing frost: first week in October.

Average growing season: 150 days.

A general statement of the climate of the Chaco Canyon area, based on records in the Chaco, interpolations from neighboring stations of longer record at Aztec, Bloomfield, Crownpoint, Farmington, Fruitland, Haynes, Shiprock and Tohatchi, and statements from local inhabitants, follows:

The rainy season (with 46 per cent of the annual total) falls in the summer months of July, August, and September. The summer rains are normally convectional, and spotted in distribution, often accompanied by high winds and hail. Annual precipitation means vary from less than six inches in the western area to more than fifteen inches on the higher eastern and southern mesas. Normally about fifty days of the year have .01 inch or more of precipitation. More than twenty inches of snow fall annually on the higher mesas. Occasionally roads are blocked with snow, as in January, 1937. Annual precipitation will vary more than fifty per cent either way from the mean, from year to year. The wind blows prevailingly from the southwest, but in the summer months there are diurnal shifts in the Chaco Canyon. A west wind will blow up the canyon from 10:00 a. m. until 7:00 p. m.; this will be replaced by an east wind down the canyon between 9:00 p. m. and

8:00 a. m.[8] March and April normally have the most violent windstorms, although high winds may blow in July and August. The winter months may get bitterly cold, but the summers are never intolerably hot. Even after the hottest summer days, night and early morning temperatures are cool, due to the rapid radiation under clear skies at an elevation of 6,000 feet and higher.

Most visitors to the Chaco Canyon would class it immediately as a desert. The comparative lack of water and the sparse vegetation would seemingly justify such a classification. The writer has taken the record from complete years in the Chaco Canyon and applied the Koeppen system for the determination of climate.[9] According to this analysis the Chaco Canyon is normally a cold desert, bordering on the steppe (BWkfw, near BSkfw). Should the Chaco Canyon average one more inch of rain a year, it would have a steppe climate. Certain years are steppe years, although seven to eight out of every ten are seemingly desert years. While the Chaco Canyon is desert in climate, the adjoining mesas are probably steppe.

As has been mentioned, the Chaco River is an ephemeral stream which drains most of the area. However, in between the Chaco tributaries are a number of semi-permanent lakes or ponds, occupying small areas of interior drainage. These are located principally on the Chaco plateau to the south of the Chaco Canyon. Besides these ponds, and artificial tanks constructed for the watering of sheep, there are a number of springs and seeps, and countless *tinajas* and *charcos*. Undoubtedly the prehistoric inhabitants of the Chaco relied in part on these waterholes on the mesa tops, as trails lead up to them from the various pueblos below in the canyon. The mesa-top waterholes are filled only by seasonal rains, but a number of the springs are perpetually fed by seepage, down through the sandstones and along bedding planes, from large areas. The largest springs of the area are to be found at the base of outcroppings of the Ojo Alamo formation, to the north of the Chaco Canyon. Attempts at well drilling by white settlers in the Chaco area have demonstrated that (1) there is no permanent water table in the Chaco Canyon away from the underflow in the bed of the river; (2) there are artesian basins to the south of the Chaco Canyon; (3) the most likely source of water is in the porous sandstone immediately above the Mancos shale; (4) most of the water from wells is hard, quite often salty. The water at present provided by surface and sub-surface run-off after summer rains is normally sufficient to mature crops of maize and beans in the Chaco Canyon, when directed to the fields by diversion dikes.

8. Dodge: "Diurnal Winds . . . in Northwestern New Mexico," pp. 299-300.

9. Koeppen as modified by Russell. See Russell: *Dry Climates of the United States*, I, pp. 19-20, 22-24, and map; and Russell: *Dry Climates of the United States*, II, pp. 247-248, 270-274, and maps.

Biota:

According to archaeologic evidence, the present flora and fauna of the Chaco area have altered somewhat, but not radically, during the past millenium. Rushes, canes, willow twigs, timbers of yellow pine, cottonwood, willow, and spruce, and charcoal from piñon and Douglas fir, found in excavations, indicate a closer supply of these items than is true at present. It is much more logical to bring the forests of pine and piñon thirty miles closer from the Continental Divide and the Dutton plateau than to believe that the prehistoric inhabitants of the Chaco lugged by hand great logs (one remnant of a post or pillar has been found that measured 26½ inches in diameter) over long distances. Furthermore, there are still a few scattered piñon trees on the mesas north and south of the Chaco; and a few lonely yellow pines were growing on the mesa south of Casa Rinconada and in the side arroyos of the Chaco Canyon until a dozen years ago.[10] The last yellow pine near Pueblo Bonito (on the south mesa) was cut down for fire wood in 1927, so that now the nearest pines are some sixteen miles up the canyon. Jackson, in 1877, reported cottonwoods down stream from Pueblo Bonito. All these have died, and now the nearest cottonwood trees are eight miles up the canyon. It is not unreasonable to assume that during a portion, at least, of the prehistoric period, the Chaco River flowed between low banks—possibly through a series of pools—which were bordered by growth of rushes, canes, willows, and cottonwoods. Not only is there archaeologic and documentary evidence for a former existence of such growths near the main sites, but there is also corroboration of the postulated surface supply of water in the considerable number of frogs carved in turquoise and modeled in terra cotta.

The present vegetation of the canyon floor is chiefly of the Great Basin microphyll desert type,[11] characterized especially by sagebrush *(Artemisia)*. On the alluvial flats of the canyon floor, at an average elevation of six thousand feet, greasewood *(Sarcobatus vermiculatus)* is dominant, associated with sagebrush, bunch grasses *(Sporobolus)*, rubberweed *(Hymenoxys)*, tumble weed *(Salsola pestifer)*, salt bushes *(Atriplex)*, rabbit brush *(Chrysothamnus)*, blue grama *(Bouteloua gracilis)*, galleta grass *(Hilaria jamesii)*, feather grass *(Stipa)*, poverty grass *(Aristida)*, crownbeard *(Verbesina)*, etc. On talus slopes, rocky ledges, and scattered over the mesa and valley surfaces of the Chaco plateau are occasional yuccas and cacti. The shallow, stony soils of sandstone ridges and mesas carry a sparse vegetation of junipers *(Juniperus*, locally called cedars), piñon *(Pinus edulis)*, and sage-

10. See Bradfield: *Economic Resources of Chaco Canyon*, pp. 36-38; and Douglass: *Dating Pueblo Bonito*, pp. 45-47.

11. Shreve's terminology. Shantz terms it Northern Desert Shrub.

brush, with parklike openings scantily covered with steppe grasses. The inter-mesa tracts are vegetated with sagebrush, rubberweed, blue grama grass, some prickly pear and cane cacti *(Opuntia)*, and other grasses and cacti. Very sandy soils support joint fir *(Ephedra)* and redtop grass *(Agrostis)*. Along the ponds and lakes of the area grow carrizo *(Phragmites phragmites)*, rushes *(Juncus)*, bulrushes *(Scirpus)* and sedges *(Carex)*. During the past three years the Soil Conservation Service has planted in the Chaco Canyon more than 330,000 trees and shrubs, and a couple of thousand pounds of grass seed.[12]

The fauna of the Chaco area has been almost totally neglected by zoologists. From archaeologic and historical studies, however, it is evident that very few if any newcomers have appeared upon the scene since the abandonment of the Chaco Canyon pueblos. On the other hand, American antelope or pronghorn *(Antilocapra americana americana)*, American elk or wapiti *(Cervus canadensis)*, mule deer *(Odocoileus hemionus macrotis)*, bighorn sheep *(Ovis canadensis canadensis* and *O. c. texiana)*, and bears *(Euarctos* and *Ursus)* seemingly once inhabited the Chaco plateau. At present not one of these mammals is to be found in the area. Antelope have been gone from the valleys for more than 50 years; mule deer and elk have not been seen in this part of New Mexico for at least a generation; while the bears have retreated to the adjacent mountains, and the bighorn sheep have hidden out in the San Juan Mountains or retired to southern ranges. These animals, mainly herbivorous, were apparently driven out by man through hunting and the introduction of domesticated grazing animals. With the large herbivores went the carnivores, mainly *Felidae*, that had preyed on them. This opened the field to rapidly multiplying throngs of smaller fry, among whom the rodents took the lead. At present the mammalian life of the Chaco area is dominated by rabbits, hares, rats, mice, prairie dogs, gophers, and squirrels—with an occasional coyote or fox to place a slight curb upon the rodent multiplication. In actual fact, however, probably hawks, owls, and snakes prey to a greater extent upon the rodents than do the *Canidae*.

A list of the more common rodents would include: the Texas jackrabbit *(Lepus californicus texianus)*, Colorado cottontail *(Sylvilagus auduboni warreni)*, Rocky Mountain cottontail *(Sylvilagus nuttalli pinetus)*, chipmunks *(Eutamias)*, at least four species of squirrels *(Sciurus, Citellus,* and *Ammospermophilus)*, the Zuñi prairie dog *(Cynomys gunnisoni zuniensis)*, about a dozen kinds of mice, six species of rats, an occasional porcupine *(Erethizon)*, the golden pocket

12. These plantings and sowings included: tamarisk *(Tamarix)*, willow *(Salix)*, broad leaf cottonwood *(Populus wislizeni)*, narrow leaf cottonwood *(P. angustifolia)*, wild plum *(Prunus americana)*, *Parosela* shrubs, western wheat grass or bluestem *(Agropyron smithii)*, sacaton *(Sporobolus)*, and sand bunchgrass *(Oryzopsis hymenioides)*. Of the trees and shrubs, about 70 per cent are growing.

gopher *(Thomomys perpallidus aureus)*, and beaver *(Castor canadensis frondator)* in the San Juan river. Within the Chaco Canyon proper the Moki kangaroo rat *(Dipodomys longipes)*, banner tailed kangaroo rat *(D. spectabilis baileyi)*, Baird's pocket mouse *(Perognathus flavus flavus)*, scorpion or grasshopper mouse *(Onychomys leucogaster melanophrys)*, white-footed or tawny deer mouse *(Peromyscus maniculatus rufinus)*, antelope ground squirrel *(Ammospermophilus leucurus cinnamomeus)*, Zuñi prairie dog, golden pocket gopher, Texas jackrabbit, and Colorado cottontail rabbit are the rodents most frequently seen. It is probable that a thousand years ago, when coniferous forests extended into the Chaco area, there were numerous representatives of tree squirrels *(Sciurus)*, wood rats *(Neotoma)*, and other forest loving rodents that are now rare or absent. Three species of wood rats *(Neotoma lepida lepida, N. mexicana fallax*, and *N. cinerea arizonae)* do inhabit the rocky cliffs and ledges of the Chaco, where they erect nests of saltbush branches, pieces of cactus, etc.

Among the carnivores occasionally seen in the Chaco area (and presumably more common in past time) are: mountain lions *(Felis concolor)*, plateau wild cat *(Lynx rufus baileyi)*, western red fox *(Vulpes macrourus)*, New Mexico desert fox *(Vulpes macrotis neomexicana)*, Arizona gray fox *(Urocyon cinereoargenteus scottii)*, gray wolf *(Canis lycaon nubilus)*, San Juan coyote *(Canis latrans estor)*, mink *(Lutreola vison energumenos)*, Arizona weasel *(Mustela arizonensis)*, Arizona skunk *(Mephitis mesomelas estor)*, badgers *(Taxidea taxus)*, and the bears mentioned previously. Of the *Chiroptera* there are a number of species in the Chaco area including, certainly, the brown bat *(Eptesicus fuscus fuscus)*, and the black-nosed bat *(Myotis subulatus melanorhinus)*.

The bird, reptilian, molluscan, arthropod, and lower forms of life have been practically unstudied in the Chaco Canyon area. Among the birds definitely identified in the Chaco Canyon are: the redwinged blackbird *(Agelaius phoeniceus)*, cowbird *(Molothrus ater)*, western crow *(Corvus brachyrhynchos)*, western mourning dove *(Zenaidura macroura marginella)*, golden eagle *(Aquila chrysaetos)*, red-shafted flicker *(Coleptes cafer collaris)*, hawks *(Buteo* sp.), piñon jay *(Cyanocephalus=Gymnorhinus cyanocephalus)*, Woodhouse jay *(Aphelocoma californica woodhousei)*, Shufeldt's junco *(Junco oreganus shufeldti)*, Arkansas kingbird *(Tyrranus verticalis)*, horned larks *(Otocoris alpestris)*, American magpie *(Pica pica hudsonia)*, nighthawks *(Chordeiles* sp.), Bullock's oriole *(Icterus bullocki)*, owls (several species), scaled quail *(Callipepla squamata pallida)*, American raven *(Corvus corax)*, white rumped shrike *(Lanius ludovicianus excubitorides)*, sparrows *(Chondestes, Spizella,* etc.), cliff swallow *(Petrochelidon albifrons)*, thrushes *(Hylocichla* sp.), canyon towhee

(Pipila fuscus mesoleucus), thrashers *(Toxostoma* sp.), vulture *(Cathartes aura septentrionalis)*, woodpeckers *(Dryobates*, etc.), and wrens. Occasionally water birds, such as mallards, pintails, teals, and grebes, may be seen in passage across the Chaco. The wild turkey *(Meleagris gallopavo)*, which is now found no closer than in the Zuñi, Chuska, Jemez and San Mateo mountains, once probably roamed the forested areas of the Chaco and Dutton plateaus.

Amphibians necessarily, in this arid area, are not numerous. At present only the toad *(Bufo* sp.), and the leopard frog *(Rana pipiens)* are known by the writer to exist in the Chaco area. Undoubtedly frogs, toads, and salamanders were present in considerable numbers when the Chaco possessed a greater water supply. Lizards are numerous, including Bailey's collared lizard *(Crotaphytus collaris baileyi)*, western earless lizard *(Holbrookia maculata approximans)*, southern brown-shouldered uta *(Uta stansburiana elegans)*, striped swift *(Sceloporus consobrinus)*, and horned toads *(Phrynosoma* sp.). Among snakes noted are: the western striped racer *(Coluber taeniatus taeniatus)*, western bull or gopher snake *(Pituophis catenifer)*, white-bellied garter snake *(Thamnophis eques)*, prairie rattlesnake *(Crotalus confluentus= C. viridis)*, wandering garter snake *(Thamnophis ordinoides elegans)*, and the whip snake *(Masticophis flagellum flavigularis)*. Although not noted by the writer, it is possible that a few mud turtles and tortoises exist in the Chaco area. Pepper, during his excavations at Pueblo Bonito, found both carapace and dried "turtle" carcass. A few small land snails, species unknown, may be found in the canyon. As there is no permanent stream there are no fish. Various unidentified flies, mosquitoes, grasshoppers, beetles, bugs, butterflies, moths, hornets, wasps, bees, ants, spiders, centipedes, scorpions, millipeds, *Crustacea*, worms, etc., are present.[13]

NATURAL RESOURCES

Vegetable:

The archaeologic record of plants utilized by the prehistoric inhabitants of the Chaco area is necessarily much less complete than for animals and minerals. Fortunately, however, not all portions of plants were consumed by man, weather, decay, and time. Charred woods, imprints in plaster and adobe, nut shells, rinds, stems, leaves, husks, bark, fibers, cobs, pollen, meal, etc., have allowed the ethnobotanist to provide the archaeologist with a considerable number of identifications. To date, the following plants have been recovered from excavations and cliff cavities in the Chaco Canyon:[14]

13. For general treatments of New Mexican fauna see F. Bailey, V. Bailey, Cockerell, Van Denburgh, Essig, Henderson, Ligon, and Pilsbry.

14. Data from published and manuscript reports. Terminology in general follows Wooton and Standley: *Flora of New Mexico.*

Arrow reed (?)—No botanical identification. Possibly arrow grass *(Triglochin maritimum)*, arrow head *(Sagittaria arifolia)*, or arrow weed *(Pluchea sericea)*. None of these has been noted in the canyon area. (See Reeds.)

Beans (red) (?)—No botanical identification. Probably a *Phaseolus*, a number of which are wild in New Mexico in addition to the cultivated kidney and tepary beans. Beans and pods found in cliff cavity.

Cane cactus *(Opuntia arborescens)*—Cane or whip cactus (also known as cholla, candelabrum cactus, prickly pear, etc.) is scattered over the entire Chaco area. It was used in roofing, and for implements; also, probably, for food.

Cocklebur *(Xanthium commune)*—Burs found in definitely prehistoric strata. This is contrary to belief that the common cocklebur was introduced into New Mexico. No known prehistoric use; possibly the seeds were eaten.

Cotton *(Gossypium* sp.)—Species seemingly *G. hopi*. This was probably cultivated to a slight extent.[15] No wild cotton is known from northern New Mexico. Lint, seeds, and a boll have been found. Used for cordage, textiles, and on ceremonial objects.

Cottonwood or poplar *(Populus* sp.)—Probably *P. wislizeni*, *P. acuminata*, and *P. angustifolia*, all of which grow in the San Juan basin. Formerly more abundant along the Chaco River. Logs, branches, sticks, and charcoal have been recovered. Used for pueblo construction, implements, and firewood.

Dogbane *(Apocynum* sp.)—Kidder mentions *Apocynum* string from the Chaco. This fiber-providing plant could have been obtained in the area.

Gourd *(Cucurbita* sp.)—Not identified. Probably *C. foetidissima*. Rinds found in cliff cavities. Use unknown.

Greasewood or chico *(Sarcobatus vermiculatus)*—Abundant in the Chaco Canyon. Used for implements and firewood.

Horsetail or scouring rush *(Equisetum* sp.)—Probably *E. arvense*, *E. hiemale*, and *E. laevigatum*, all of which grow along streams and in *cienegas* in the San Juan basin. They have not been noted in the Chaco Canyon, but probably were present in prehistoric times. Used in roofing and matting.

Juniper or cedar *(Juniperus* sp.)—Rocky Mountain *(J. scopulorum)*, Utah *(J. utahensis)*, and one-seeded *(J. monosperma)* junipers are well represented in the Chaco vegetation. The Utah and one-seeded

15. (Brand): *Symposium on Prehistoric Agriculture*, article by V. H. Jones. pp. 54, 56-58.

species are most abundant. Archaeologic evidence indicates use for pueblo construction, firewood, torches, implements, cordage, and textiles. The gum also was used in ornamental inlays, etc. Probably the junipers likewise provided food, dyestuffs, and medicine.

Maize or corn *(Zea mays)*—Leaves, stalks, quids of silk, cobs, kernels, meal, and pollen have been recovered. The evidence in hand would indicate a flint corn, although quite probably flour and dent corns were cultivated also. Cobs having 4, 6, 8, 10, and 12 rows have been reported. Probably the 4-row count was erroneous. Cobs with 8, 10, and 12 rows are most numerous. The plant was used for food, in ceremonies, and for fuel.

Manzanita (?)—An implement of manzanita wood *(Arctostaphylos* sp.) has been reported doubtfully. No manzanita grows in the Chaco Canyon, but it is fairly common in the Chuska Mountains.

Mesquite (?)—A broken piece of carved wood, presumably mesquite *(Prosopis* sp.), has been reported by Pepper.[16] No mesquite is found in northern New Mexico closer than an occasional shrub in the valley of the Puerco of the East.

Mountain Mahogany *(Cercocarpus parvifolius)*—Doubtfully identified as material of various implements. Grows in the Chuska mountains.

Pepper or chili (?)—Pods of a pepper *(Capsicum)* appearance have been found in one Chaco excavation. *Capsicum* does not grow wild in northern New Mexico, and presumably was introduced to the Pueblos by the Spaniards.

Pine *(Pinus ponderosa scopulorum)*—The western yellow pine has but recently died out in the main ruin area of the Chaco Canyon. Possibly a considerable stand of this pine once existed in and near the canyon. Logs were commonly used for *vigas* and posts.

Piñon *(Pinus edulis)*—The piñon is found scattered over the Chaco area, though apparently not so much as formerly. Wood, charcoal, ash, gum or resin, nuts, and hulls are commonly found in excavations. The piñon wood was used in pueblo construction and for firewood; its nut served for food. The gum was used in the same fashion as that of juniper.

Pumpkins *(Cucurbita moschata* and *C. pepo)*—These pumpkins (normally referred to as "squashes" by archaeologists) were apparently the only cucurbits cultivated in the Chaco Canyon. Stems and rinds have been recovered.

Reeds (?)—This term, along with rushes, has been overworked by archaeologists. There is a suspicion that many items loosely classified as reeds may be cattail *(Typha)*, bulrush *(Scirpus)*, rush

16. Pepper: *Pueblo Bonito*, p. 109.

(Juncus), sedge *(Carex)*, and other non-grasses. The carrizo or cane reed *(Phragmites communis* or *P. phragmites)*, which is found in the moist localities of the Chaco area, was used in roof construction, matting, and for arrow shafts. It is possibly the "arrow reed" of some writers.

Rushes (?)—One may not rely upon the botanical exactness of items referred to as rushes. True rushes *(Juncus)* of several species are found in the pond areas of the Chaco plateau, and formerly were probably in the Chaco Canyon proper. Rushes were used for roofing and matting.

Sacaton *(Sporobolus* sp.*)*—The sacaton grasses, also known as bunch grass, dropseed, etc., grow over much of the Chaco area. They were used prehistorically in the construction of roofs, in matting, and probably for food. *S. cryptandrus, S. wrightii,* and *S. airoides* are the most important species in this area.

Sedges *(Carex* sp.*)*—A number of species, normally restricted to moist areas. Used in the same fashions as rushes.

Spruce *(Picea* sp.*)*—A few timbers of spruce have been recovered from Chaco ruins. Probably both *P. parryana* and *P. engelmanni* are represented. These grow at present in the higher mountains.

Sunflower (?)—Remains of wild sunflower have been mentioned from Chaco ruins. These may be true sunflower *(Helianthus), Helianthella,* or crownbeard *(Verbesina).* All three grow in the Chaco area, although *Helianthus anuus* may have been introduced at a comparatively late time. Probably used for food.

Walnut *(Juglans* sp.*)*—At present no wild walnuts grow within a hundred and fifty miles of the Chaco Canyon.[17] Shells of both the canyon or cliff walnut *(J. rupestris)* and *J. major* have been found as elements in necklaces.

Willow *(Salix* sp.*)*—Formerly rather common in the Chaco Canyon. Poles, sticks, and twigs have been recovered. Used in roof construction, for implements, and basketry.

Yucca *(Yucca* sp.*)*—Both the datil *(Y. baccata)* and the amole *(Y. glauca)* grow in the Chaco area. Leaves, pods, seeds, and fibers are commonly found in excavations. The yuccas were used for cordage, sandals, basketry, etc. Probably the fruit was used for food, and the roots as a soap.

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17. Dominguez and Escalante: *Diario y derrotero,* p. 386, mention seeing in the San Juan area "un arbol que nos parecia nogal." Chapin: *Land of the Cliff-Dwellers,* p. 162, mentions a bowl of walnuts found at Mancos, and comments that the nearest wild walnuts are 250 miles from Mancos.

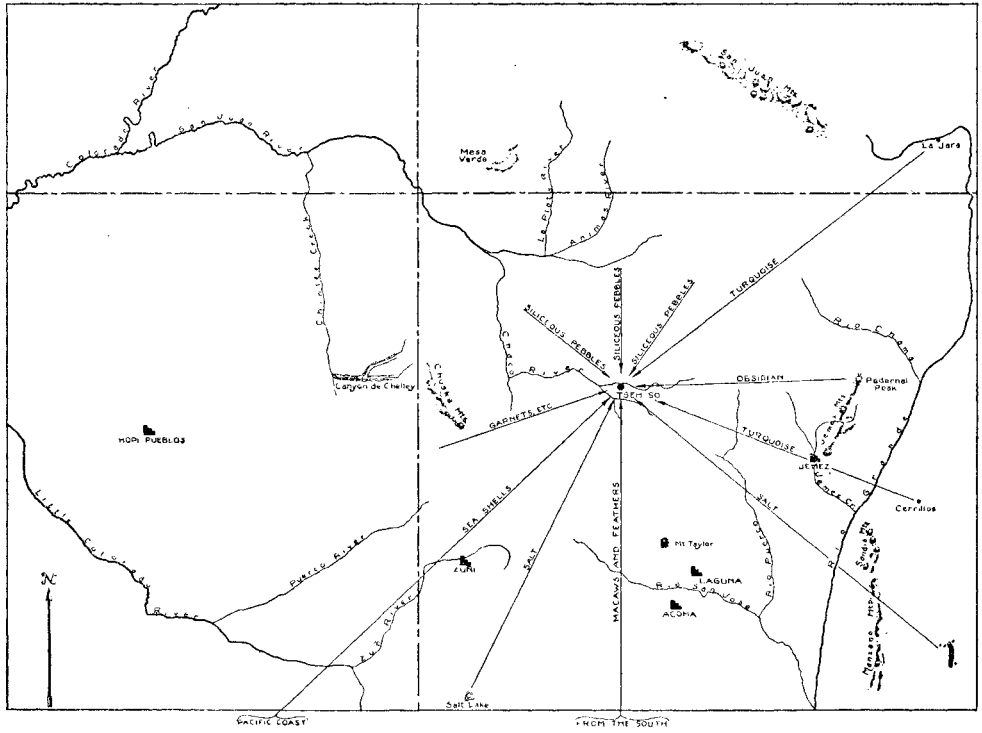
Judging from the ethnobotany of the modern Zuñi, Tewa, and Navajo, hundreds of different species of wild plants (in addition to those discussed above) must have been used by the prehistoric peoples of the Chaco Canyon. Most of these plants undoubtedly grew in the Chaco Canyon area, but probably hunters, traders, warriors, and travelers brought to the Chaco many seeds, fleshy fruits, nuts, roots, medicinal and ceremonial herbs, dye stuffs, woods, etc., from considerable distances. Furthermore, there is the possibility that the Chaco peoples indulged in seasonal treks to the Chuska, San Juan, Jemez, San Mateo, and Zuñi mountains areas—or even farther—to harvest piñon nuts, gather berries, dig roots, etc. Among the items available in the Chaco drainage basin are the following:[18]

Food: Seeds of amaranth *(Amaranthus)*, sagebrush *(Artemisia)*, goosefoot *(Chenopodium)*, dodder *(Cuscuta)*, cacti, sand bunchgrass *(Oryzopsis hymenoides)*, purslane *(Portulaca)*, sand dropseed *(Sporobolus cryptandrus)*, crownbeard *(Verbesina enceliodes)*, and vetch *(Vicia)*, parched or in gruels or breadstuffs. Roots, tubers, bulbs, etc., of wild onion *(Allium)*, Mariposa lily *(Calochortus)*, Indian parsnip *(Cymopterus)*, spurge *(Euphorbia)*, wild carrots *(Daucus pussilus* and *Lomatium orientale)*, wild celery *(Phellopterus montanus)*, wild potato *(Solanum fendleri)*, and sand verbena *(Abronia fragrans)*. Greens from leaves, efflorescence, and stalks, of amaranth *(Amaranthus)*, bee plant *(Cleome)*, cañaigre *(Rumex)*, *Acanthochiton wrightii*, milkweed *(Asclepias)*, saltbush *(Atriplex)*, and purslane *(Portulaca)*. Various pulpy fruits of the barrel cactus *(Echinocereus)*, juniper *(Juniperus)*, tomatilla *(Lycium)*, prickly pear *(Opuntia)*, piñon *(Pinus edulis)*, wild cherry *(Cerasus)*, sumac *(Rhus)*, wild currant *(Ribes)*, wild rose *(Rosa)*, bramble *(Rubus)*, and datil *(Yucca baccata)*. Acorns likewise are available in the foothills, especially of the Utah oak *(Quercus utahensis)* and of the Gambel oak *(Q. gambelii)*.

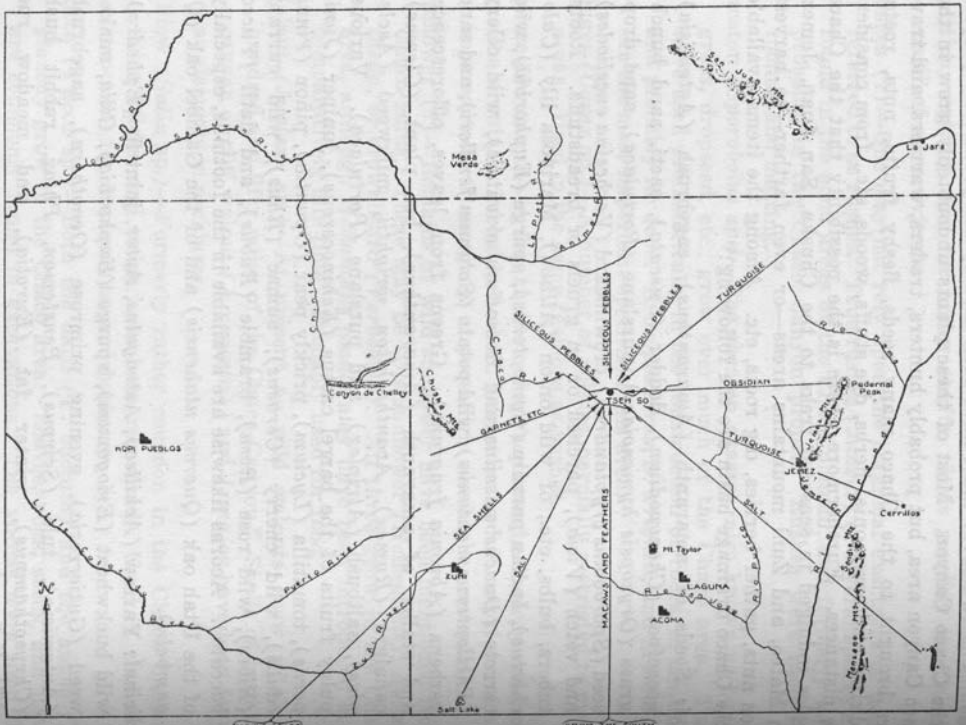
Medicinal: Yarrow *(Achillea)*, *Astragalus*, *Aster*, joint fir *(Ephedra)*, wild buckwheat *(Eriogonum)*, spurge *(Euphorbia)*, *Gilia*, snakeweed *(Gutierrezia)*, evening primrose *(Oenothera)*, sagebrush *(Artemisia)*, tule *(Scirpus)*, *Penstemon*, *Phlox*, rabbit bush *(Chrysothamnus)*, winter fat *(Eurotia)*, and meadow rue *(Thalictrum)*.

Dyes: Alder *(Alnus)*, saltbush *(Atriplex)*, barberry *(Berberis)*, rabbit bush *(Chrysothamnus)*, cliff rose *(Cowania)*, larkspur *(Delphinium)*, rubber plant *(Hymenoxys)*, juniper *(Juniperus)*, four o'clock *(Mirabilis)*, prickly pear *(Opuntia)*, mistletoe *(Phoraden-*

18. Only a limited number of the possible examples are listed.



MAP III—PROBABLE LOCATION OF MINERAL SOURCES



MAP III—PROBABLE LOCATION OF MINERAL SOURCES

dron), piñon *(Pinus edulis)*, sumac *(Rhus)*, cañaigre *(Rumex)*, and cota *(Thalesperma)*.

Fibers, matting, and baskets: Dogbane *(Apocynum)*, carrizo *(Phragmites communis)*, rushes *(Juncus)*, horsetail *(Equisetum)*, sedges *(Carex)*, sacaton *(Sporobolus)*, willow *(Salix)*, *juniper* (*Juniperus)*, and *Yucca*.

Miscellaneous: Most of the plants commonly used in building and for firewood have been mentioned previously. Needles could be obtained from yuccas and cacti. Soap is provided by the amole *(Yucca glauca)*. Piñons, junipers, and other conifers, yield gums and resins. Smoking material could be secured from sumacs, willows, and *Nicotiana attenuata*.

Mineral:

The minerals and rocks utilized prehistorically in the Chaco Canyon constitute a list of considerable length. The archaeologic record probably coincides fairly closely with the actual list, excepting in the pigments and hydrocarbons. There follows a complete list of minerals recovered from Chaco excavations:[19]

Agate (SiO_2)—A variegated chalcedony form of quartz. Both banded and moss agates have been found in Chaco ruins. Unworked. Probably derived from silicified logs in Kirtland shale and Ojo Alamo conglomeratic sandstone.

Alabaster ($CaSO_4 . 2H_2O$)—A fine-grained, sub-translucent variety of gypsum. Possibly obtained from the Mesaverde group or the Kirtland shale, but more probably brought in from eastern deposits near the Nacimiento uplift or along the lower Rio San Jose.

Albatite (sic)—Reported from Chetro Ketl. No further data. Possibly albertite or albite.

Aragonite ($CaCO_3$)—Same chemical composition as calcite but crystallizes in the orthorhombic system, and is harder. Use unknown. Possibly from Lewis shale, but more probably from the Kirtland shale, from fossil shells, and from the Puerco and Torrejon formations.

Argillite—A schist or slate derived from clay. Pipes of argillite were found at Tseh So. Probably derived from argillaceous shale beds in the Allison member, or from the Lewis or Kirtland shales.

Azurite ($2CuCO_3 . Cu(OH)_2$)—A blue carbonate of copper. Frequently found in Chaco ruins unworked, in beads, and powdered for pigment. Probably derived from the Zuñi mountains, or from

19. Data from published and manuscript reports. See Map III for postulated sources of certain minerals and rocks.

isolated patches in the Navajo (old usage) sandstone in the Dutton plateau.

Basalt—A dense, fine-grained dark-colored igneous rock containing much hornblende. Used for percussion and grinding tools, but not common. Possibly brought in from the river terrace deposits along northern tributaries of the San Juan, or from the lava flows north of Bluewater, some fifty miles south of the Chaco.

Calcareous tufa ($CaCO_3$)—A redeposited limestone form of calcite. So far in the Chaco, found only in the Chetro Ketl excavations. Used for beads. Calcareous rocks are rare in the Chaco area, but the Lewis shale contains some thin layers of impure limestone which may have contributed to the formation of tufa.

Calcite crystals ($CaCO_3$)—A crystalline form of calcium carbonate, found rather commonly in Chaco ruins. Used for beads and pendants. Calcite crystals are found in bedding planes in the Puerco formation.

Cannel coal—Commonly considered to be a compact variety of bituminous coal, although it averages less fixed carbon and more volatile material. Possesses dull luster and conchoidal fracture. Used for beads. No deposits of cannel coal have been reported from the Chaco area, but possibly small lenses occur in the predominant sub-bituminous seams. The identification may have been erroneous, instead of jet or lignite.

Carbonaceous shale—Altered clay beds containing considerable brownish bituminous material. Quite common in the Chaco Canyon, especially in the upper portion of the Allison member. Used for flooring, etc., in pueblo construction, and for pot covers, ornaments, etc.

Chalcedony (SiO_2)—A light-colored cryptocrystalline variety of quartz, transparent to translucent, and with a waxy luster. Agate and onyx are forms of chalcedony. Found commonly as material for scrapers, knives, projectile points, polishing stones, hammer stones, etc. After sandstone, chalcedony and chert were the minerals most commonly used for artifacts in the Chaco area. Probably derived from silicified logs in the area, and pebbles in the Ojo Alamo, Puerco, and Torrejon formations.

Chalk ($CaCO_3$)—A soft, whitish compact limestone form of calcite. Reported from Pueblo Bonito. No chalk beds are known in the Chaco, but there may be small deposits in the Lewis shale.

Chert (SiO_2)—An impure, brittle, usually grayish-colored quartz. Chert is sometimes called hornstone; also the term chert is often applied to any impure flinty rock, including jaspers. The usage of the term in archaeologic reports is uncertain. Used for arti-

facts in the same manner as chalcedony. Pebbles of gray, brown, and black chert are found in the nearby Morrison, Ojo Alamo, and Torrejon formations; but possibly much of the chert used in the Chaco area (and all over northern New Mexico) came from the prehistoric quarries on the flank of the Cerro Pedernal in the Chama drainage.

Clay—Earthy material, plastic when wet, composed chiefly of hydrous aluminous silicates. Most of the clays in the Chaco Canyon are recent alluvial (in the valley fill), and argillaceous shales. Principally in the upper portion of the Allison member, and to a minor extent in the Chacra sandstone, are thin stringers of hard white clay interbedded with lignite and sandstone. Experiments with this clay indicate that it is identical with most, if not all, of the clay used by the prehistoric inhabitants of the Chaco in making their ceramics. This same clay was utilized in making much of the plaster used in the pueblos, both in a pure form and mixed with caliche (a calcareous adobe or clay). The sandy alluvial clay or adobe, found exposed in the Chaco channel walls, was used for plaster, mortar, and wall fill. Beads and other ornaments were likewise made from clay.

Copper (Cu)—The only malleable metal found in Chaco excavations. Bells, hammered copper, beads, and nuggets have been found in Pueblo Bonito and in Chetro Ketl. Although native copper is found as close as in the Zuñi Mountains and in Rio Arriba county, there is no evidence that it was mined prehistorically in New Mexico. The general supposition is that the raw and worked copper items were traded up from the south, possibly from Durango or Zacatecas in Mexico.

Diabase—A fine-textured dark-colored igneous rock; actually a general and collective term applied to fine-grained varieties of dolerite, gabbro, and diorite. Used to a minor extent for instruments of percussion, etc. Probably brought in from the area north of the San Juan river.

Diorite—A dark-colored igneous rock with medium or coarse grains. Used infrequently for cutting blades, percussion tools, etc. Also probably derived from the river terrace pebbles to the north.

Flint (SiO_2)—A semi-translucent gray to black quartz with a pronounced conchoidal fracture. The term has been used quite loosely, and probably the items so identified were of chert. True flint is not known from the Chaco area, nor from Northwestern New Mexico at all, according to the definition of flint accepted by many mineralogists.

Galena crystals (PbS)—A lead sulphide, the commonest of the lead minerals. Found in two Chaco Canyon excavations, unworked. In the Zuñi Mountains and in Rio Arriba county are the nearest sources.

Garnet—This term is applied to the members of a varied group of metallic silicates. Garnet has been reported only from the Pueblo Bonito excavations, and was probably the pyrope or blood-red precious garnet. These are obtained from ant hills, etc., in the vicinity of Fort Defiance, Arizona, and elsewhere as in Buell Park, and Garnet Ridge on the Utah-Arizona line.

Gilsonite or Uintahite—A brittle variety of asphalt, lustrous black in color, with a conchoidal fracture. Probably the same as manjak. Found in Utah, and western Colorado, and in veins in sandstone strata southwest of Aztec. It superficially resembles another asphalt (wurtzilite), and has frequently been confused with the jet variety of lignite. Usually employed for ornaments, inlays, and "buttons."

Gneiss—Commonly a metamorphosed granite of a light color. The nearest source is in the conglomeratic Ojo Alamo sandstone. So far found only in one Chaco ruin, in instruments of percussion. Possibly brought in from the Garnet Ridge area.

Goethite (Fe_2O_3. H_2O)—A hydrated iron oxide resembling limonite. Found in Pueblo Bonito. Probably found with other oxides of iron in the area.

Granitic rocks—A group of medium-fine to coarse-grained plutonic acidic igneous rocks, normally light colored. A few manos at Tseh So are of granite. Probably derived from the Ojo Alamo conglomerate.

Gypsum ($CaSO_4$. $2H_2O$)—A hydrous calcium sulphate found in several forms including alabaster, selenite, and rock-gypsum. Found commonly in the Chaco ruins, used in plaster, and for beads, pendants, tablets, etc. These uses refer to the rock- or plaster-gypsum. Gypsum is found scattered through the Mesaverde group, but is more abundant in the Kirtland shale.

Hematite (Fe_2O_3)—An iron oxide. Occurs commonly in the argillaceous and fossil concretion forms, and less commonly in the earthy or red ochre form, throughout the Chaco area. Polished cylinders of problematic use, concave concretions used as mortars, beads, and other varied forms are found commonly in Chaco ruins. Usually when an archaeologist reports "hematite," he is referring to the non-earthy forms. (See Iron Concretions, and Red Ochre.)

Iron concretions—Term loosely employed for various concretions, usually of hematite, in the Chaco area.

Iron pyrites or pyrite (FeS_2)—This pale brass-yellow "fool's gold" is an iron sulphide. Occasionally it is found unworked in Chaco ruins. It occurs sporadically as concretions in the local coal seams; and is found both in crystalline and massive form in the Chacra sandstone. It is possible that some of the pyrite reported by archaeologists may be marcasite.

Jasper (SiO_2)—An opaque massive quartz, usually red, brown, or yellow in color. Used rather commonly for projectile points and ornaments. Derived from silicified logs, and from pebbles in the Ojo Alamo conglomeratic sandstone. Possibly some of the jasper may be a product of the burning coal beds of the Chaco area which have baked clays and shales into porcelain jasper.

Jet—A "jet black" variety of brown coal or lignite. It is a compact hydrocarbon, takes a high polish, and has a conchoidal fracture. Used for beads, "buttons," inlays, and various other small carved items. There may be some confusion in the identification of items listed by archaeologists as jet, lignite, and gilsonite. Probably derived from the coal seams in the Chaco Canyon.

Kaolin—A white residual and sedimentary clay composed chiefly of kaolinite. Pieces of raw kaolin have been reported from two Chaco ruins. It is quite possible that these identifications were in error, as the clays of the San Juan area are chiefly clay shales, plastic clays, and fire clays.

Lignite—A variable variety of coal, ordinarily brown in color and ligneous in texture, which checks irregularly and breaks into thin slabs. The black form of lignite is known as sub-bituminous coal. This is the dominant type in the Allison and Chacra members of the Mesaverde. In 1905 R. Wetherill opened up a mine, one mile west of Pueblo Bonito, in the upper portion of the Allison where five feet of coal seams were exposed. There is no evidence that the prehistoric dwellers of the Chaco Canyon ever deliberately used coal as a fuel, although carbonaceous shale was used as a flooring material, and various ornaments of lignite have been recovered. It should be mentioned, however, that in August of 1936, Dr. Ernst Antevs and the writer noted fragments of lignite concentrated in the fire pits of several pit houses which had been exposed by the collapse of a section of the Chaco river bank near Shabik'eshchee.

Limestone ($CaCO_3$)—A variety of calcite. Occasionally found in Chaco ruins, worked into tablets or palettes, and beads. Possibly derived from the layers of impure limestone in the Lewis shale, but more probably from Lower Cretaceous rocks in the Dutton plateau to the south.

Limonite—Commonly a mixture of several hydrated iron oxides, usually found in amorphous, concretionary, and earthy forms. Both unworked concretions, and earthy limonite (yellow ochre) are found in Chaco ruins. Derived from various rocks throughout the Chaco area.

Malachite ($CuCO_3$. Cu $(OH)_2$)—A green carbonate of copper. Found unworked, and ground for pigment. Occurrence same as that of azurite.

Mica—A group of minerals, including muscovite or "isinglass" and biotite or black mica. Mica sheets have been reported from Pueblo Bonito. Probably obtained from Rio Arriba county.

Monzonite porphyry—A fine to medium grained group of igneous rocks with a porphyritic texture. Used at Tseh So for instruments of percussion. Possibly derived from the Ojo Alamo conglomeratic sandstone.

Obsidian—Volcanic glass, with a decided conchoidal fracture, commonly black in color. Fairly common as a material for projectile points. Possibly derived from pebbles in the Ojo Alamo sandstone, but more probably obtained from the Jemez—Cerro Pedernal area where a stream known as Obsidian creek contains numerous nodules or pebbles of this material.

Ochre, red (Fe_2O_3)—The earthy or rouge form of hematite. Used as a pigment. Found sporadically over the Chaco area in sandstones and shales.

Ochre, yellow ($2Fe_2O_3$. $3H_2O$)—The earthy form of limonite. Used as a pigment. Found scattered over the Chaco area, especially near Pueblo Alto. At present yellow ochre is worked commercially near Farmington.

Onyx (SiO_2)—A horizontally banded form of agate or variegated chalcedony. Found as beads at Chetro Ketl. Probably derived from the Kirtland shale, Ojo Alamo sandstone, and Puerco and Torrejon formations.

Petrified or silicified wood—Woody material replaced normally by silica to constitute psuedomorphs after wood containing agate, amethyst, chalcedony, jasper, opal, onyx, and quartz. Commonly used for arrowheads and instruments of percussion. Fragments and logs of petrified wood are frequently found in the Kirtland shale and Ojo Alamo sandstone.

Picrolite ($H_4Mg_3Si_2O_9$)—A variety of serpentine with long coarse fibers, not easily separated nor flexible. Reported from Chetro Ketl in beads. Possibly obtained from the Garnet Ridge area, Arizona-Utah, or from Rio Arriba or Catron counties.

Pumice—A cellular form of volcanic glass. Reported from Pueblo Bonito. Probably derived from the area immediately southwest of Mount Taylor, where pumice deposits have been worked commercially in recent times.

Quartz (SiO_2)—The dioxide of silicon, possessing a large number of distinct varieties. In addition to sandstone, quartzite, petrified wood, onyx, jasper, flint, chert, chalcedony, and agate—discussed separately—rock crystal, and milky or vein quartz, have been found in Chaco ruins. Probably derived from the Ojo Alamo sandstone and from the Puerco and Torrejon formations.

Quartzite—Metamorphosed silicaceous sandstone. Used for percussion instruments. Probably obtained from pebbles in the Ojo Alamo conglomeratic sandstone.

Reddle—A clay and red ochre mixture resembling argillite, but softer. Found as beads at Tseh So. Probably obtained from local shales.

Rhyolite—A dense, fine-grained, light-colored volcanic rock, constituting a variety of felsite. Used for hoes at Tseh So. Probably derived from the Ojo Alamo sandstone, or brought in from the east.

Sandstone—A rock composed of grains of sand, usually of quartz. The dominant rock in the Chaco area where the cementing material is usually calcite and iron oxides. Sandstone was by far the most important non-organic material utilized by the prehistoric inhabitants of the Chaco. It was the chief component of the masonry houses; most of the metates, manos, and mortars were of sandstone; also, trays, palettes, disks, sandal lasts, and many other artifacts were made of sandstone. Pictographs were painted on sandstone walls, and petroglyphs were carved over thousands of square feet of canyon wall and sandstone boulder. Bedrock as well as fragments were used as rasps, grindstones, and knife sharpeners.

Selenite ($CaSO_4 \cdot 2H_2O$)—A transparent cleavable crystalline variety of gypsum. Unworked fragments of various sizes have been found in Chaco ruins; also worked as ornaments. It may possibly have been used in windows, as later Pueblo peoples have utilized the larger crystals. Selenite is found sporadically throughout the canyon, and there is a stratum in the cliff just back of Tseh So. Should selenite have been used as a window material, possibly sufficiently large crystals were brought in from the area south of the Mesa Lucero and west of the Rio Puerco of the East.

Serpentine ($H_4Mg_3Si_2O_9$)—A non-crystalline massive mineral of various shades of green. Reported at Chetro Ketl in beads. Possibly from northern Arizona, or from Rio Arriba or Catron counties.

Shale—A soft sedimentary rock, with normally a thinly laminated structure, formed by the consolidation of beds of mud, clay, or silt. In the Chaco area the shales are only less important than the sandstones. Gray, green, brown, and black shales are most common, the black to gray carbonaceous shales being preponderant. Shale was used as floor material, for beads and other ornaments, olla lids or covers, tablets and palettes, etc. Archaeologic reports normally do not differentiate among the shales, but some reports list specifically: argillaceous shale, green-shale, carbonaceous shale, ferruginous shale, and siltstone. Siltstone is merely a quite soft shale lacking in quartz particles.

Steatite or soapstone ($H_2Mg_3Si_4O_{12}$)—A compact gray to green form of talc. Reported from Pueblo Bonito as a coarse green steatite. This may be a talc-schist. Possibly obtained from the Garnet Ridge area or from Rio Arriba county.

Sulphur (S)—A yellow non-metallic element. Reported from Pueblo Bonito as native sulphur. Distributed in small quantities throughout much of the Chaco area, especially in the shales and coal seams.

Talc ($H_2Mg_3Si_4O_{12}$)—The foliated form, as distinguished from the massive steatite, is often referred to as talc. Reported from Shabik'eshchee. Provenience the same as for steatite.

Trachyte—A variety of felsite superficially closely resembling rhyolite. Reported from Pueblo Bonito. Accompanies turquoise from the Cerrillos district.

Turquoise—A basic copper aluminum phosphate. This semi-precious stone was and is the most prized ornament material among the Indians of New Mexico. It was the material most commonly used for beads, pendants, inlays, etc., in the Chaco ruins, as at Pueblo Bonito where more than 50,000 pieces and items of turquoise were recovered by the Hyde Expedition. Although the districts of La Jara, in southern Colorado, and Los Cerrillos, near Santa Fe, were about equally distant from the Chaco Canyon, it is commonly assumed that most of the Chaco turquoise came from Los Cerrillos.

In addition to the various rocks and minerals reported to date from Chaco excavations, presumably future excavations and more accurate identifications will provide further items—both as to minerals and rocks, and as to uses. There are, moreover, a few minerals that can confidently be expected from further work in Chaco ruins. Among these are barite or heavy spar ($BaSO_4$), used as a pigment, which is found in the strata of the Kirtland shale; siderite or brown spar ($FeCO_3$), used as a pigment, and also found in the Kirtland shale; and various metamorphic and igneous rocks (such as andesite, schist, gabbro, slate, and olivine), which could have been picked up in the river

terraces and conglomerates of the region to the north of the Chaco. Salt, to date, has not been recovered from Chaco excavations. Considering its solubility, this is to be expected. Undoubtedly the prehistoric inhabitants of the Chaco obtained salt from certain plants, and also acquired it by trade or by special expeditions to such localities as the Zuñi Salt Lake, and the Salinas near Willard. The present Navajo inhabitants of the Chaco are reported to get an impure salt from a deposit (not known to the writer) somewhere in the Escavada Wash area. Salt also could have been obtained from saline springs which occur in the Chaco area.

Shells:

Although produced by organisms, shells of molluscs are mineral in composition, and are therefore discussed in this section. Shells of fossil molluscs and brachiopods (such as *Inoceramus*, and spirifers) found locally, fresh water clams (origin uncertain) and seashells (from both Pacific and Atlantic waters) have been found in Chaco ruins. In terms of absolute numbers, and the number of ruins in which they have been found, the leading shells are *Olivella, Glycymeris, Strombus*, and *Murex*. *Haliotis* (abalone) shells have been found only at Pueblo Bonito, to date. The last named five genera, together with other genera (such as *Conus, Turritella, Cerithidea*, and *Trivia)* found in ruins of the San Juan drainage outside of the Chaco Canyon, must have been obtained by trade as their nearest sources would be the Gulf of California, the Pacific Coast of the Californias, and the Gulf of Mexico—all hundreds of miles distant. The bulk of shells known in the Chaco came from Pacific waters. Shells were used principally for beads and other ornaments, but also for trumpets *(Strombus* and *Murex)*, and as receptacles *(Haliotis)*.

Animal:

Fairly numerous remains of bone, horn, hide, hair and feather, allow the identification of some 20 genera of mammals, and eight genera of birds that were definitely contemporary with the ancient inhabitants of the Chaco. Fish bones (species not stated, and source not known) and the remains of "turtles" (species not given) have been reported from Pueblo Bonito; and fossil shark teeth have been found in several sites. No reptilian or batrachian remains have ever been reported from Chaco excavations. Judging from the evidence of location and condition of various bones, it may be concluded that various species of rabbit, the prairie dog, the American antelope, and the mule deer, along with the turkey, were the favorite animals for food. Implements and ornaments were most commonly made from the bones of deer, turkey, and rabbit. Feathers, fur, hair, and skins were all used in making articles of clothing, and for ceremonial objects. The best

preserved and most complete skeletons recovered have been those of the turkey, dog, and macaw. This would lead to the assumption that these animals were either domesticated or kept in captivity, and that they were not commonly used, if at all, as items of food. The evidence of bone condition would, however, allow the conclusion that the turkey was eaten at times. Since the identification of bird remains is more difficult than that of mammals, the following list of mammls is probably much closer to the actual number utilized in the Chaco than is the bird list.

American antelope *(Antilocapra americana americana)*—Various bones.

Badger *(Taxidea taxus)*—A few limb bones found at Tseh So.

Bear (species not given)—Claws, skin, jaw and other bones found at Pueblo Bonito and Chetro Ketl.

Beaver *(Castor* sp.*)*—Jaw found at Pueblo Bonito.

Bison *(Bison bison)*—A few bones reported from Chetro Ketl. This is far west of the former range, which extended only as far west as the eastern slopes of the Sangre de Cristo Mountains in northern New Mexico.

Coyote *(Canis latrans)*—Various bones. Possibly of dog, in some cases.

Deer *(Odocoileus hemionus)*—Numerous bones, skins, and antlers of the mule deer.

Dog *(Canis familiaris)*—Numerous bones, and several whole skeletons.

Elk *(Cervus canadensis)*—A fair number of bones from three sites.

Fox *(Urocyon cinereoargenteus scottii)*—Bones of the gray fox from two sites.

Gopher *(Thomomys perpallidus aureus)*—A few bones of the golden pocket gopher. Possibly intrusive.

Lynx *(Lynx rufus baileyi)*—Bones from Tseh So.

Mountain lion *(Felis concolor)*—Claws reported from Pueblo Bonito.

Mountain sheep *(Ovis canadensis)*—Horns, jaw, teeth, etc., from two sites.

Mouse (various species)—Possibly intrusive in some cases. Tawny deer mouse *(Peromyscus maniculatus rufinus)* definitely identified.

Porcupine *(Erethizon* sp.*)*—A porcupine jaw reported from Pueblo Bonito.

Prairie dog *(Cynomys gunnisoni zuniensis)*—Bones quite common. Some possibly intrusive.

Rabbit—Numerous bones, and pieces of skin, representing the Texas jack rabbit *(Lepus californicus texianus)*, Colorado cottontail

(Sylvilagus auduboni warreni), and Rocky Mountain cottontail *(S. nuttalli pinetus.)*

Rat (several species)—Bones from the wood rat *(Neotoma mexicana fallax)* have been definitely identified from two sites.

Squirrel *(Citellus* sp.*)*—Bones of at least one species of ground squirrel.

Birds:

Eagle *(Aquila chrysaetos)*—Bones and feathers of the golden eagle. Less common only than remains of the turkey.

Flicker *(Coleptes caffer collaris)*—Feathers of the red-shafted flicker.

Hawk *(Buteo* sp.*)*—Bones and feathers from two sites.

Macaw *(Ara militaris)*—Complete skeletons of more than a dozen green macaws were found in Room 38 of Pueblo Bonito. These macaws were evidently kept in captivity. Various macaw bones and feathers were found elsewhere in Pueblo Bonito. Probably traded up from the mountains of southern New Mexico, where they are still found occasionally.

Magpie *(Pica pica hudsonia)*—Bones from Leyit Kin.

Piñon birds *(Cyanocephalus cyanocephalus)*—Bones reported from Pueblo Bonito.

Quail *(Callipepla squamata pallida)*—Bones of the scaled quail reported from Leyit Kin.

Turkey *(Meleagris gallopavo)*—Bones, complete skeletons, egg shells, and feathers commonly found in Chaco sites. Possibly domesticated, certainly kept in captivity, and hunted in the wild state.

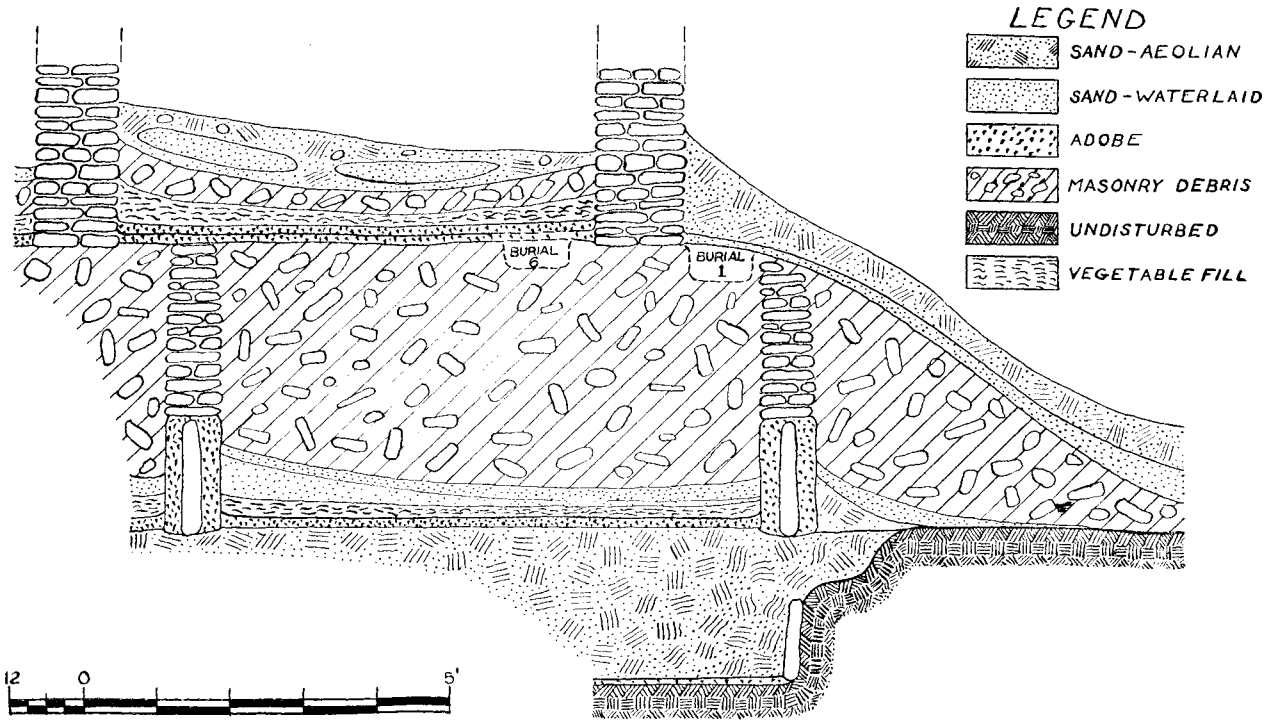


FIG. 1. EAST-WEST SECTION AT ROOM 11, MOUND 50

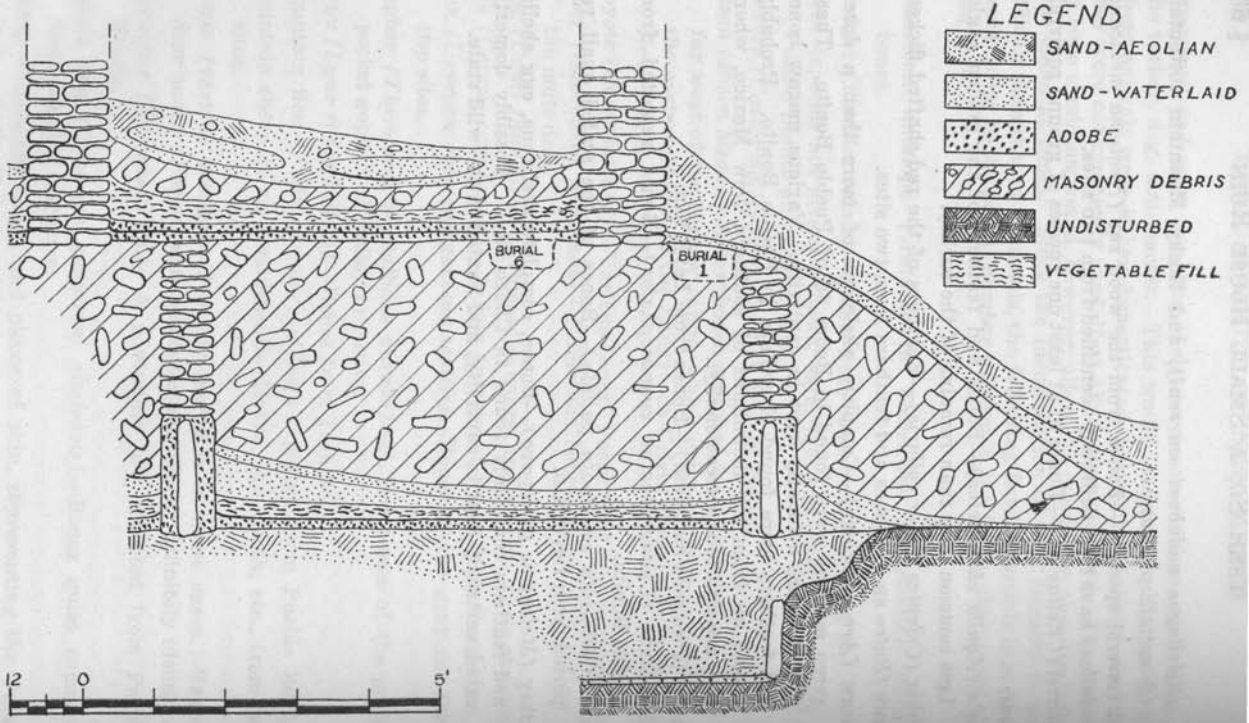


FIG. 1. EAST-WEST SECTION AT ROOM 11, MOUND 50

PART II

THE SITE AND THE EXCAVATIONS

By FRANK C. HIBBEN

The ruin mound is but one of many which lie in a cove immediately to the east of the Research Station of the University of New Mexico and the School of American Research. It was chosen not only because of its accessibility but also because superficial shard evidence seemed to indicate a typical structure belonging to that class which has been designated as the Chaco small house. This site, because of the richness of the shard evidence, seemed to indicate special possibilities, both for archaeological research, insomuch as but little is known of this type of structure, and also for the instruction of students. This particular ruin had been designated as the fiftieth in the series of ruins, large and small, which had been enumerated in the charting of the Chaco Canyon during a survey carried out by Dr. Reginald Fisher. In accordance with the cataloging system of the Museum of Anthropology of the University of New Mexico, this ruin is designated as Bc50, B being the initial to indicate the archaeological area of the State of New Mexico, c designating the specific area of Chaco Canyon, and 50 the ruin itself. Following the custom of other excavations in the Chaco, this one was given the additional name of Tseh So, meaning "windows" or "openings,"[1] a name which was applied to it by some of the Navajo laborers, possibly because of the large number of apertures which appeared in the walls after the digging had progressed.

The mound, before excavation, presented no features of especial interest (Plate Ia). It was a roughly oval pile with the long axis lying north and south. Its apex, approximately over the center, was some seven feet above the level of the surrounding wash. This level is only approximate insomuch as the wash from the cliff talus to the south has filled in the adjacent end of the mound to raise the level several feet above the land immediately to the north of the ruin. This mound is adjoined by another one of similar size and similar shape, some fifty feet to the east, which has been given the number of Bc51. In between these two house mounds was a pile of refuse which seemed to offer exceptional possibilities because of the appearance of human bones at several places on its surface. During the summer's excavation of 1936, Bc50 was 80 to 90 per cent excavated, stratigraphic test trenches were carried into the refuse mound just mentioned, and one room in Bc51

1. *Tseh* signifies rock, *So* means star—in this case crystal. Tseh So, rock crystal, is used by analogy for window or opening. Possibly refers to the presence of selenite back of the ruin. A better spelling might be *Tséson'*.

was completely examined. Insomuch as Bc51 seems to offer possibilities for further research, this report will confine itself to Bc50, or Tseh So, and the refuse mound which lies between the two ruins.

EXCAVATION METHODS

The entire month of August, 1936, was consumed by this excavation. The students of the 1936 Chaco Field Session were employed as junior archaeologists, overseers in charge of minor projects and general assistants under the supervision of the staff of the Field Session. The laborers used were some ten to sixteen Navajos, the number being inversely proportionate to the proximity and duration of "squaw dances," "sings," and horse races.

The students, assisted by the laborers, first traced out all of the walls possible on the surface of the mound (Plate IIa). A room was assigned to each two students as a special responsibility. Room numbers were assigned to kiva enclosures also, as these had been used for living purposes in every case. The walls of the rooms on the west tier were distinguishable on the surface before excavation. Many of the other walls, and those especially of the kivas, were from one to three feet below the surface. In the southeast corner of each room, a column one meter square was left as a permanent record of the stratigraphy within that room. The rest of the room fill was excavated in foot levels, the artifacts from each level being sacked and examined separately later in the field museum. All artifacts were numbered with the Museum of Anthropology numbers immediately upon their acquisition. Burials, when encountered, were taken out by members of the staff (Plate IIb). The somatological material first was photographed with the permanent museum numbers noted, and then was prepared and sacked in the field. All wood and perishable objects were preserved in the field with appropriate materials and removed to the field museum. The kivas presented a special problem but were treated in general as were the rooms, a "strat" column being left from the original surface down to the first floor.

After excavation had proceeded in the superstructure down to the first floor, these "strat" columns were scraped clean, photographed, described and graphed. A regular photographic crew was constantly prepared to photograph any new objects or subjects of interest which came to light. Throughout the excavations and the subsequent examination of the stratigraphy columns, the shard evidence was carefully noted and percentages computed.

In addition to the above, a trench was carried completely around the ruin to serve as a stratigraphy test on the fill surrounding the exterior. Additional trenches were cut in at right angles to the en-

circling trench at the four points of the compass and carried out twenty-five feet from the walls.

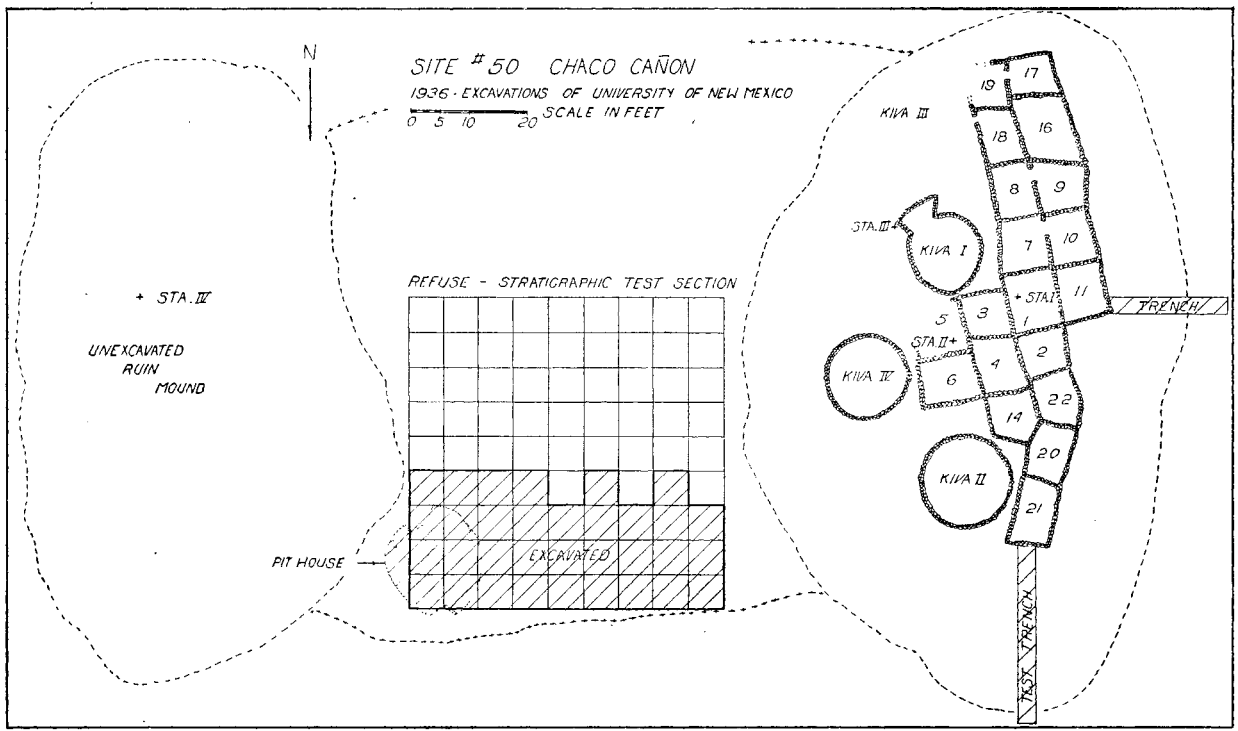
All excavated earth was examined twice for content—from trowel to shovel, and from shovel to wheel barrow, according to each level as mentioned before. This dirt was then deposited in the low flat to the north of the mound, well out of the way and below the drainage level of the excavation. Drainage from the denudational slope above the mound was accomplished by a V-shaped cut to carry the run-off water to both sides of the mound.

The stratigraphy test in the refuse mound was carried on at the same time as the main excavations. Also, a surveying crew kept in constant touch with the developments of the excavation as they progressed.

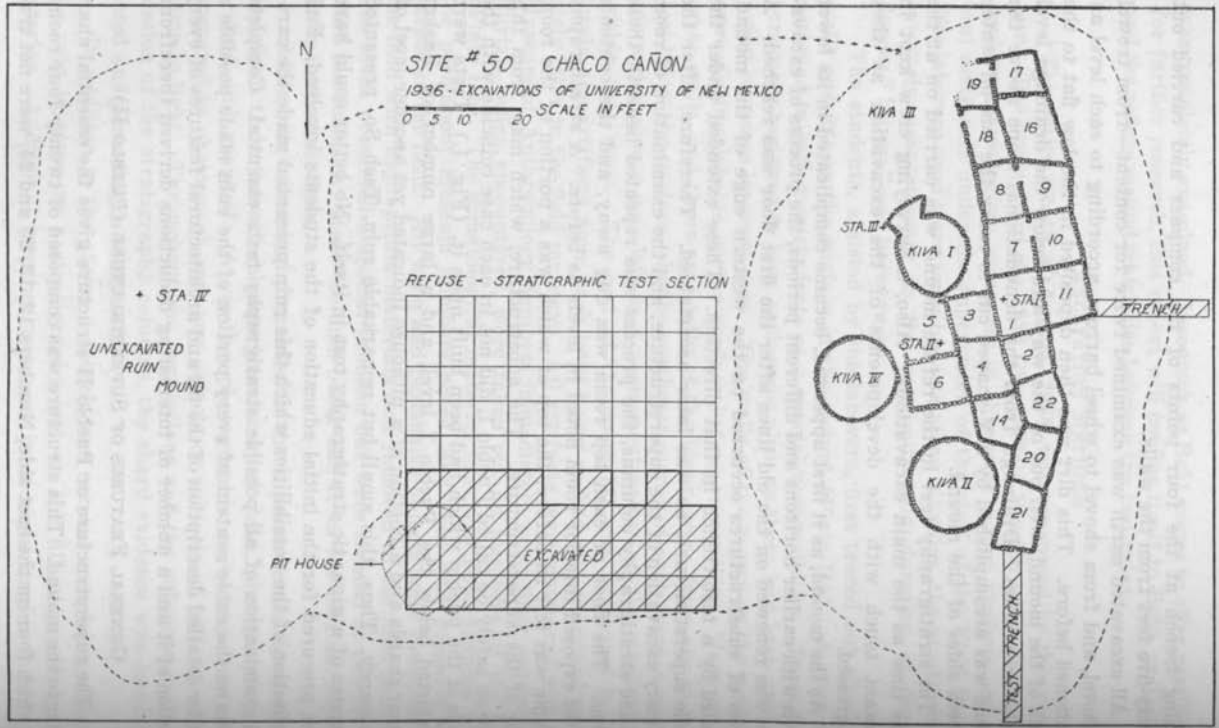
As the mound, as it first appeared, became complicated in its lower levels with earlier horizons and different periods, the process of excavation was renewed on the old lines after the first floor was reached. A series of substructures occurred on the western edge of the mound, located by a test trench in that direction. These extended under the whole superstructure, as was later ascertained. Therefore, after the primary excavation of the superstructure, and the examination of room fill and stratigraphy columns, the process was repeated beneath these rooms. The floor of each top room was dug away, and the contents of the exposed interior room noted in levels as before. A stratigraphy column was left as before, the top of which was a portion of the room floor of the superstructure. The substructure, which may from this time on safely be called Pueblo I, did not in each case coincide with the walls of the pueblo which had been built upon it. (Fig. 1.) Tests were completed below the Pueblo I level, and a large number of Basket Maker shards and a portion of a pithouse indicated yet another level of occupancy. Thus, this small but remarkable ruin, Tseh So, presented features of a gigantic stratigraphy test in itself. No better could have been procured for the initial education of the students involved. Full realization of the possibilities which this ruin presented made the careful examination of all possible stratigraphy tests essential. Complete notes on the cubic content of every portion of the ruin made possible a rather detailed description of the fill and architectural features of every portion of it and a number of interesting deductions derived therefrom.

GENERAL FEATURES OF SUPERSTRUCTURE (PUEBLO II)

The superstructure or Pueblo II structure gives the essential character to the mound. This structure was composed of twenty-four rooms of which four on the east side, Numbers 12, 13, 23 and 24, were not true



Map IV. Plat of Excavations
(As of August 20, 1936)



MAP IV. PLAT OF EXCAVATIONS
(As of August 20, 1936)

rooms but kiva enclosures. The twenty rooms remaining were arranged in a double row north and south with five additional rooms placed on the east side to form a structure roughly T shaped in plan. The kivas, four in number, were placed on the east side of the structure.[2]

Masonry. The room walls of the Pueblo II pueblo were of poorly constructed stone masonry of single thickness, having no rubble or stone core. The essential peculiarities of this type of masonry are: the use of rather large building blocks, all of sandstone, roughly squared, most of them naturally so, a few of them pecked and shaped, and non-banded. These comparatively large blocks (average dimensions 14" x 6" x 8") were interspersed with much adobe plaster studded with many small spalls of sandstone chips, water-washed pebbles, and pot-sherds. This type of masonry, although varying slightly from room to room, is the type throughout the Pueblo II structure (Plates VI, VIIa, b). It was quite evident that Rooms 8, 18, and 19, were added on to the rest of the pueblo after the building of the original structure. The character of the walls and *viga* supports, and the amount of debris give evidence of a second story over Rooms 1, 2, 3, 4, 22, and possibly 14. Of the nature of this, little may be said except that apparently the masonry was of the same general type as that below. The single wall thickness does not hold up well and any slight sinking of the ground, such as that which occurred in several places because of a settling of the Pueblo I structure underneath, causes bad distorting and buckling of these thin Pueblo II walls. In several places, in order to get down to the Pueblo I and Basket Maker levels with safety to the students and workmen, it was necessary to remove portions of the badly sagging and unsafe walls.

Openings. These walls were pierced in many places by numerous "windows" or doorways, some open and some sealed, the sealing being done with the same types of masonry and the same shard spalling as accompanied the walls of the rooms. Most of these doorways were provided with a well-worn sill and lintel, and, in one case, wooden uprights on the sides. The lintels also were of wooden pieces. These doorways are rather small according to modern standards, as is usual in such pueblos. Measurements averaged eighteen by thirty-six inches for those openings complete enough to measure.

Plaster. The plaster yet adhered to the interior of many of these walls. It was of sandy adobe smeared on with the hand and varying in thickness from an eighth of an inch to an inch. The plaster on the south side of Room 1 was especially well-preserved and showed four distinct smoke-blackened layers, each exhibiting many finger and hand impressions. As far as could be ascertained from the fragments of plaster

2. See Map IV.

preserved, there was no decoration or coloring on these interiors. The plaster of certain of the kivas was quite otherwise, as will be mentioned in the description of those structures.

Floors. The floors were of hard-packed but unburned adobe throughout, varied in some instances, such as Room 14, with slabs or scales of carbonaceous shale, gathered presumably from the outcroppings in the cliff immediately behind the ruin. The sandy character of the adobe floors in some cases rendered them difficult of perception and of distinction from the hard-packed sandy aeolian fill and adobe washed from the walls, which in each case constituted the layer immediately upon the floor. Several floor layers were detected in some of the rooms, as in Rooms 8, 9 and 10, where two successive floor levels were found, one laid directly upon the other at an interval of about three inches. The floors in the kivas presented a different problem.

Roofs. The roofs of the Pueblo II structure were of the usual pueblo type, supported on *vigas* averaging about eight inches through. Fragments of some of these were found in place. In Room 4, a large section of the roof was found intact, fallen, after the breaking of the central *viga* running in an east-west direction, upon a quantity of debris which had collected in the room before the collapse (Plate V).

Cross members of piñon and juniper, averaging three inches in diameter, had been laid at right angles to the *viga*, i. e., north and south in this case, and at intervals of a foot. At right angles to these last and covering the entire surface, were split slabs or slivers of juniper. On top of these, and again at right angles, that is, parallel with the piñon cross members, was a matting of, in this case, horsetail reed *(Equisetum)* bound together so as to form a compact whole by twisted strands of yucca fibre every six inches along their length. On this last was placed, evidently, a final covering of rubble, leaves, brush and adobe.

It must be mentioned in this connection that from the prints of the roof covering from other rooms, the construction was essentially the same but the horsetail reed was varied with sacaton grass bound together in the same way. Also, the primary covering of juniper slabs did not seem to be constant, although it also occurred in Room 1. Prints of the roof preserved in the adobe lumps from Rooms 9 and 16 show that fragments of matting, and occasionally fragments of basketry, and even of fabric, were used either to patch holes in the roof or to supplement the reed cover.

Cists and Bins. A limited number of cists and bins were encountered in several of the rooms in the south end of the pueblo. Room 19 contained three such bins set immediately on the floor and outlined by sandstone slabs (Plate IIIa). These measured a foot in each diameter and about six inches deep, with the side toward the center of the room

made at an intentional angle. The cracks between the stones were filled with an abundance of adobe plaster. No evidence of fire was present.

Room 17, adjoining, contained a cist in its southeastern corner, as did also Room 16 in its southeastern corner. These cists were in each case two feet in diameter and two and a half feet deep. They were supplied with an adobe coating which differentiated them from the adobe floor surrounding and were lined with adobe plaster to about one half their depth. Their use is problematical insomuch as they were not furnished with any grass or matting lining which might indicate storage cists. The cists in the kivas were of a different nature.

Fireplaces. Fireplaces were found in several of the rooms, being located only in those which were on the outer edges of the pueblo where the structure was very obviously of a single story. Rooms 9, 14, and 16 were furnished with firepits, these being of two distinct types. That which occurred in Room 14 represents perhaps the most usual type. This is a rectangular depression, ten by twelve inches, let into the floor to a depth of four inches and outlined with four slabs on edge. Two broken manos, projecting in from opposing corners of the rectangle, served evidently as pot rests. The fire pits in Rooms 9 and 16 were centrally located and made of adobe directly in the adobe floor. These were circular, some fifteen inches in diameter and eight inches deep. A low coping of adobe separated them from the adobe floor as in the case of the adobe cists mentioned above.

Special Structures. Under the head of special structural features in the Pueblo II unit may be grouped certain innovations such as the use of polishing and sharpening stones built directly into the wall, frequent use of trough metates built in the wall, and two examples of protruding stones beneath doorways used as convenient steps for entrance and exit. On the north wall of Room 1 was a large sandstone piece which had evidently been used for sharpening of bone implements and possibly for those of stone also. The lintel of a doorway between Rooms 8 and 9 had evidently been used as a sharpening medium for stone implements with broad-bladed or broad-bitted cutting edges. Steps or projecting stones were noted on the west side of Room 7 and on the east side of Room 10 to accommodate the doorway between these two rooms. Metates were used liberally as building material, and in at least two instances may have served as wall receptacles.

SUPERSTRUCTURE PUEBLO II

The Kivas

The kivas of Tseh So were four in number. Two of these were kivas "with a southern extension," or, as they are popularly called in the Chaco, "Keyhole Kivas." These four kivas were placed, as was noted

before, on the east side of the pueblo, three in a line along the main tier of rooms and the fourth at the end of the room extension formed by Rooms 3, 4, 5, and 6. Two of these kivas, those toward the north end, were plain pit kivas with straight sides and a rectangular bench; and the kiva farthest to the south (Kiva 3) exhibited San Juan type pilasters. The masonry in all four kivas was essentially the same as the masonry for the rest of the pueblo, although as a whole, the walls were better formed and better laid. The building blocks of sandstone which formed the pilasters, benches, and parapets were, as a rule, well-shaped and carefully laid to form a comparatively smooth wall with but few of the sandstone spalls noted before. Pottery spalls were liberally used to stud the plaster between the stone courses. All four of the kivas were fitted with fire pits, fire screens, and ventilators, in the regulation manner. Each of the four was oriented towards the south, i. e., the ventilator shaft was oriented to the south. One of the most interesting features is the series of turkey skeletons which were found back of the fire screens in all of the kivas. In each case the deposit consisted of an entire turkey skeleton spread out in the space immediately in front of the ventilator shaft. In Kiva 4 there were two skeletons. These are all of young female turkeys, and in all five skeletons the head is missing. The meaning of these offerings is purely conjectural.

Kiva 1 (See Plate VIII and Fig. 2a)

Kiva 1 is located to the east of Rooms 7 and 8, and to the south of Rooms 3 and 5. The enclosure surrounding this kiva is designated as Room 12. The kiva proper is nine and one-half feet in diameter and the same distance in depth, with a bench running around its circumference six feet from the floor level and seventeen inches wide. Kiva 1 was provided with a southern extension in the form of a platform two feet by four feet ten inches in dimensions, and at a depth of four feet from the surface. Underneath this platform runs the ventilator shaft, fourteen by eighteen inches in dimensions from its entrance or opening in the kiva, below the edge of the platform, to its exit at the surface through a chimney of masonry a foot square immediately to the south of the platform extension. This ventilator shaft was covered over in its horizontal extension under the platform with overturned metates supported on wooden cross members which are still in place. At its end on the kiva floor it was also provided with wooden uprights plastered in with adobe on each side of the opening to form a rounded frame. This rounded framework on the floor of the kiva opens out onto a small semi-circular platform, a foot by two feet in width, and some three inches high, placed upon the kiva floor as a sort of threshold for the ventilator entrance. This small platform just mentioned, and the opening to the ventilator shaft, were separated from the rest of the

kiva by a low wall of masonry eighteen inches high, which ran in a semi-circular direction from the wall on the one side of the ventilator shaft to the wall on the other. This last named partition wall served as a fire screen for the fire pit directly behind it to the north. However, it is most unusual to find the fire screen or partition wall joining the walls of the kiva both to the east and to the west. The fire pit immediately to the north of this screen wall is still slightly to the south of the center of the kiva. It was well made, sunk into the kiva floor, lined with slabs of sandstone, and was well filled with ash when found. A small hole three inches in diameter, eighteen inches east of this fire pit, may have been the sipapu. No other depression which might have been used for this purpose is in evidence.

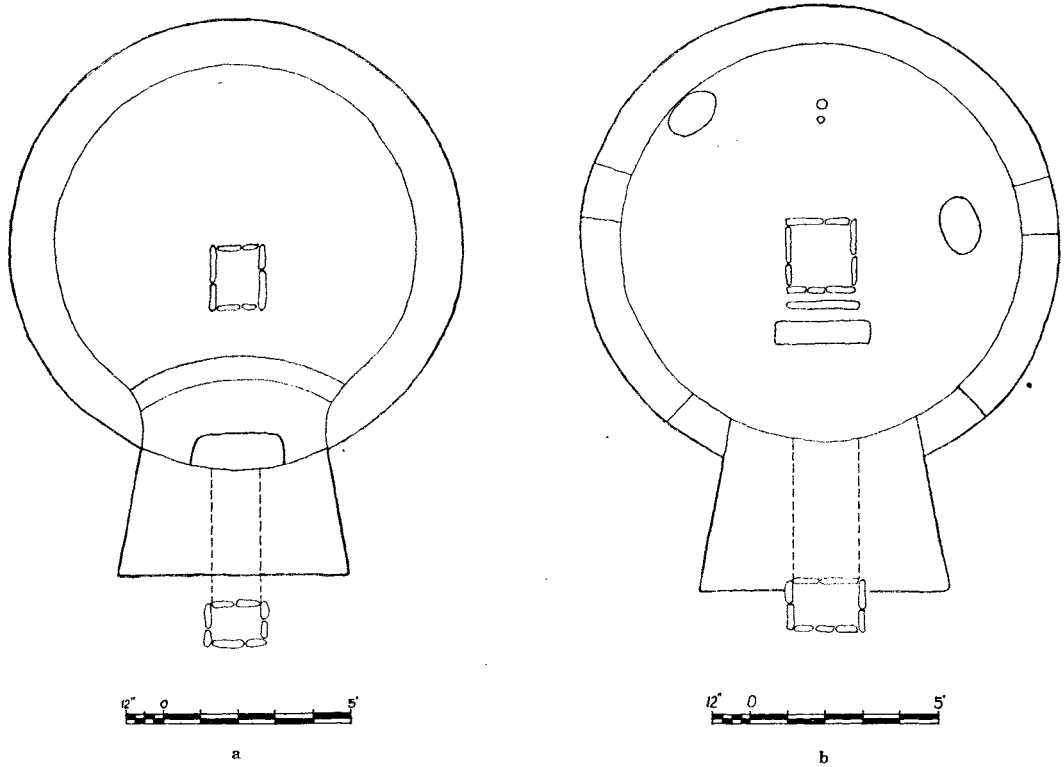
The shard evidence showed the Escavada, Exuberant Corrugated, and Gallup combination predominating, as was true in the rooms. Of several hundred shards pried from the plaster of the walls, Escavada ran as high as 80 per cent, Lino and Red Mesa were next, with Gallup running a poor last.

A most interesting situation was found on the north side of Kiva 1 where a large section of the kiva was cracking and apparently sinking into a soft space beneath, along with the north wall. A small test hole, dug through the side of the kiva in this direction, produced large numbers of Red Mesa shards, as might have been expected. A test hole dug through the floor of the kiva produced Lino gray ware.

Evidently Kiva 1 had been excavated in Pueblo II times down through, or at least to the edge of, the original Pueblo I mound and possibly extended into the Basket Maker levels. The caving observed on the northern side of Kiva 1 may indicate a subsequent settling or decaying out of large volumes of animal and vegetable matter in the Pueblo I structure on that side.

Kiva 2 (See Plate IX)

Kiva 2 is the northernmost of the kivas of Tseh So, besides being the largest in diameter and the deepest. The kiva proper is twelve feet in diameter north and south, thirteen feet in diameter east and west, and is at a depth of ten feet from the surface adjacent to the wall of Room 14. The usual ledge or bench runs around the circumference of the kiva, with the exception of that portion immediately above the screen wall and the ventilator opening. This bench varies from six inches in width on the west wall to twelve inches on the east wall, and is thirty-two inches from the floor. Kiva 2 was not provided with a southern or "keyhole" extension, but the south side rose vertically to the surface with no offset or shelf. The ventilator shaft in this case rose immediately behind and to the south of the south wall of the kiva, coming out in an opening approximately a foot square, of rough



a b

FIG. 2. a—KIVA 1; b—KIVA 3

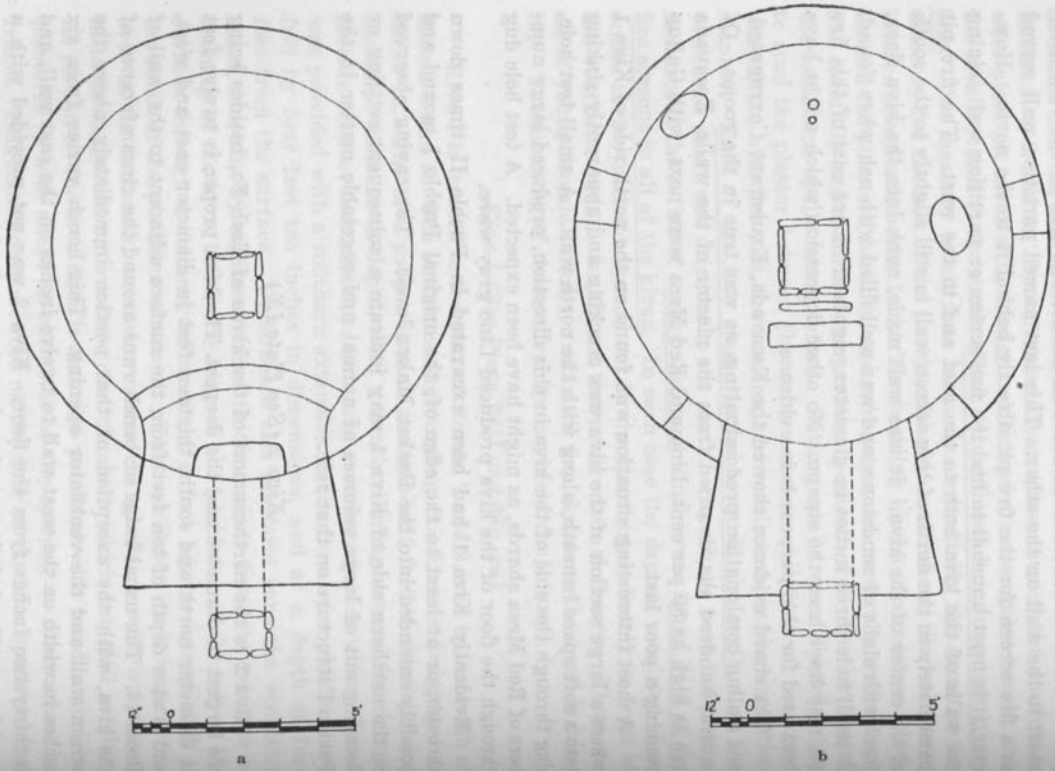


FIG. 2. a—KIVA 1; b—KIVA 3

masonry, between the kiva and the north wall of Room 6. This ventilator shaft was accommodated at its open end in the kiva by a coping of wooden uprights and adobe to form an arcuated opening in the shape of a "broken-sided" arch. The south portion of the kiva, immediately in front of the ventilator opening, was screened off from the rest of the kiva by a low single-thickness wall of masonry, as in Kiva 1. This masonry extends from side to side of the kiva, leaving a space in front of the ventilator shaft seventy-two by thirty-two inches. This was not provided with a low threshold platform, as in Kiva 1. The fire pit lies immediately to the north of this screen wall in essentially the same plan as Kiva 1. The fire pit was lined with stone slabs sunk into the floor, as before. A small hole to the east, six inches in diameter and some twelve inches deep, possibly served as the sipapu.

Kiva 2 is of especial note because of several interesting cists or recesses which occur in its walls. One of these is in the north wall below the edge of the bench, some two feet from the floor. This is a small recess floored with a single slab of sandstone eight inches square, the whole recess being roughly five by five inches across, and six inches deep. The largest of such receptacles occurs upon the east side of the kiva, also in the side of the bench. This is a large receptacle of roughly circular outline, some two feet in all dimensions, floored with a piece of shale. When discovered, this recess was closed and sealed by a carefully shaped slab of sandstone, rectangular with rounded corners, which had been placed across the opening and plastered in place with adobe. The recess, however, was empty when discovered. Two other recesses or wall cists, occur on the south side of the kiva immediately to the west of the ventilator opening just on top of the bench. These openings, each about eight inches in depth, were neither lined nor closed but merely open alcoves, possibly for the accommodation of ritualistic paraphernalia.

The plaster of Kiva 2 could be observed in detail insomuch as large quantities yet adhered to the wall. The plaster in most places consisted of fourteen layers of pure adobe, each approximately a sixteenth of an inch thick and superimposed upon the preceding layer. The layers could be distinguished easily because of the smoke-deposited soot on the surface of each layer, which formed a number of varves of alternate dark and light colors. The plaster in this case was not decorated and not colored.

Several *vigas* from this kiva were recovered for dendro-chronological purposes.

Kiva 3 (See Fig. 2b)

Kiva 3 lies the southernmost of all the kivas, and flush with the southernmost room of the pueblo, Room 19. This kiva also presents a southern extension which makes it assume the "keyhole" form men-

tioned in connection with Kiva 1. Kiva 3 has an additional feature in the form of four pilasters, which adjuncts are reputed to be a San Juan feature.[3] The kiva itself is almost exactly round, measuring ten feet ten inches in diameter, north-south and east-west. It was provided with the usual bench or ledge, ten to twelve inches wide and fifty to fifty-four inches from the kiva floor. The floor of the kiva is nine feet below the original surface and is especially featured by being paved with large slabs of carbonaceous shale. The southern extension of the kiva measures six feet five inches east and west, and six feet nine inches north and south. The back or south wall of this extension is varied in this case by a bulge or pilaster of plastered masonry to accommodate the ventilator shaft which rises in that place.

The ventilator shaft itself arises behind the fire deflector, and measures eleven inches by eighteen inches. The usual wooden lintel is in place. This shaft passes horizontally underneath the southern extension of the kiva and rises through the pilaster just mentioned.

The deflector differs from that in Kiva 1 in that it is not joined to the sides of the kiva on each side of the southern extension, but is a free-standing wall of masonry thirty-one inches long and sixteen inches high, and of single stone width.

The fire pit lies directly behind the deflector and is augmented by yet another upright slab on the deflector end which may have served as an auxiliary deflector or fire screen. The fire pit measures twenty-one by twenty inches and is eight inches in depth. It was entirely filled, when found, with fine white ash.

A small hole three inches in diameter, seventeen inches from the east wall, evidently formed the sipapu. Two other holes of about the same size, and about three inches apart, were found to the north of the fire pit midway from the pit to the wall. These may be diagnosed as loom holes.

In addition to these holes, there occurred a shallow cist through the carbonaceous shale floor to the west of the fire pit which contained the entire skeleton of an ordinary dog *(Canis familiaris)*.[4] This had been slightly flexed to accommodate it to the oval contours of the cist which lay only eight inches below the floor. The cist had been carefully covered over with plastered adobe, the outlines of which were in very marked contrast to the surrounding shale.

The most striking feature of Kiva 3 is undoubtedly the very good multiple coat of plaster which yet adheres to the walls below the bench, and especially the series of designs which were incised into this plaster (Plate X). These incisions take the form of at least seven different groups of figures, for the most part on the north and west

3. Prudden: *Circular Kivas of Small Ruins in the San Juan Watershed.*
4. Consult section on mammal and bird remains, pp. 101 and 104.

walls of the kiva. However, others may have been destroyed by the scaling away of the outer coats of plaster on the rest of the wall. The figures were done in a casual, yet systematic manner. Among those which may be tentatively identified are a seeming house design, a maze, a fish, and a possible vegetable or tree design. These figures may be studied in the accompanying illustration (Plate X). In addition to the figures incised into the surface of the plaster, there are traces of paint of two colors, black and white, on the north wall. No shapes seem to be represented in the paint traces discernible at present.

Kiva 4

Kiva 4 is easternmost of the four kivas of Tseh So, and lies adjacent to Rooms 5, 6, and 15. It most greatly resembles Kiva 2 in general structure, in its pit-like appearance, and in the absence of a southern extension and pilasters. Its walls are vertical, well-formed, and of fair masonry of the same type as the rest of the pueblo. A goodly amount of plain unpainted and unincised plaster, of some seven distinct coats, yet adheres to the walls. The usual bench encircles the kiva, twenty-five to thirty inches above the kiva floor, for all its circumference with the exception of that portion immediately in front of and adjacent to the ventilator and the fire screen. The bench is especially wide at the north side of the kiva, and erratically narrows to a point and blends into the wall on the east side. On the west it ends in a well-rounded shoulder, as usual. The kiva floor lies at about nine feet from the original surface.

The ventilator opening is eighteen inches high by twelve inches wide and rectangular. It enters the south wall of the kiva for some three feet, then turns at right angles to the surface as in Kiva 2.

The deflector is similar to that of Kiva 3 in that it does not adjoin the walls of the kiva on either side of the fire pit. This deflector lies thirty inches from the ventilator opening, is twenty-one inches in length and eighteen inches high, and is of single stone thickness. The fire pit lies just to the north of the deflector and in dimensions is eighteen by fourteen by nine inches deep. It is lined with squared sandstone slabs.

No sipapu was definitely located as such, but two receptacles or cists occurred in the walls of the kiva. One of these is a semi-circular opening twenty-four inches wide and fourteen inches high at its apex which was let into the end of the west bench five inches above the floor. This is a plain ungarnished opening, fashioned in the masonry and lined with adobe. Another of these wall cists or openings occurred on the west wall above this last named, although of somewhat smaller dimensions. It presented the same features, and was lined with adobe, as the previous one.

EVIDENCE FROM SHARDS IN THE SUPERSTRUCTURE

From the shard evidence found in the superstructure of Tseh So, this structure is plainly of Pueblo II origin. On a table in back (Table I) the three highest percentages of shards under each of the headings are noted. Those wares which were found in especial abundance at Tseh So are Escavada Black on White, Gallup Black on White, Chaco Black on White, Mesa Verde Black on White, Red Mesa Black on White, La Plata Black on Gray, Kana-a Black on Gray, Kana-a neck-banded, Lino Gray Ware, Wingate Black on Red, Puerco Black on Red, Tusayan Polychrome, Chaco Corrugated, and Exuberant Corrugated. There were also represented by a few, or in some cases by a single shard, several trade wares of interest which will be noted in place. Those mentioned above constitute by far the greater bulk of the shards found on the floor level. In seven out of twenty-four rooms (only twenty rooms provided floor level data) Escavada displays the highest percentage. Exuberant Corrugated leads next in six rooms, and Gallup in five rooms. Of those second in importance in this category, Escavada leads with seven instances out of the twenty-four, Exuberant with six, Red Mesa with four, and Gallup with two. Of those types third in importance on the floor level, Red Mesa occurs in six instances, Exuberant Corrugated in four instances, Gallup also in four instances, Escavada in two. From this it may be seen that the combination which runs highest in percentages on the floor level is predominantly Gallup Black on White, Escavada Black on White, Red Mesa Black on White, and Exuberant Corrugated. There are a few erratic percentages such as McElmo leading with 18 per cent in Room 22, but Escavada runs a close second with 17 per cent. Sixteen per cent of the shards on the floor of Room 4, and 14 per cent in Room 14, are Chaco Black on White. With the exceptions just noted, the Escavada-Exuberant-Gallup-Red Mesa combination reigns supreme. There is no need to mention that this is a Pueblo II combination of perhaps early Pueblo II date because of the large percentages of Red Mesa present.

The shards which were used as spalls in the plaster of the general masonry of the walls were of invaluable service in the dating of the pueblo. Of these, only Rooms 4, 6, 7, 9, 11, and 14, exhibited enough to gain any appreciable percentages. In these, the highest percentages are found to be Escavada in two instances, and Exuberant Corrugated in three instances. The second and third in importance tended to be Red Mesa and Escavada, and in one case, in Room 9, 13 per cent of the shards were found to be Lino Gray Ware. This shard combination is found to be essentially the same as that diagnosed from the floors of the rooms, although with Pueblo I leanings.

Rooms 2, 10, and 11 each contained a sealed doorway in which many shards were used as spalls. In these Exuberant Corrugated, Escavada, Gallup, Red Mesa, and Wingate predominated.

Dating. A *viga* beam (Museum No. Bc50 35/30) yielded the only date available from the entire ruin. This is A. D. 922+, a non-bark date. This specimen is derived from a floor in Room 15 associated with a shard combination of Escavada, Exuberant Corrugated, and Red Mesa. A number of other specimens gave probable dates, but this one is the only one recorded as reliable. Dr. Douglass has examined this and the other specimens as well, and substantiated only this date. The other pieces are so decayed as to leave some doubt.

SUBSTRUCTURE OR PUEBLO I

It was soon discovered after excavation had progressed to some extent, that the main pueblo, which was designated as Pueblo II, had been built on the mound of an earlier structure. In addition to this general information, it was soon ascertained that the Pueblo II structure did not cover entirely the mound beneath, but was built for the most part on top of and to the east of this mound. That area lying to the north and west of Rooms 2, 11, 20 and 22 of the superstructure was found to contain several rooms of a building of a date prior to that of the one which has been described above, and these rooms were unencumbered by any later structure built upon them. It is perhaps to be supposed that the growth of the Pueblo II structure was from the central section and the east side towards the west, and that this growth was never completed so as to cover all of the mound beneath. All of these structures beneath the Pueblo II superstructure, are here designated as substructures and numbered according to rooms. Three such were excavated on the western and northern side of the pueblo mound.

In addition to the substructures which appeared on the northwestern side of the pueblo, it became evident that the entire Pueblo II superstructure had been built upon the remains or mound of an earlier edifice. This, of course, is shown along the western walls of Rooms 2, 20, and 22, where it appears that the walls of the Pueblo II bear no relation to the walls of the substructure beneath and that the substructure was evidently a mound with weathered walls and filled-in rooms before the superstructure was ever built upon it. This filling in of the substructure may or may not have been intentional. The stratigraphical evidence from the fill of these rooms, however, shows a combination of water-laid and aeolian fill mingled with the crumbled debris of the peculiar masonry so as to indicate a quite natural disintegration of this substructure, representing an unconformity of some duration of time.

The walls of the substructure, immediately below the Pueblo II structure, bore no relation to the walls of the superimposed structure, and, furthermore, were of a much different type. It is also worthy of

note that the floor levels of the Pueblo II superstructure were by no means on an even level. It would appear that the superimposed pueblo was built upon an earlier one which was also a rounded mound with the apex somewhere under Rooms 7 and 10. This high point was somewhat to the south of the apex of the latter or final mound. In the light of all this evidence, as well as the abundant shard material, it may be assumed that this substructure is Pueblo I in date.

GENERAL FEATURES OF SUBSTRUCTURE (PUEBLO I)

Walls. The walls of the substructure of Tseh So were of a most interesting variety. Character was given to this masonry by a series of large upright sandstone slabs which formed the core of the wall, especially at the base. Many of these slabs are two and a half feet in each dimension, with a thickness of two to four inches. Several of them show extended use as metates. These larger slabs were set in single thickness, edge to edge, upright, in a manner which is reminiscent of the Basket Maker pit house structures which may be seen on all sides of this ruin. These uprights were embedded in the ground a sufficient number of inches to hold them solidly in place, as well as to support a considerable quantity of crude masonry above. The wall at its base was rendered thicker, usually to a depth of about eight inches, by the addition of thick layers of puddled adobe on both sides of the sandstone slabs. On top of this rather precarious masonry base, the wall was heightened by more puddled adobe, small slabs of sandstone laid horizontally, and numerous spalls stuck into the adobe at random. This wall was a very much weaker structure, in its upper portion, than even the rather shaky masonry of the superimposed Pueblo II. However, it seems to have served very well insomuch as it is still standing in some places to a height of five feet above its original floor level.

Examination beneath the floors of the superimposed structure (Pueblo II) invariably revealed walls of this type running at angles with no relation to the upper walls (Plates Ib, VIIb, c). In most cases, due to the impossibility of completely removing the superstructure, it was difficult to ascertain the exact dimensions of those substructure rooms without endangering the students and the workmen. Enough were followed, however, to gain a fair idea of their extent and general plan. It was also determined that the kivas of Pueblo II had been sunk down through and at the cost of the Pueblo I structure beneath. Several old corners, especially beneath the floor of Room 15, gave ample evidence of this. Needless to say, the walls which are here typical of Pueblo I fall far below any registered wall sequence which has so far been worked out for the Chaco Canyon. Even the masonry of the Pueblo II structure is below the heretofore designated Type I for this

region. Also, these walls are remarkably like the Wingate Phase walls which have been described by Mr. Harold Gladwin.[5]

Floors. The floors of the substructure are hard-packed adobe but appear to be quite an accidental layer. They are in no wise the smooth and evenly finished floors of the Pueblo II structure. In several places in the substructure the floor appears to be composed of several layers of adobe and refuse as though it were an accidental accumulation packed down by hard use. Bones, and other material, embedded in the floor, would indicate a surface of this origin. Also, at the edges of the rooms there was no rounding of the floor into the wall plaster as had been the case in the Pueblo II. Floors of this nature were revealed over the entire area of the Pueblo I substructure.

Roofs. Little evidence of the roof structure of the Pueblo I was secured. However, several lumps of adobe in the fill of the substructure may serve as evidence for this part of the pueblo. These adobe lumps seem to indicate a roof which was more nearly wattlework than any other type of construction. Comparatively large branches or sticks, some of them as much as an inch in diameter, were laid directly at right angles upon larger ones which apparently did service as *vigas.* The adobe was applied directly to these sticks just mentioned, and yet bears the imprints of them to the extent that they may be identified as piñon, cottonwood, and possibly some other species. It may not be determined from the few adobe impressions recovered, whether these branches were actually woven or merely laid across the *vigas.* No split pieces were evidenced in this construction. It is impossible to state how the coping of the roof was finished, nor, indeed, whether the Pueblo I structure had a roof strong enough or enough debris represented to indicate a second story.

Cists, Bins, Fireplaces. A small depression in Room 2 of the substructure may have been used as a fireplace. This is a rudimentary, shallow basin, adobe-lined and in no way separated from the floor, in the northwest corner of this room. A few ashes and the slightly blackened wall at the back of this pit indicate the presence of at least one fire. The fact that no other fireplaces were discovered in the substructure may be due either to: (1) the possibility that they may have been missed as being those portions underlying the heavy walls of Pueblo II and therefore not excavated, or (2) the possibility that they may have been located outside of the pueblo proper.

Only one structure which may be termed a cist or a bin was discovered. This is a polygonal bin outlined on the floor of Pueblo I in that area beneath the floor of Room 4 of the superstructure. This was composed of seven slabs of sandstone set on edge, embedded into

5. Gladwin: *Medallion Papers,* No. 15, fig. 4.

the floor so as to form a seven-sided receptacle. As stated in connection with the fireplaces, other cists or bins may exist in those portions which could not be excavated.

Special Structures. Under this heading may be mentioned a structure of unknown use which occurred in that portion of the Pueblo I pueblo which lies immediately under Room 10 of the superstructure. In this place, within the enclosing walls of the substructure, there occurred an enclosure composed of flat slabs on edge which may or may not have been a cist. The slabs were so arranged as to enclose an area approximately six feet long and a foot and a half wide, the long axis extending in a north and south direction. The northerly end of this peculiar enclosure lies beneath the south wall of Room 11. No indication of its use is evidenced nor does it recur in any other part of the excavation.

SHARD EVIDENCE FROM SUBSTRUCTURE

Throughout the fill of the substructure, and in greater numbers on the floor, the shards display a predominant percentage of Red Mesa. The Red Mesa is varied in some instances by Lino, Escavada, and Kana-a neck-banded—Lino running the highest percentage of these as may be seen from the accompanying table (Table I). Several more or less complete Red Mesa bowls and one Kana-a pot were recovered from the floors of the rooms in the west substructure. This evidence is supplemented by abundant Red Mesa shards in the levels under the room floors of the superstructure over the whole of the pueblo. This evidence, coupled with the typical masonry, and the typical artifacts, make the designation of the substructure as Pueblo I conclusive.

PART III

SUMMARIES AND CONCLUSIONS

Much of summary material pertaining to Tseh So has been given in tables, graphs, and plans. The distribution of shards and artifacts —by rooms and by levels—has been presented in Tables I and III, compiled by Mr. Frank C. Hibben. In lieu of a detailed and verbose discussion of masonry types, Dr. Florence M. Hawley has constructed a chart (pp. 88 and 89) with descriptive material. This presents not only the masonry types at Tseh So, but also the entire known sequence in the Chaco Canyon. (See Plates VI, VII, and Fig. 3)

SUMMARY OF POTTERY FROM TSEH SO

By FLORENCE M. HAWLEY

Basket Maker III pithouses and sections of the dump are represented by Lino Gray and by La Plata Black on White. The pottery complex from the Pueblo I rooms, from the Pueblo I burials, and from the Pueblo I levels of the dump for Tseh So is consistent, Red Mesa and Escavada Black on White, Lino Gray and Kana-Gray, and Exuberant Corrugated (Plates IIIc, XIIb, XVc, d, XVIIc, d) being the prevalent types. In the Pueblo II rooms, burials, and levels of the dump, the complex was made up of small amounts of the preceding types plus larger proportions of Gallup and of Chaco Black on White.

One of the most interesting problems of the archaeology of the area at present is the origin of some pottery types and the influence of outside areas or patterns of culture upon the types of the Chaco. At this point it is difficult to say whether the Little Colorado culture complex stemmed from the Chaco or the Chaco from the Little Colorado, but the two are closely bound up. Lino Gray, prevalent in the Basket Maker III sites, such as Shabik'eshchee village, Judd's Chaco pit houses, and the pit houses excavated by the 1936 University of New Mexico field school, is widely distributed throughout northern Arizona and New Mexico, and into southern Colorado. Lino Gray is found over a larger area than its Chaco associate, La Plata Black on White, for in the west the Lino Gray is associated with the Lino Black on Gray, a type of Basket Maker III Black on White decorated in black carbon paint which contrasts with the iron paint used in the east.

Little, then, may be deduced from the presence of Lino Gray ware in the Chaco, but the presence of La Plata Black on White in the period of Basket Maker III links the canyon with the area running north into the Four Corners district and across the line into Colorado, and south to the Zuñi district. The few shards of dull orange-red on light

orange found in the dump of Tseh So suggest the possibility of first experiments in producing a color scheme apart from the customary black on white. One shard of White Mound Black on White indicates trade with sites on the Arizona Puerco.

In Pueblo I we find the Red Mesa Black on White (Plate XVb), which is known to extend south to the Red Mesa country around Coolidge, New Mexico, Escavada Black on White (Plates XIIb, XIIIa) likewise covers this area, and variants of the two types extend far outside the district and even over into the Rio Grande. The culture of this period was more extended than that of the preceding period. Moreover, considerable trade is evident for this period. Deadman's Black on Red and Kana-a Black on White extend eastward from the Flagstaff district of Arizona; shards of these types are common in Pueblo I Chaco fill but not so prevalent as to suggest home manufacture. Shards of small bowls of the early reddish-brown ware with black burnished interior from the Upper Gila district indicate trade with the south. A few shards of a crude black on red ware with gray paste, and one small bowl of this type, appear to be the experimental attempts of the Chaco people, or of some near neighbors, to imitate the black on red wares brought in from the outside.

In Pueblo II we find the local Escavada and Gallup (Plates XIIb, XVIa, XVIId) and Chaco Black on White ware, whose relatives extend westward into Arizona, southward to take in the Zuñi district and much of the Central district of the Little Colorado, and eastward into the Rio Grande. Relatives likewise extend north to Lowry Ruin, in southwestern Colorado. Trade with the Kayenta district to the west is indicated by Tusayan polychrome (Plates XIIb, XIVb), and with the Little Colorado to the southwest by Wingate Black on Red (Plate XIIb), both fairly common as trade pieces in the Chaco. McElmo Black on White (Plates XIa, b; XIIIa, b; XVa; XVIb; XVIIa-c) was a large item in trade with Mesa Verde settlements outside the canyon, or was made by some colonists living in the canyon. The Mogollon contributed San Francisco Red ware from the south, and the Upper Gila added some of the finely ridged Upper Gila Corrugated with its lustrous black smudged interior. Trade was evidently a thriving business about 950 A. D.

The shards used as spalls in the walls of Tseh So (Table I) come from the Pueblo II upper structure. They are of the Pueblo I complex, as one might expect. The builders gathered up shards which were at hand, probably on the dump, and used them; we could not expect them to break up the jars and bowls in use in their own households when they needed fragments to prevent mortar from pushing out through the crevices in walls they were building. The shards from the Pueblo II doorways, which were eventually filled in with masonry,

tell a different story. These shards are of the Pueblo II complex. The doorways were evidently filled in after the builders had lived in this upper village for some time and their wives had been making the pottery of Pueblo II. They had thrown the fragments of the broken vessels onto the refuse mound, from whence shards were picked up for use by the local masons when neighborhood quarrels or outside danger made closing their doorways advisable.

The associated types representing Basket Maker III, Pueblo I, and Pueblo II complexes at Tseh So were worked out by stratigraphy in the dump, by superposition in the rooms, and by association with dated cross finds of shards. These types and the level of origin of burials were used as the bases for deducing the periods of skeletal remains taken from graves. By study of cross finds and of related types of shards from outside the Chaco, it is possible to reconstruct something of the trade (and of the expansion of the periods represented), a trade extending in every direction except to the east, and one of the widest expansions known for the prehistoric Southwest. Lack of trade shards from the east, but expansion into the east and finds of Chaco trade shards in the east, are likewise noted for Pueblo III, and may possibly be due to the fact that agricultural or other products were traded into the Chaco from the east in exchange for Chaco pottery, the excellence of which would have made it a very desirable item where poorer clay or lack of skill produced less durable or less artistic wares. Such an exchange of the durable Zia pottery for shawls, metates, and foods from Santo Domingo and from San Felipe is found within the Rio Grande today.

SUCCESSION OF CHACO CANYON MASONRY TYPES

By FLORENCE M. HAWLEY

PERIOD	NEW NAME	OTHER NAMES			DESCRIPTION	
		HAWLEY, 1934	JUDD	JACKSON		
	Crude Rubble Without Core	Chetro Ketl Type VI			Thick irregular slabs laid in abundant mortar	10
	Fine Unbanded With Core	Chetro Ketl Type V	Pueblo Bonito Type IV		Rubble core faced with small slabs; unbanded	9
	Spalled Blocks With Core	Chetro Ketl Type IV		Number III	Rubble core faced with blocks chinked with small spalls	8
P III	Inferior Wide Banded With Core	Chetro Ketl Inferior Type III			Rubble core faced with uneven rows of slabs separated by wide bands of spalls	7
	Fine Wide Banded With Core	Chetro Ketl Fine Type III	Pueblo Bonito Type III	Number II	Rubble core faced with evenly spaced rows of slabs separated by wide bands of spalls	6
	Narrow Banded With Core	Chetro Ketl Type II	Pueblo Bonito Type II		Rubble core faced with slabs separated by narrow bands of spalls	5
	Unfaced Slab Small Spalled	Chetro Ketl Type I	Pueblo Bonito Type I	Number I	Thin irregular slabs laid in abundant mortar	4
P II	Blocks Without Core				Small blocks surounded with small spalls or potsherds in abundant mortar	3
P I	Slab Base Rubble				Slab base supporting rubble wall of small stones in abundant mortar	2
B M III	Slab Lined Pit House		Pit Houses		Slab lined pits	1

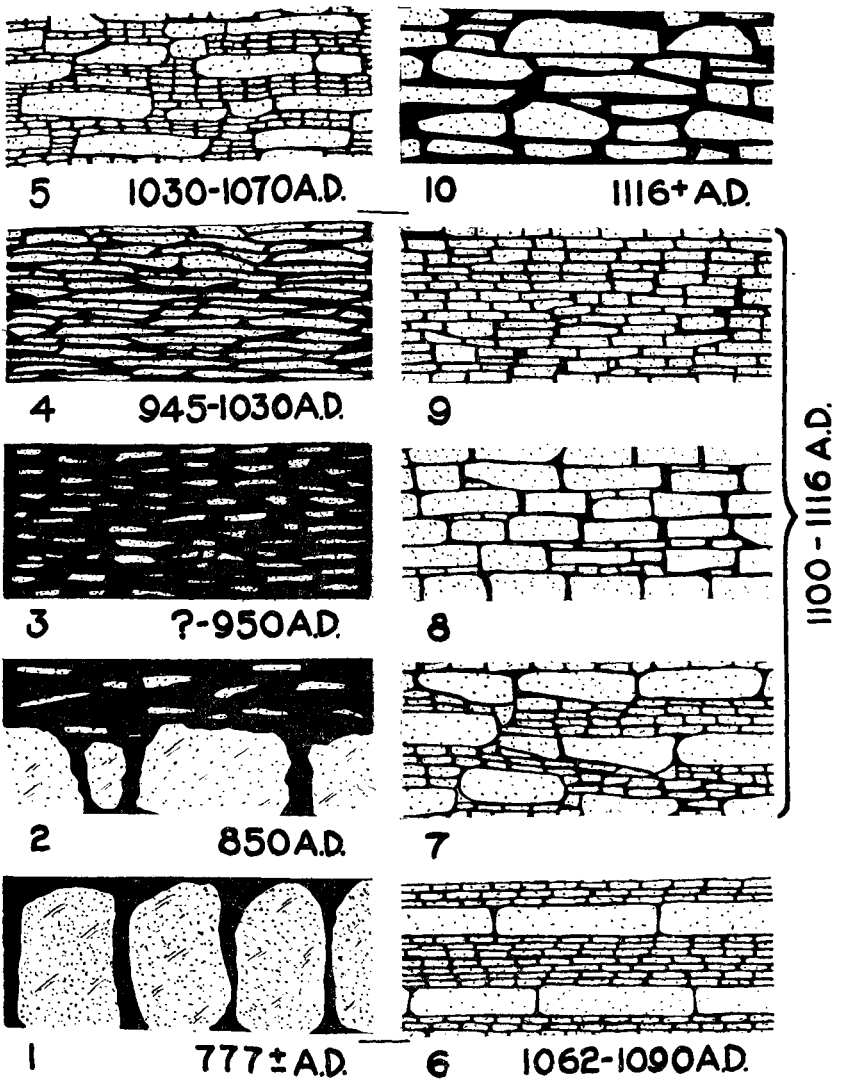

5
1030-1070A.D.
10
1116+ A.D.
4
945-1030A.D.
9
3
?-950A.D.
8
1100 - 1116 A.D.
2
850A.D.
7
1
777± A.D.
6
1062-1090A.D.

FIGURE 3

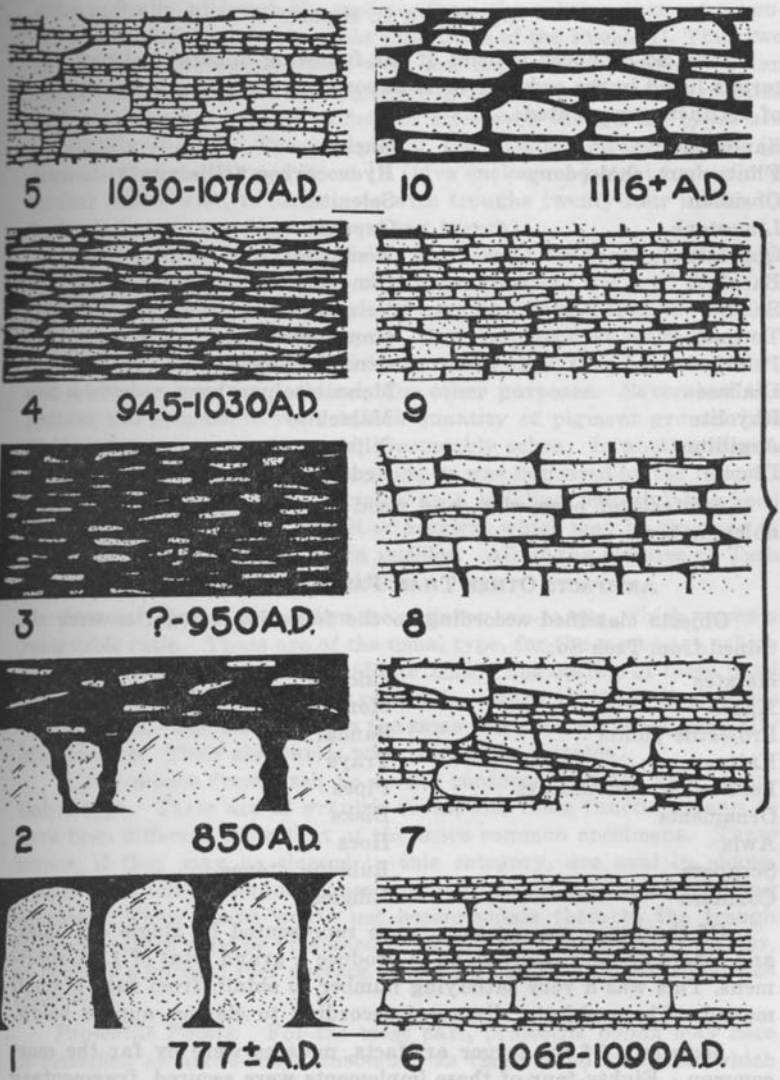

5 1030-1070A.D.
10 1116+A.D.
4 945-1030A.D.
9
3 ?-950A.D.
8
2 850A.D.
7
1 777±A.D.
6 1062-1090A.D.
1100 - 1116 A.D.

FIGURE 3

STONE AND OTHER ARTIFACTS

By FRANK C. HIBBEN

Tseh So produced articles of the following mineral and rock materials listed in the order of their importance according to the number of artifacts represented:

Sandstone	Gneiss
Flint, chert, chalcedony	Hydrocarbon (Gilsonite?)
Obsidian	Selenite
Limestone	Gypsum
Quartzite	Hematite
Basalt	Limonite
Shell	Vein quartz
Turquoise	Iron concretions
Petrified wood	Granitic rocks
Diabase	Monzonite porphyry
Rhyolite	Malachite
Argillite	Siltstone
Diorite	Reddle

Artifacts of bone, clay, and wood were also present in considerable numbers.

ARTIFACTS OTHER THAN FABRICS AND BASKETRY

Objects classified according to the following categories were obtained from Tseh So:

Metates	Palettes
Manos	Mortars
Projectile points	Sandal last
Knives	Trays
Percussion instruments	Pipes
Ornaments	Disks
Awls	Hoes
Scrapers	Rubbing stones
Counters	Effigies

Of the types present some were represented by single examples, and others by very many so as to produce a grand total of 1182 specimens. This was a very satisfying number to obtain from such a small mound. These objects, discussed according to classes, appear below.

Metates. Of the larger artifacts, metates were by far the most common. Eighty-four of these implements were secured, fragmentary and intact, and from both the Pueblo I and II levels. These were all of a single type, the open end trough or scoop metate (Plate XXI), which

is usual from these horizons. Those from Pueblo I and II levels did not differ radically, although the metates from the substructure were usually constructed from larger slabs than those of the Pueblo II. Thus two metates from the substructure west are depressions eighteen by ten inches worn into slabs measuring three by four feet. All of the metates from both levels present a variety of sizes even though the types are remarkably similar. The troughs of the metates measure from [a diminutive specimen from Room 13 (kiva enclosure)] eight inches long by four inches wide, to large ones with troughs twenty-four inches by twelve inches (as one from the east test trench).

Metates from the Basket Maker level are of the same general type but tend to possess closed ends, thus approximating the bowl form.

As to the uses of the metates, it may be inferred that the inhabitants were a corn grinding people. However, upon at least some occasions, these metates were used for purposes other than to meal maize, and a number were used entirely for other purposes. Several of the metates and fragments yet retain a quantity of pigment ground into their surfaces, in most cases red, presumably ochre. In another case a metate had been used to grind gypsum, as was indicated by the remains on its surface. The use of metates as a building material has been noted before. This last is a trait or accident which may be observed in the walls of many of the modern pueblos. All of the metates of Tseh So were made of calcareous sandstone.

Manos. Manos outnumber the metates two to one, which seems a reasonable ratio. These are of the usual type, for the most part, which accompanies the trough metate (Plate XXI). The outline of these hand stones is that a round-cornered rectangle. Many of them display use on both faces. The material was the same in almost all cases, normally of sandstone. Their size varies with that of the metates.

A few manos from Tseh So do not conform with the above mentioned type. These are of granitic rocks, and their function seems to have been different from that of the more common specimens. These manos, if they may be classed in this category, are oval in shape, thicker than the rectangular ones, and with slightly rounded grinding surfaces. Their shape would not accommodate them to the trough metates so there must be presumed a slightly concave metate or mortar, or perhaps a natural rock surface. No such nether grinding stone was discovered.

Projectile Points. For the most part, projectile points may here be classified as arrowheads, insomuch as there is no specimen which approaches a spear head. However, a few from the Basket Maker levels may have seen service on atlatl shafts. The arrowheads from Tseh So fall into five distinct types (Plate XXII), three associated with the superstructure and two with the Basket Maker level. These are:

1. Side notched, square base
2. Three quarter notched, narrow stemmed, barbed
3. Triangular, square base
4. Large with wide stem, square shoulder or rudimentary barbs
5. Narrow, straight stemmed, barbless

Of these, the first three occurred in the Pueblo II structure and in those portions of the refuse mound associated with Pueblo II shards. The last two types occurred only in the pithouse under the refuse pile and in the Basket Maker horizons underneath the main ruin. The shapes also are varied but fall easily into the above types. The form of several of these points is especially fine, and the chipping and retouching are excellent. It may be mentioned that the Basket Maker types are duplicated at Shabik'eshchee. Materials are chalcedony, chert, flint (?), obsidian, and petrified wood.

Knives. Under this heading are implements of varied shapes. Knives or cutting implements of the triangular, lanceolate, and side-notched varieties were found. Two such lay on the floor of Room 17. These were: a triangular knife of red chert with the tip missing, and a cutting implement in the form of a large, side-notched arrowhead three inches long. Lanceolate forms and near lanceolate shapes occurred in fair quantities at different levels in other rooms of the Pueblo II building.

Percussion Instruments. Percussion tools included axes, hammers, mauls, and hammerstones (Plate XX, a, c-e). Of these, the hammerstones outnumbered all the rest by a large percentage. The axes are of three main types:

1. Full grooved, fairly small, with cutting edge
2. Double grooved with narrow cutting edge
3. Grooved only by rudimentary notches on corners of large sandstone block. Cutting edge reduced to an angular point

The hammerstones are of two types:

1. Round, globular, or subangular forms, shaped by use
2. Pitted for thumb and forefinger

Mauls are also of two main types:

1. Worn down axes obviously used for other than cutting purposes
2. Full grooved pebbles or small boulders with two percussion faces

Several specimens of each of these classes were found at Tseh So, with the exception of the double-grooved axe of which there was only one specimen. Materials are quartzite, basalt, diabase, diorite, gneiss, monzonite, and petrified wood.

Ornaments. Ornaments may best be classified by their mode of wearing. There were from Tseh So:

Bracelets
Beads
Pendants
Ear or nose plug (?)
Ear pendants
Buttons
Rings

Several fragments of shell bracelets were found, all of these queerly enough, in the refuse mound. These were made from a fair-sized shell (*Glycymeris* sp.) with the central portion incised and cut or sawn away (Plate XXII). This type of bracelet is common in other culture areas of the Southwest as, for instance, the Mimbres, Verde Valley, Chihuahua, and Gila.[1]

Beads of many varieties were common in this mound (Plate XVIIIa). Beads of sections of bird bones are most numerous, with turquoise, gypsum, reddle, and nut beads occurring in this order of frequency. The ant hills upon all sides of the ruin could be sifted with profit for turquoise beads. Of especial interest were a number of beads of amorphous gypsum which had been polished so as to produce a hard or glazed surface. No beads were discovered with burials other than the string of bone tube and hickory nut beads mentioned before.

Many pendants, mostly of small size, occurred in various places in the fill. Their form was practically constant, *id est*, an elongated spheroid or round-cornered rectangle with a drilled hole at one end.

A single, small, conical plug a half inch long has been tentatively identified as a nasal plug. The material is shell and the specimen is well worked. It possibly should be classified as a labret.

Ear pendants may or may not be differentiated from pendants used with beads. No criterion of difference has been noted.

Buttons, or objects of such shape, were made exclusively of lignite or some similar hydrocarbon (Gilsonite?). Several fragments of these were found in Ruin 50, and a complete specimen was discovered in Ruin 51. These are circular, plano-convex objects of about five-eighths of an inch diameter with well-worked surfaces. They are perforated by two holes on the same plane drilled at a slant to come together an eighth of an inch beneath the surface.

A single ring of bone was present in the Pueblo I level. This was evidently a thin section cut from a large limb bone. From its size it may have served as a finger ring.

1. See section on shell identification, p. 98.

Awls. A considerable variety and number of bone awls were found among the objects of interest from Tseh So (Plate XVIIIb, c). These may be classified according to their material rather than their usage insomuch as the largest or the smallest may have served as awls, perforators, husking pins, etc. These awls were made from the following bones:

Ulnae—ungulates
Cannon bones—ungulates
Ribs—ungulates
Split sections of large bones—ungulates
Turkey tibiae
Other bird bones (femura, humeri, etc.)
Jackrabbit bones

The length of these awls varied from one-half inch to seven inches. In this connection may be mentioned one small awl or needle which was supplied with a perforation evidently to serve as a bodkin or sewing apparatus.

Scrapers. No scrapers of stone were found. However, a fair series of bone scrapers were recovered, of which almost all were made from deer or antelope humeri (Plate XVIIIb). Those scrapers not worked from humeri, employed deer phalanges abraded down to a scraping edge. Some of these scrapers of bone may have had additional handles. Their upper ends usually exhibited some wear.

Counters. Worked shards, of both circular and rectangular form were fairly common. These are plain, drilled, or notched along the edges. In addition to these worked shards, there were also some bone specimens which fall into this category. These are sections of scapulae and worked fragments of limb bones with no other function apparent than as counters. Two small lenticular bone sections of this type were decorated with cross-hatched incisions on one side.

Palettes. Under this heading are grouped objects of various shapes adapted to this function. Especially applicable were a number of finely worked and smoothed slabs of sandstone and limestone, rectangular in shape, which were undoubtedly palettes (Plate XIXd). Also there were several small circular or oval items of stone, less carefully worked, and others manufactured from fragments of metates. All of these showed traces of pigment: red (hematite), yellow (limonite), and one instance of green (malachite). The areas of paint showed a circular smear on the palette surface, as though a circular scrubbing motion had been used for the mixing. The rectangular palettes measured from eight by fourteen inches to fragments three and one-half by four and one-half inches.

Mortars. For the most part the mortars of Tseh So were natural concretions, the hollows of which had been utilized. However, a single mortar of sandstone from Room 6 was carefully and symmetrically made for this purpose (Plate XIXc). The interior cavity was six inches in diameter and showed red pigment. No implement which may have served as a pestle was recovered from the ruin.

Sandal Last. A single specimen of this type was found on the floor of Room 16 (Plate XIXb). It was of the conventional shape for the Pueblo three-quarter round-toed sandal, with a small offset on one end. It was made of a very fine-grained sandstone, smoothly finished with a semi-polish. Queerly enough, it showed a quantity of yellow paint on one of its surfaces.

Trays. Trays of both wood and stone were cataloged from Tseh So. In the vegetable material of Room 1, the fragments of a large rectangular wooden tray were scattered throughout the mass. This was of cottonwood, with slightly turned up edges and smoothly worked surfaces. The wood was impregnated heavily with grease. In the fill of Room 1 occurred a large oval tray of sandstone. This was twenty inches long on its main axis and fifteen inches broad. It was ground smooth on the exterior, but was somewhat rougher on the interior. A number of fragments of similar objects were likewise found.

Pipes. Only two specimens of tobacco pipes were present among the artifacts, and one of these was only a fragment. These pipes were of the tubular variety, and both of argillite. The drilling had been done with a hollow drill, and the surface subsequently smoothed. Although both pipes were badly chipped, neither would have exceeded two inches in length.

Disks. Problematical objects of this sort were encountered in fair numbers in the Pueblo II levels, but in no other (Plate XIXa). These disks were wafer-thin circular plaques of sandstone from two to eight inches in diameter. Most of them were well-worked and smooth. A few showed pigment on one or both surfaces, and may have been used as palettes. A variation of these disks was presented by two examples which were fitted with a slight (one inch) projection on one edge. Possibly a number of the disks were used as olla tops or lids.

Hoes. Objects in this class may be either hoes or adzes but insomuch as such specimens from other Chaco ruins have been regarded as hoes, this precedent may be here followed. These were implements of small size (five inches long and three and one-half inches broad at the bit), of rhyolite (Plate XXb), and of chert, chipped and ground and finished with a high polish. The bit was the broadest portion, the sides diminishing to almost a point at the upper end. Two notches were

provided for hafting, which was very evidently at right angles to the blade. The smooth and unscratched blades of these instruments would seem to eliminate their use in gravelly or rocky ground or possibly as hoes altogether.

Rubbing Stones. Rubbing or polishing stones were invariably river pebbles of handy shape and size which displayed their use only by evidences of wear. These were very similar to those in use among the Pueblos today. There were several pieces of hematite and limonite in this class which were probably used as sources of paint rather than for their rubbing qualities.

Effigy Forms. There were found certain effigy forms of terra cotta and wood which may be grouped under this head. The most remarkable group of these occurred on the floor of Room 1. The frontispiece of this report reproduces the most complete of these which is in the form of a tablita of a human face.

These wooden objects were all done in cottonwood, worked to the thickness of a shingle. The subjects were depicted both by outline and by interior painting. This painting was primarily turquoise green and dead black, supplemented by white, dark red, and brown. The accompanying figure (Fig. 4a-f) may best describe these forms. Those recognizable are some sort of bird, a dragon fly, a human face, and possible portions of some animals.

In addition to these, there was one effigy, of terra cotta ware, of the body of an animal remarkably like a horse. The head and feet were missing, unfortunately, but the torso and stumps of legs were well preserved. The form of the belly, flanks, and other anatomical features were well modelled. The piece was covered with a red slip and evidently was affiliated with the Wingate series.

Methods of Working of Materials. Practically all known aboriginal methods of working bone, shell, and stone were exemplified at this little mound.

Shell showed methods of cutting, breaking, drilling, sawing, abrading, and incision, There was no inlay or etching.

Bone displayed cutting, breaking, splitting, drilling and incising.

Stone was worked by pecking, chipping, grinding, polishing, drilling, incising, and breaking. On the edges of certain of the palettes was displayed a method of incising from both sides with a sharp instrument and subsequently breaking off the piece. This is a technique which, of course, was most popular with the aboriginal workers of jadite in British Columbia. Another palette showed a most interesting method of drilling with a hollow reed or possibly a piece of metal (copper?), supplemented with sand or pumice and water. The core of this piece was still in place. Not only did the inhabitants know most of the major

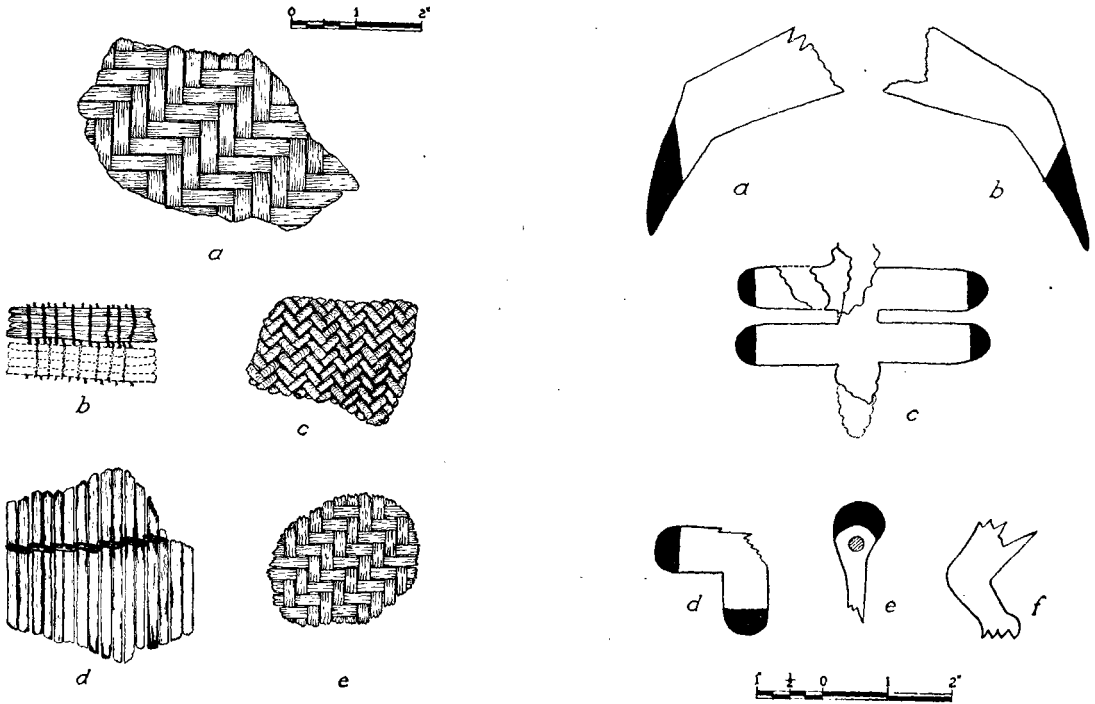


FIG. 4. MATTING AND WOOD FRAGMENTS

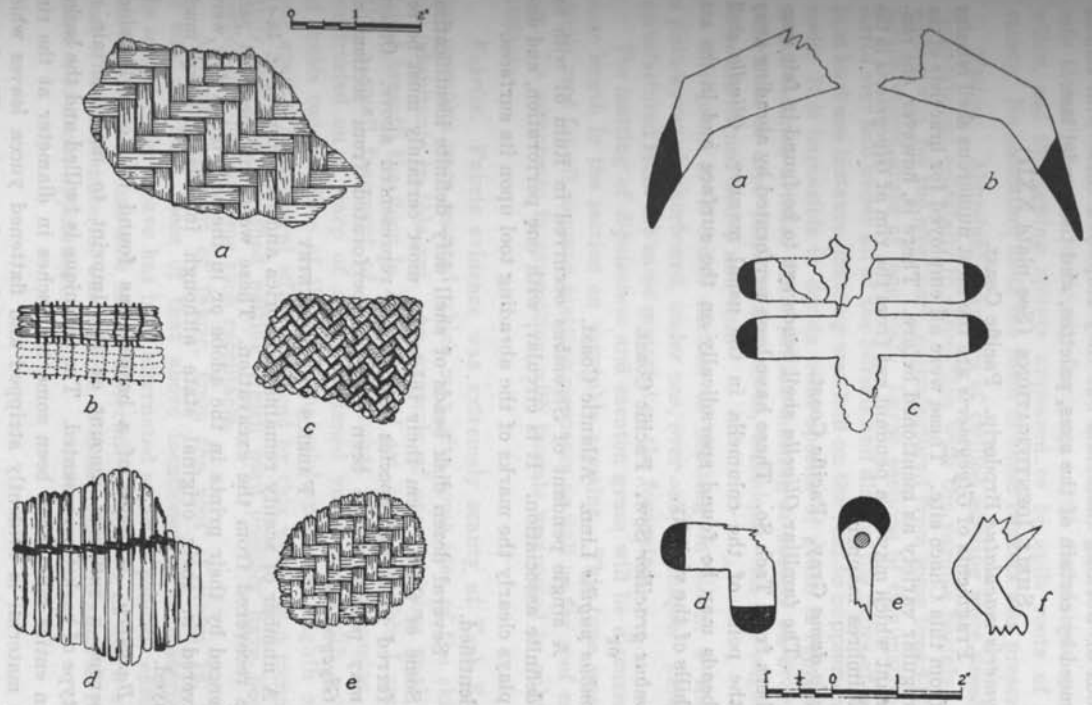


FIG. 4. MATTING AND WOOD FRAGMENTS

methods of working materials but they employed these with skill as evidenced by certain of the axes, palettes, and the sandal last.

SHELL IDENTIFICATIONS (See plate XXII)

Glycymeris maculatus Broderip. Pacific Coast.

Fragments of *Glycymeris* are the most numerous shell remains from this Chaco site. These were all employed for bracelets of the regular variety as mentioned before. There is, however, one remnant which may be a pendant cut from the rim of *Glycymeris* in the Mimbres manner.

Olivella dama Gray. Pacific Coast.

The familiar *Olivella* shell beads are to be found in fair numbers from Tseh So. These have been perforated by abrading away the point of the columella in the usual manner. *Olivella* shell beads may be found sporadically on the surface and in the ant hills of the vicinity.

Strombus gracilior Sow. Pacific Coast.

or

Strombus pugilis Linn. Atlantic Coast.

A single pendant of *Strombus* occurred in Ruin 51 with no definite association. It is circular, with one perforation, and displays clearly the marks of the abrading tool upon its surfaces.

Unidentified.

Several dozen disk beads of shell defy definite identification. Some of them, from their thickness, most certainly must be referred to larger species than those represented above. Others may possibly have been cut and perforated from sections of *Glycymeris*.

FABRICS AND BASKETRY

A number of scanty remains of fabrics and basketry (Fig. 4a-e) were recovered from the excavation. These were for the most part evidenced by their prints in the adobe or in the soil, but a few were recovered in their original state although invariably very much decayed.

Basketry. A print of a basket was found in Room 10 which preserved a sufficient amount of the imprint to make certain of the type of basket represented. The technique is twilled and the basket when entire must have been some ten inches in diameter at the rim. The material is evidently stripped and flattened yucca leaves which were bent over around a wooden or stick hoop for a rim. The form of the basket is a shallow and rather flattened bowl.

Several shards from the Pueblo II level showed evidence of coiled baskets on their exteriors. This coiling was in many cases extremely

fine, a few specimens exhibiting twelve to fifteen coils to the inch. The coils themselves were evidently done on a rod foundation, possibly willow, and the sewing splints appeared to be split roots of some variety. No indication as to the form of these baskets was present.

Matting. Abundant examples of twilled matting were present in the excavation especially in connection with the various burials. This matting was, for the most part, manufactured from some broad-bladed, parallel-veined grass of long leaf. Large sections of this matting occurred over and under all of the burials and also on the floors of rooms. In at least one instance, matting was laid on the roof to supplement the reeds. It is impossible to decide what species of grass is represented by this common article. This twilled matting is usually an over two, under two, or over three, under three, technique. At the edges the stems are turned under and tied.

The print of a small section of matting in Room 8 showed a plain-woven checkerboard, under one, over one, technique. This was manufactured from the same material as the foregoing.

The matting of *Equisetum* and sacaton grass will be discussed at some length in the section on vegetable remains. This type was evidently used for all common matting purposes as well as for roof covering. Its occurrence in connection with burials was noted in only one instance.

Fabrics. Fabric evidence was extremely scanty at Tseh So but two examples were secured which may give some idea of the skill of the inhabitants in this art. An example of open twining work was found beneath the floor in Room 20, *id est*, in the Pueblo I section. This, a small fragment of some six inches in each dimension, was constructed on a warp of single flattened yucca fibre with a woof of double twisted fibre of the same material spaced an eighth of an inch apart. The general effect produced by this weave is a comparatively fine square-meshed netting which may possibly have been a portion of a bag or some such receptacle.

Another fragment of fabric, from the roof of Room 16, may or may not be a piece of that above mentioned. The material is the same but the weave has been alternated so as to produce checkerboard patterns on one side of the material. Insomuch as but a small piece of this last material was secured, it is impossible to state as to its function or exact appearance.

TABLE III

MAMMAL AND BIRD REMAINS

Room location	Meleagris gallopavo	Aquila chrysaetos	Neotoma mexicana fallax	Cynomys gunnisoni zuñiensis	Lepus californicus texianus	Sylvilagus auduboni warreni	Sylvilagus nuttalli pinetis	Thomomys aureus	Canis familiaris	Antilocapra americana	Odocoileus hemionus	Lynx baileyi	Peromyscus maniculatus rufinus	Ovis canadensis texianus	Taxidea taxus berlandieri
1	4			9	16	26					3				
2	19		8	22	30	41	2	1		2	5				
3			1		13	9	1		3	4	6				
4	15			19	44	28	2		1/2	5	12/4	1		1	1
5							1							1	
6				2		1			4						
7						3								2	
8	3			22	62	38	2	1			2				
9											6				
10				2						3					
11							1								1
12					5				1						
13	20	1		6	36	61	5		3		4		1 skull	1	
14			2					2							
15	1				2					2					
16			2			3	2	1							
17	6				1	8					1				
18			2												
19	1					4				/2					
20					4	3			/4	/2	/3			/3	
21	6				7	8				3	5				
22	15			6	13	20				5	23/17				
23											1				1
24															
Kiva 1	complete & 14					2									
2	complete & 3												1	Horn & 2	
3	complete & 7								complete & 3						
4	2 almost complete & 1														
Sub Struct. 1								1	6		3	com-plete			
2					4				11		9				
3									1		7				
Trench	2			3	20	14			16	3	17				
	82 .087	1 .001	15 .016	91 .096	265 .293	279 .297	16 .017	6 .006	55 .058	31 .033	77 .082	1 .001	2 .002	11 .011	3 .003

MAMMAL AND BIRD REMAINS

By FRANK C. HIBBEN

Mammal and bird remains were very numerous at Tseh So and a good collection of several thousand pieces was secured both from the ruin itself and from the refuse pile. It must be stated, however, that the supply from the refuse pile was disappointingly small. The fill of the rooms themselves was the greatest source of this material.

Complete remains were found in several instances and under most interesting circumstances. Thus, complete skeletons of turkeys were found between the fire screen and the ventilator in each of the four kivas, and two such were found in Kiva 4. Each of these turkeys was a female, and in each case the skull was missing. It was at first supposed that a complete bird had been thrown down the ventilator shaft and thus carried out into this space with the subsequent wash. However, in Kivas 2 and 3 the bones were articulated and obviously placed in an extended position. Furthermore, the remains were placed symmetrically in this space and directly on the low platform which covers the floor in that area.

In this connection must be mentioned the rather interesting accompaniment of turkey bones with the burials at Tseh So. Every burial with the exception of one, the immature burial from Room 7, was accompanied by one or more bones of *Meleagris gallopavo*. These were usually femurae and humeri, but other parts occurred also. It must be stated, however, that this association is not definite, insomuch as the fill of all the graves was mixed with a liberal quantity of many kinds of mammal and bird remains. The *Meleagris* bones seemed to be in direct association with the burials and to be along side of the food vessels which had been placed with the dead. The bones were never in the vessels.

In a cist in the floor of Kiva 3 was the complete skeleton of an immature dog. This cist had been prepared by an excavation down through the shale floor, the hole being lined with adobe and sealed with adobe, forming an area of marked contrast to the darker colored floor. This cist was just to the north and east of the fire pit. The dog was only slightly flexed and lying on the right side with its head to the south, as will be noticed was also the direction of the burials. The bones were laid in, or subsequently covered with, a fine infiltration of mud which represented, evidently, the wash from the walls and roof.

A nearly complete lynx skeleton was found on the floor of the substructure to the west.

In the matter of articulated bones, several limbs were found which were laid in such a position as to indicate that the ligaments were in

place at the time of their deposition. Two of these were deer and one an antelope, in each case placed on the room floor. In no sense were these burials, or other than accidental depositions.

In several of the rooms, noticeably Rooms 1 and 11, bone fragments supplemented the shards as spalls in the walls. Also, two adobe lumps which bore the impressions of roof structure contained embedded bone fragments. In the fragments of the roof of Room 16 these bone splinters were obviously used as pegs to hold down a piece of cloth, the imprint of which yet remained plainly visible.

Many of these bone fragments bear interesting impressions showing methods of working. The bones were cut by incising a groove around the circumference and subsequent breaking. Long bones were split lengthwise by inserting a wedge and splitting the bone shaft. The joints were cut through by the same incising technique. Bone incising as decoration was also practiced to a limited extent, but the few examples from Tseh So were more scratches according to a plan than incisions. A bone embedded in the north wall of Room 1 displayed several vertical grooves which were the result of working by abrasion.

Implements of animal and bird bones from this site show about equal numbers of deer, antelope, jackrabbit and turkey utilized, with perhaps deer and turkey predominating. Many of the implements were obviously made from the limb bones of large herbivorous mammals but positive identification was uncertain.

The considerable number of bone beads recovered from Tseh So were all manufactured from the long bones of turkeys. Those mentioned in connection with burial Bc50 60/6 were of this type.

The accompanying table gives (Table III) a picture of the distribution of the bone remains and of the different types represented. A more elaborate table had been prepared, showing the distribution of these remains by levels, but as the bones proved to be about equally distributed through the room fill, this table is not here represented. Also, in compiling the percentages, the material from the rooms, and refuse pile, as well as from the test trenches, was utilized. This table, however, shows only those specimens from the rooms, kivas, and the trenches immediately surrounding the ruin. These percentages are a close parallel to those from the refuse mound and ruin combined. The numbers indicate the number of bones found in each situation, exclusive of complete or articulated skeletons. Those below the line indicate specimens found below the floor, *id est*, in the substructure. Note especially those species *absent* in the substructure.

Sylvilagus auduboni warreni—(Colorado Cotton Tail) 29.7%

The remains of this rodent bulked large in the bone remains from almost every room of the pueblo. It is most natural to suppose that this mammal should have played a large part in the food

economy of the Chaco people as it is found in fair numbers in the region today. The Chaco Canyon is well within the borders of its range although the altitude is in general somewhat low. Insomuch as this species is one of the Upper Sonoran and Transitional zones, its frequency here may be a valuable clue to former edaphic conditions in the Chaco. No other member of the *auduboni* group was identified from this ruin although *Sylvilagus auduboni cedrophilus* occurs just to the south.

Lepus californicus texianus—(Texas Jack Rabbit) 29.3%

The many fragments representing the Texas jack rabbit are second only to those of the cotton tail. Room 8 was especially prolific in the remains of this rabbit, but these did not seem to represent any articulated individuals but rather a large collection of single, and in most cases, broken bones. Four femuri of the Texas jack rabbit occurred on the floor of the second substructure room on the west side of the mound. The presence of these bones on this level is most interesting, especially as all of these four showed signs of having been worked.

Cynomys gunnisoni zuniensis—(Zuñi Prairie Dog) 9.6%

The percentage of the Zuñi prairie dog is a doubtful figure although it follows next in order of number of bones recovered. The situation of some of these remains beyond question represents a part of the food of the original inhabitants of Ruin 50, but others are undoubtedly the result of rodents deceased in their burrows in the mound from natural causes. During the excavation, many such burrows were encountered and many had wrought havoc with the burials. None, however, went deeper than the floor of the Pueblo II structure. Insomuch as the prairie dog is an accepted delicacy to most Indian palates of the present day, it was not surprising to find it represented here. The first pit in Kiva 3 yielded prairie dog bones slightly charred. No other species of prairie dog was represented.

Odocoileus hemionus—(Mule Deer) 8.2%

The specific variety represented in this instance is probably *Odocoileus hemionus hemionus* although no positive identification may be made from the skeletal material. These deer bones occurred in fair numbers both as refuse in the room fill and as material for implements. It will be noticed also that the mule deer was apparently quite as much used in Pueblo I as in the later level, or perhaps even more so inasmuch as other species seem to be absent in the early period. The deer bones were almost invariably broken so that only joints and slivers of the shafts remained. This is, of course, a common expedient among primitive people for ex-

tracting the marrow. Undoubtedly many of the hundreds of fragments of unidentified bones are referable to this species although it is impossible of proof.

The source of these deer is only a matter of conjecture, but it is not impossible that many of them may have come from the immediate neighborhood. Stories of old informants have much to say of the game formerly inhabiting the low country and piñon-juniper country where it is now completely absent.

Canis familiaris—(Common Dog—Coyote) 5.8%

Under this heading may be grouped both the domestic dog and the coyote. It is extremely dubious whether the Indian dog of Chaco times ever departed very widely from the wild coyotes and wolves with which he undoubtedly at times interbred. The bones of the dog show up in fair numbers throughout the rooms and especially in the substructure. It is worthy of note that these remains are represented largely by portions of jaws and skulls, and the larger bones when present are whole and not splintered with a maul. This may be an indication that the dog or coyote was not a food item but is not conclusive evidence. The fact that the dog was an acceptable dish to some Indians and is here intermingled with other obvious food items may be taken to the contrary. The complete skeleton in Kiva 3 has already been mentioned.

Antilocapra americana americana—(Antelope) 3.3%

It is an established fact that the antelope was once common on the mesas of the Chaco region, and the arrows of Tseh So evidently brought down at least an occasional beast. The narrow toe bones were used for scrapers and awls and the scapulae for scrapers. As a food item the bones were broken in the same manner as those of the deer. The lesser number of antelope as compared with deer may be due to the greater difficulty of their capture rather than comparative numbers. Antelope bones were discovered in the Pueblo I level below Rooms 19 and 20.

Sylvilagus nuttalli pinetis—(Rocky Mountain Cottontail) 1.7%

As this rabbit has a center of distribution north of the Chaco in Colorado, it is interesting to find it even in moderate numbers at this site. It is especially interesting as this is a pine forest or Transitional zone form and no such pine forest now occurs within many miles of Chaco Canyon. *Sylvilagus nuttalli pinetis* does occur in the Jemez range to the east and for an unknown distance south.

Neotoma mexicana fallax—(Colorado Wood Rat) 1.6%

The remains of an ancient rat nest in a corner of Room 2 undoubtedly accounts for some of the *Neotoma* remains in

that place, although the bones were scattered throughout the room. Other bones, especially one from the fire pit of Room 14, probably represent a use of this rat as food. As the wood rat is fairly common in the area and the Chaco is well within its range, it seems reasonable to conclude that it was not a favorite food item. Its normal upper Sonoran range fits in well with Chaco flora and altitude. Needless to say, the wood rat is not undelectable among the present day Navajos.

Ovis canadensis texiana—(Texas Bighorn Sheep) 1.1%

The present range of this most interesting animal is restricted to the Guadalupe Mountains of Texas and southern New Mexico. However, undoubtedly it once had a much wider distribution, not only in the northern mountain ranges but in the breaks and open country of the northern portion of the state as well. The few fragments of *Ovis* which were yielded by Tseh So may be referred with reasonable certainty to *texiana*. The area beneath the floor of Room 20 contained three fragments of *Ovis* bones, among them a portion of a jaw and teeth. This dentition is heavier than is allowed under the species *Ovis canadensis canadensis* and is therefore *texiana* or *auduboni*, and probably the former. No bones of *Ovis* were certainly identified as among those used for tools.

Thomomys perpallidus aureus—(Pocket Gopher) .6%

The *Thomomys* or western pocket gopher is represented by many varieties in northern New Mexico. There is no colony in the immediate vicinity of Mound 50 at the present time, but there may well have been in past years. The few bones of this species may be out of place on the food list entirely. However, many Indians of today, notably the California Miwok, consider a pocket gopher pounded to an edible pulp a delectable delicacy.

Taxidea taxus berlandieri—(Texas Badger) .3%

A few gnarled and twisted bones found on the room floors were unmistakably those of the powerful digging equipage of the badger. That this animal was taken occasionally for food seems entirely logical. Badgers are seldom numerous and evidently only an occasional one found his way into the flesh pots of Tseh So.

Peromyscus maniculatus rufinus—(Tawny Deer Mouse) .2%

This typical little rodent was also identified from Tseh So, especially from several skulls. Undoubtedly other species of the small rodents were present, but identification was difficult without the skulls. It is also hardly to be supposed that the white-footed mouse was a food item used by the aborigines of Chaco. Its presence in the ruin is undoubtedly due to entirely natural causes.

Lynx baileyi—(Plateau Bob Cat) .1%

Outside of a nearly complete skeleton of a lynx found on the floor of the substructure, only one other bone was found, this being a humerus from Room 4. That this animal was known to, and used by, the ancient inhabitants seems certain. However, it would scarcely have been a major food item, if it were eaten at all, and the difficulty of catching these cats would also have limited their presence at Tseh So.

BIRD REMAINS

Meleagris gallopavo—(Wild Turkey?) 8.7%

Of all the bird remains, the greatest number by far were those of the turkey. Of all the bones at the ruin 8.7% were those of the *gallopavo*. These were found under all conceivable circumstances, as was mentioned before in connection with the burials and the kivas. Perhaps the most interesting notation concerning the turkey was its total absence in the Pueblo I level. There are certainly enough specimens to insure of this being more than merely negative evidence.

Is is interesting also to speculate upon the source of these birds, as well as upon the long-mooted question of their domestication. A fragment of egg shell from Room I has the circumference and shape of a turkey egg. Also, the Chaco country at present is not suited for turkeys as there is little or no oak scrub mast or piñon nuts. This situation may have been different in 1000 A. D., however. Large numbers of turkeys were brought to Tseh So, but whether alive or dead it is impossible to say.

Aguila chrysaetos—(Golden Eagle) .1%

The golden eagle was represented by a single ulna, with accompanying radius, on the floor of Room 13, which is the kiva enclosure for Kiva 3. The bones were lying directly on the surface of the enclosure to the northwest of the kiva, an angle which had evidently been used at one time for habitation. It is useless to speculate as to the culinary or ceremonial purposes of this bird at this site. Judging from more modern parallels, this wing may well have been used for the latter purpose.

VEGETABLE REMAINS

By FRANK C. HIBBEN

FOODS

The following vegetable items were positively identified which were possible food items:

Zea mays, 12-row and 8-row varieties; *Cucurbita moschata; Juglans major; Juglans rupestris;* Bracket fungus (species); and starch and protein meal other than maize.

Zea Mays. Maize remains were the most abundant of the food items identified. Small cobs occurred in every level in about equal quantities. Certain fire pits, however, such as those in Rooms 15 and 18, contained the greatest number of corn cobs. No room which might be termed a granary was located.

In Room 1 was found a large deposit of vegetable material from which most of the above identifications were made. This was a mass of matter some two feet thick lying directly on the floor at a depth of five and one-half feet from the surface and covering the entire floor of the room. In this deposit occurred at least two hundred cobs of 12-row maize, and fragments from many more. This 12-row maize is of the same variety as grown by the Navajos of the region today. The most notable general aspect of this maize was its stunted appearance. No complete cob was more than four and one-half inches long, and most of them were under three and one-half inches. The diameters also were quite small.[2] All of the cob remains exhibited lateral flattening from the superincumbent earth load.

A limited number of cobs were recovered in a fragmentary condition from the substructure (Pueblo 1) rooms on the northwest side of the mound. These were of an 8-row variety, and were even more stunted and warped than those from the Pueblo II above. No kernels were found so that the variety has not been determined.

In connection with the maize it must be mentioned that several varieties of meal found in the kivas were examined to see if corn meal was represented. None of these was definitely established as corn meal, although some of them contained starch.

Cucurbita moschata. The gourd family was represented at Tseh So only by *moschata,* although all of the specimens were examined for the possible presence of *maxima* this far north. Most of these identifications were made on the basis of twenty-two fragmentary pumpkins,

2. Brand: "Symposium on Prehistoric Agriculture," article by Franke and Watson, pp. 19-37; and Alexander & Reiter: "Report on the Excavation of Jemez Cave," p. 62.

represented by stems, rinds, and seeds found in the deposit in Room 1 mentioned before. Also, a potsherd containing some seeds of the *moschata* was found on the floor of Room 2.

Juglans major. The large walnut is an interesting record for the Chaco Canyon. This identification was made from three nuts which formed part of a necklace found with burial Bc50 60/6. In this case a portion of the shell had been cut away so that a cord might be passed through the columella and the nut thus used as a bead. Fragments referable to *Juglans* were also found charred in a fire pit in Room 16.

Juglans rupestris. The smaller species of walnut was also represented by three shells on the same necklace mentioned above. These had been cut in the same manner for suspension as were the *major* specimens. The possible source of these walnuts is only a matter of conjecture. There is little doubt that the trees did not grow in the Chaco area.

Bracket fungus. A large section of bracket fungus was found with the rest of the vegetable material in Room 1. It was impossible to identify this as to species, but the cross sections displayed the unmistakable structure of the bracket fungus. A large lump of resin on its base seemed to indicate a fungus growing on a resinous tree, probably pine or piñon in this case. The mere fact of its presence with the maize and pumpkin remains, and the known edibility of some fungi are the only basis for listing this as a possible food item.

Starch and protein meal. In Kiva 2 a small quantity of whitish meal was found contained in a broken olla neck superimposed on a circular potsherd as a base. The meal, when stained and observed in the microscope, proved to be made up of about equal proportions of protein and starch. This was definitely not corn meal. As most of the nut meals would run much higher in protein, this meal may have been made from beans but this is only a conjecture.

Another small quantity of meal from the same kiva proved not to be vegetable at all but amorphous gypsum. However, this substance (which, as far as appearance goes, is a true meal) seems from its situation to have been used for a like purpose—not for gastronomical purposes but possibly ceremonially in the kiva.

IDENTIFIED VEGETABLE MATERIAL OTHER THAN FOOD

The following non-subsistence items were also identified from Tseh So:

Juniperus (sp.); *Pinus ponderosa; Pinus edulis; Populus* (sp.); *Equisetum* (sp.); *Sporobolus* (sp.); *and Yucca* (sp.).

Juniperus. Large posts of juniper, several inches in diameter, were used as *vigas* and as cross pieces in the roof construction of the pueblo. Also, smaller poles of juniper were used as lintels in the ventilating shafts of the kivas as well as lintels, uprights, and sills in several of the room doorways, notably those in Rooms 2 and 4. Split fragments and slabs of juniper were used also to augment the roof covering of sacaton and horsetail. Large quantities of such juniper fragments were found in connection with the cache of food in Room 1 mentioned before.

Juniper bark also seems to have been utilized by the inhabitants of Tseh So. A small fragment of plain woven matting in Room 1 is made of this material. Fragments and scraps of juniper bark from other sections of the pueblo seem to indicate the use of juniper bast for both cordage and matting purposes.

Pinus ponderosa. Vigas of pine occurred in a fragmentary condition in both the rooms and the kivas. The largest of these was slightly under eight inches in diameter and was a long *viga* which ran east and west across both Rooms 2 and 4. Pine beams used in the kivas were somewhat smaller in diameter, judging from the fragments which remain. The larger size of those from the rooms may have been made necessary by the addition of a second story over the central portion. Several bunches of charred pine needles also occurred in the ruin, a mass of these being found in the fireplace in Room 16. These seem to be the remnants of several bunches or tufts of long needles bound together to make a small broom or whip. No evidence of the binding was present, however.

Pinus edulis. As piñon occurs in large quantities in the immediate vicinity of Chaco Canyon, and probably did even more so in ancient times, it is but logical that the inhabitants of Tseh So used this species to a very considerable extent. Fragments of piñon occurred in considerable quantities in every fire pit which was examined. Piñon limbs in small fragments were also used sparingly in the roof construction. In general the piñon does not lend itself to the making of straight poles or sticks which would be the most useful for this purpose.

Populus. Cottonwood is found (formerly much more abundantly) along the Chaco River, and figures large in the vegetable remains from Tseh So. In the ash pits it is second only to piñon, or perhaps equal in importance, insomuch as cottonwood ash tends to reduce itself to a fine powder which does not permit of identification. Cottonwood poles were used exclusively in the roof structure of Room 7, and sparingly in the rest of the pueblo. Some quantities of cottonwood bark also occurred in the vegetable cache in Room 1.

Equisetum. Rushes referable to this genus were found in the roof construction of approximately half of the rooms. This percentage is somewhat uncertain insomuch as a number of the identifications were made on the basis of prints in the roof adobe only. The rushes were used, as stated before in the description of the roof materials, as a covering over the poles, which were in turn laid at right angles to the *vigas.* The rushes were carefully laid parallel, cut off at both ends so as to form straight sticks which might be bound together in the manner of a loosely-constructed matting. The binding used was two-ply yucca fibre. Rough matting, similar to that used on the roofs, was also employed for burial wrappings and for other general matting purposes. A section of such matting, fourteen inches square, underlay the immature burial Bc50 60/3. Fragments of similar nature occurred in Room 8 on the floor, Room 7 possibly in connection with burial Bc50 60/2, and on the floor of Kiva 3.

Sporobolus. Sacaton grass at the present time occurs sparingly over a large area. Sporadic and diminutive clumps may be found in certain wet portions of the Navajo Reservation, in a few isolated spots of the New Mexico Gila and in a few places in the Rio Grande Valley. Undoubtedly Chaco Canyon once supported a considerable growth of this interesting plant. Most of the identifications were made from roof material, where the sacaton grass was used in much the same manner as the *equisetum* and possibly in even larger quantities. It may be remarked that the adobe prints of the sacaton showing the familiar sacaton nodes displayed a greater regularity of technique in the manufacture of the roof covering than did those using the horse tail. One example, also an adobe print, showed that the spacing between the parallel reeds had been accomplished by knots in the yucca binding interspersed between each stem. Two fragments of sacaton grass were recovered from the floor of Room 1 which were undoubtedly sections of compound arrows. Neither of these was complete enough to show the wooden base or the wooden point, and they may never have possessed them. However, one of these showed the remains of some gut binding around one end, and the interior of the reed was reamed out as though for the accommodation of a wooden neck or foreshaft.

Yucca. Judging from a number of fragments found throughout the ruin, and especially in connection with the roof construction, yucca cordage was in general use at this site. This, as well as could be determined, was only of the two-ply variety.

In addition to yucca cordage, yucca leaves (of both narrow and wide leaved varieties) were evidently used in the Chaco Canyon as elsewhere during prehistoric times. The main evidence for this is an almost complete sandal recovered from the floor of Room 3. This is

apparently of the regular Pueblo type, although unfortunately a portion of the toe end is missing. The tying of the sandal (incomplete) was of yucca cord. The preservation of this piece was due to the position of the sandal underneath a sandstone slab lying directly on the floor.

SUBSISTENCE

By DONALD D. BRAND

The evidence from Tseh So, as well as from other sites of similar age in the canyon, indicates that these Chaco inhabitants of one thousand years ago were a sedentary agricultural people who supplemented their diet of cultivated plants with the fruits of hunting and gathering. Agriculture was undoubtedly pre-eminent, as the already considerable population of the Chaco Canyon[3] would have precluded any great dependence upon hunting and gathering in the Chaco area.

Judging from the remains of mealing stones and of plants, maize was the staple food, supplemented by cucurbits. Adding the evidence from other Chaco sites, there may be reconstructed a picture of the agricultural economy in which the widely spread New World complex of maize—beans—cucurbits takes its place. To what extent wild seeds and soft-shelled nuts supplemented maize starch and bean protein cannot be estimated as these wild plants lack the residual parts (such as cobs and silk) which remain from maize. Neither can the part played by wild greens, tubers, bulbs, etc., be gauged, as they lack the stems and rinds which the cucurbits leave as evidence into the future. Seemingly the Chaco peoples were altogether lacking in cultivated food plants outside of maize, pumpkins,[4] and beans. The peaches, melons, tomatoes, peppers, onions, Irish potatoes, wheat and other plants, now quite important among the Pueblos, were not known until the coming of the Spaniards from Mexico.

Any statement concerning field cropping at Tseh So, or elsewhere in the Chaco Canyon, must be based on pure conjecture. Some evidence does exist that planting sticks and hoes were used, but nothing at all is known concerning field patterns, crop associations, fences, irrigation, methods of cultivation and harvesting, or land ownership. Presumably there was not much difficulty in clearing land, as a close forest or a dense brush cover was apparently never present. Planting with "digging sticks" was quite feasible, as the soil of the canyon floor is loose and friable. The soil is a sandy loam, easy to work, but poor

3. During the period 850 to 1000 A. D., within which Tseh So probably existed in its Pueblo I and II phases, such sites as Una Vida, Peñasco Blanco, Chetro Ketl, and Kin Biniola were occupied.

4. The term "pumpkin" rather than "squash" is used advisedly. In common speech these terms are used indifferently for varieties of *Cucurbita pepo, C. moschata,* and *C. maxima,* but precise usage would restrict the term pumpkin to the first two species. Only *C. moschata* and *C. pepo* remains have been recovered from prehistoric ruins of the Southwest and North America, with *C. moschata* predominating in the Southwest. Both *C. moschata* and *C. pepo* were cultivated in the Chaco Canyon. See Erwin: *Nativity of the Cucurbits,* and Erwin: *Nativity of Cucurbita Maxima.*

in phosphates, potash, and nitrates, and susceptible to surface concentrations of alkali. It is possible that the long continued diversion of flood waters over the farm areas may have resulted in such a heavy concentration of black alkali that large areas had to be abandoned. This may have been one of the factors that contributed to the abandonment of the Chaco during the twelfth century.

In any consideration of field patterns, existence of fences, and evidence for irrigation, it must be kept in mind that the present surface of the Chaco Canyon floor is not that of one thousand, or even of five hundred, years ago. Whatever evidence there may be on the present surface for outlines of fields or of irrigation systems must be attributed to Navajo farmers (who have cultivated plots in the canyon for anywhere from one to five hundred or more years) and to white settlers (who have been in the canyon for at least forty years).

Since numerous claims have been made for prehistoric irrigation in the Chaco Canyon, it seems advisable to consider this matter in detail. The floor of the Chaco Canyon is not comparable with the lands irrigated by the Hohokam of the Middle Gila area, for the Arizona lands are relatively open and do not possess limiting cliffs to confine and direct the movements of air and water—laden with silt and sand. In an area so closely circumscribed as is the cliff-walled Chaco, the processes of deposition and evacuation become accentuated and accelerated. Scarp fronts of crumbly sandstone and friable shale, windstorms, torrential rainfalls, and extremes of temperature, all contribute to the cycles of aggradation and degradation. Some eight centuries have elapsed since the builders of the Chaco pueblos occupied the canyon-valley. Certain archaeologists, who trace the outlines of prehistoric irrigation systems on the present surface of the canyon floor, would have us accept one or the other of the following assumptions:

1. That the present surface is and has been the same as that of eight hundred years ago, or
2. That whatever filling took place after the abandonment of the pueblos has been exactly compensated by denudation.

Patently, traces of prehistoric ditches could not be found on the present surface unless this surface were that of eight hundred years ago. It is exceedingly difficult for anyone familiar with the rapid changes effected by nature in the Southwestern landscape to believe that an original surface could be maintained for a century, to say nothing of eight centuries. Scarcely less credible is the assumption that some patron saint of archaeologists, like Joshua of old, halted the processes of nature at the proper historic moment—leaving the old occupational surface revealed to the delighted eyes of modern savants. Actually, one must look beneath the present surface, any-

where from a few feet down to as much as a rod, for the prehistoric horizons.

After ruling out the present surficial evidence, there still remains the possibility that ditch irrigation with waters taken from the Chaco River may have been carried on prehistorically. However, there is neither evidence nor need for such an assumption. Nowhere have natural arroyo channels or archaeologists' trenches revealed in their walls the outlines of former ditches. Furthermore, present conditions are certainly no more humid than in prehistoric days, yet Navajos have been raising and harvesting crops of maize, beans, etc., with no ditch irrigation, for many generations. To be sure, a form of irrigation is practiced, namely, planting fields in areas where natural subsoil irrigation will operate, and diverting surface flood waters with dikes. This is the procedure followed by the desert Papagos, who raise crops under really arid conditions; and it was undoubtedly employed by the prehistoric peoples of the Chaco. Such is also the conclusion of others who have worked in the Chaco, e. g., Neil Judd and Kirk Bryan.

Of domesticated animals, there were only the dog and, possibly, the turkey. Certainly the turkey and, perhaps, the dog were used as food. Neither pack nor draft animals were present to lighten the labors of the Chaco farmers. Among animals commonly hunted for food were the pronghorn (American antelope), mule deer, American elk, several rabbits, prairie dog, and the scaled quail. Probably the badger, bears, beaver, gopher, mountain sheep, mice and rats, porcupine, squirrels, and jays were eaten at times. Trade or occasional hunting parties may have brought in bison infrequently. The remains of other animals (such as coyote and fox, bobcat and mountain lion, eagles, hawks, etc.) probably represents the acquisition of these creatures for other than food purposes.

Altogether, the peoples of Tseh So and the Chaco could have had a well-balanced diet with no outstanding deficiencies. The few skeletal studies made to date from the Chaco are not sufficient to indicate any disease trends that might be attributed to food habits.

THE PLACE OF TSEH SO IN THE CHACO CULTURE PATTERN

By FLORENCE M. HAWLEY

No longer ago than the early 1920's archaeologists were debating the age of prehistoric Southwestern ruins and were laughing over each other's exaggerated estimates. Now, since many of the ruins have been definitely dated by the Douglass system of tree ring chronology, archaeologists debate the reasons for spurts and lags that produced very uneven levels of culture over the area during a single century. Pueblo I overlapped Basket Maker III and Pueblo II in actual dates; and Pueblo II, where found, is contemporaneous with much of Pueblo III. A vivid example of this appeared in dating the Chaco ruins.

Douglass has dated Judd's Basket Maker III pit houses in the Chaco at 777 A. D.[5] Pueblo I here has not yet been dated, but Pueblo II (as represented by the upper structure of Mound Bc50, Tseh So) dates 922 plus between ten to twenty years, the rings for which had decayed from the exterior of the dated specimen. This places the cutting date of the beam about 940 or 950 A. D., a later date than had been expected for Pueblo II in the Chaco. Chetro Ketl and Pueblo Bonito dates extend back into the 900's.[6] Dates in the late 800's came from beams built into walls in Una Vida and in Kin Biniola, but these appear to have been logs once used in earlier structures, salvaged, and re-used in later walls. We cannot avoid the evidence, however, of small Pueblo II pueblos having been built in the Chaco at the same time that some of the larger pueblos were under construction. The wall types used at this period in the two classes of structures were successive in typology and in some cases were found superposed one upon the other. Evidently the two wall types were more or less contemporaneous over a part of their period of use, although one probably preceded the other in origin. A similar statement may be made for the two classes of structures, the large pueblos and the small: they were more or less contemporaneous over a part of their period of construction and of use, although the latter preceded the former in origin.

Sedentary occupation of the Chaco goes back to the people of Basket Maker III who brought their culture into the Chaco sometime before 777 A. D. They lived in pit houses until they began to think of using slabs, such as those which lined their pit walls, as the bases of walls constructed above ground. The upper part of these walls was crude masonry, if one may distinguish by that name a wall largely of

5. Douglass: *Dating Pueblo Bonito and Other Southwestern Ruins.*

6. *Op. cit.*, and Hawley: "The Significance of the Dated Prehistory of Chetro Ketl, Chaco Cañon, New Mexico."

adobe but interspersed with small stones. The women made pottery similar to that of their neighbors to the south in the Pueblo I villages of the Red Mesa country. We may give this Pueblo I culture the approximate date of 850 A. D., plus or minus, in the Chaco.

In the early 900's the Chaco people were building small pueblos with rooms outlined by walls of small stones set in a great deal of adobe. Their most common painted pottery, Escavada Black on White, became more sophisticated in design but cruder in workmanship than the Red Mesa Black on White prevalent in the previous period, although the latter continued to be made. Some of the pueblos built during the 900's were not small, however; daring builders were expanding them beyond anything previously attempted. A new and more stable type of wall than any previously devised was used. This was built up of large slabs of sandstone set in abundant mortar. The idea of a core in a wall had not yet occurred to the builders. The fact that slab walls were found superposed over walls of the small stones set into clay in the central section of Una Vida indicates that the cruder walls of small stones probably had been devised before slab walls were used, but the dates on the small stone walls at Mound Bc50 and the dates on the slab masonry of other sections of Una Vida prove that the former were still being made for some time after the latter had been developed. This is what one might expect, for in the Chaco the study of trash mounds has demonstrated the hold-over of pottery types of a former period into the succeeding period; one does not expect clean-cut breaks between types of any element of material culture. Moreover, the dates obtained on beams taken from Pueblo III wall types which succeeded the slab masonry leave no doubt but that each of these types, although prevalent at one period, lasted over into later periods when other types were prevalent.

The small house pueblos of the Chaco were contemporaneous with the first of the large house pueblos being constructed during the tenth century. We may imagine the debates of builders on whether the new expansion was feasible and advisable, and the recommendations of masons that the larger villages be built with heavier walls. Building was upward as well as outward; towers rose and several stories were laid above each other. Pueblo II merged into Pueblo III in the eleventh century in the Chaco, and types of masonry were developed in which the inner core was covered by a surface marked into bands. The bands were of large blocks separated by bands of small spalls, the bands being narrow at first, then wide and carefully laid, then wide and carelessly laid in somewhat uneven lines. Finally the large blocks were laid up without trace of banding, and in other walls small blocks the size of the spalls used previously were laid up, likewise without trace of banding.

The pueblos begun on a large scale during Pueblo II were further built up, built over, and re-built. The neat shapes of the Chaco ruins as we see them today were not a part of the original plan of many of these pueblos; the builders changed old structures and added new ones until the completed unit fitted their taste in architecture. But not all of the pueblos occupied during this period were large. Just as there were small villages characteristic of Pueblo II but some large ones being built at that time, so there were large ones characteristic of Pueblo III but some small ones being built contemporaneously. Talus Unit 1, built against the cliff just to the west of Chetro Ketl, is an example of a Pueblo III structure as small as any of those of Pueblo II. Its masonry types and its dates leave no doubt as to its period.

While their husbands were tending the farms and were transporting and laying the sandstone slabs into walls, the women were working at their pottery and utilizing the resources of the canyon quite as effectively as did the men. Gallup Black on White succeeded Escavada Black on White, and was in its turn succeeded by Chaco Black on White,—all three types being used to some extent contemporaneously, but each enjoying its period of greatest popularity.

Then, in the early twelfth century, just when their culture was at its height and the culture of other peoples throughout the Southwest was flourishing, the population of the Chaco deserted their homes and moved out of the canyon. Why they left is a matter of theory. Perhaps they were oppressed by nomadic raiders; perhaps they were plagued with superstitions and ill omens; perhaps the constant improvident cutting of trees for building and for fire so denuded an area never heavily forested that erosion set in and the water supply sank beneath the surface until the farms could no longer support the farmers. They did not leave because of drouth; tree ring studies indicate that the large Chaco pueblos flourished through periods of drouth in the early tenth and in the middle eleventh centuries, but that no drouth occurred at the time of their exodus. Nowhere else in the Southwest is there a record of any large movement of peoples at this time; the movement and the reasons behind the movement were local.

Thus disappeared the bearers of one of the most highly developed cultures in the Southwest. The Chaco culture was not limited to the Chaco area; its influence is traceable in the Little Colorado, in the Zuñi district, up into the Four Corners, and over into the Rio Grande. Cross finds of pottery indicate that the Chaco people had carried on trade with people of these outside areas even from early times. Their trade had extended over into the Kayenta and the Flagstaff districts; up into the Mesa Verde; south to the Upper Gila; and even farther south into southern Arizona or into Mexico for the shells they cut

into jewelry and for the macaws[7] they kept for ceremonial purposes, if we may judge from the function of macaws in the pueblos where they are kept today. And the pottery types of the large area which shows Chaco influence are so closely related to those of the Chaco that it would appear Chaco people had gone out from the center and had spread the pattern of their culture through small settlements or through amalgamation with other peoples. They spread not only at the time of the final desertion of the canyon but from Basket Maker III onward. It is impossible at present to delimit accurately the area of Chaco culture proper, and it can not be said exactly where the people of the Chaco settled when they left the canyon about 1120 A. D., but by the occasional presence of banded walls and by the close affinities of local wares with the pottery of the Chaco, their influence can be traced from the Lowry Ruin in southwestern Colorado down through the Little Colorado and into the Upper Gila, east to the Pecos and Chupadero country and west to the Petrified forest.

It might be said that north of the Hohokam and the Mogollon areas of the Southwest, the Pueblo culture divided itself into two basic patterns, that of the Tusayan and that of the Chaco. The former is basically that marked off by pottery with carbon paint and polish over the paint. It was formerly designated as the "Western division," by Hawley and by Roberts. The latter is the "Eastern division," the area of pottery decorated in black iron paint, the surface of the vessel having been polished before the paint was applied. Design types and other culture characteristics likewise broadly fit into these areas, because influence from the center of highest culture virility carried out toward the peripheries.

The former designations of area may be criticized for two reasons: because the outlines are difficult to delineate, and because the idea of the culture areas originally carried geographic connotations which no longer hold in full. For instance, the Chaco was once listed in the San Juan area, which is a correct statement geographically, but its culture affinities are with the Little Colorado districts. Yet, if we list it as of the Little Colorado culture, we are criticized because it is not in the Little Colorado drainage. Perhaps the difficulty might be alleviated somewhat by the use of culture centers rather than of culture areas, but the idea of a center is likely to be tied up with the notion that the culture center is a point actually located in the center of the area affected. As a matter of fact, the culture center is not a point and need not be near the center of anything; it is merely the district of greatest culture influence at a given time and may change from period to period within a large range of influence. The concept and term of

7. Pepper: *Pueblo Bonito*, pp. 194-195.

culture pattern, already in use in ethnology, avoids both the specific use of "area" and the centralization of the term "center."

The center of most virile culture and consequently of the most influence within the Chaco pattern appears to have been either the Chaco Canyon or the Red Mesa district in Basketmaker III, and Chaco Canyon in Pueblo I, II, and III. In late Pueblo III and in early Pueblo IV the center moved to the Zuñi-Silver Creek district where pottery glaze was developed. Many of the villages of this area were deserted or died out during the great drouth of 1276 to 1299, and the culture center moved eastward to the Middle Rio Grande a little later in early Pueblo IV. There it remained, and in Zuñi and the Rio Grande pueblos of today we find the modern inheritors of a culture which rose to its peak in the Chaco between 750 and 1150 A. D.

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APPENDIX I

FLOOR DEPOSITION AND EROSION IN CHACO CANYON

By DONOVAN SENTER

The problem of Chaco Canyon deposition since the period of prehistoric occupation has caught the interest of every group of archaeologists working in the canyon. The sharply cut walls of the Chaco wash show profiles of a former creek bed which may have been that on the surface at the time the Pueblo people farmed the canyon floor. Simpson says there was no arroyo in the Chaco in 1849;[1] he found that "The Rio Chaco, near our camp, (in the upper part of the canyon) has a width of eight feet, and a depth of one and a half. Its waters, which are of a rich clay color, can only be relied upon with certainty during the wet season." Jackson,[2] in 1877, just twenty-eight years later, reports the arroyo as deep as it is today. Tomasito, an old Navajo still living in the canyon, claims that there was no arroyo there when he was a small boy. The combined data indicate a repeated filling and cutting of the central section of the canyon where the arroyo runs.

In 1928 a pit was sunk at the back wall of Chetro Ketl; the bottom of the wall, set upon the old surface level, was found 14 feet beneath the present surface, but this depth was effected by the wall intercepting material washed from the northern edge of the canyon. Nine miles up the canyon the caving sides of the wash have broken away to uncover the profiles of pit houses of Basket Maker III, beneath 10 feet of sandy deposit. This depth might have been greater, however, except for the progressive erosion of the upper bank. Neither depth could be used as an accurate criterion of deposition rate.

The lack of burial grounds for the large ruins has long been a matter of concern to archaeologists. Were they, perhaps, covered by a deep layer of sand on the canyon floor? A combination of the two problems, deposition and undiscovered burials, suggested itself, and dictated the excavation of a deep trench in the canyon floor near Chetro Ketl, a trench to be carried down until the old surface level of the Pueblo period was located. The depth of this would provide a measure of total fill away from the arroyo bed, minus possible surface erosion, between the earliest period of Chetro Ketl occupation and the present. The plan

1. Simpson: *Journal of a Military Reconnaissance from Santa Fe, New Mexico, to the Navajo Country*, p. 87. [Simpson may have been giving dimensions of stream flowing in the arroyo at that time, and not for the arroyo proper.—D. D. B.]

2. Jackson: Report on the Ancient Ruins Excavated in 1875 and 1877, *10th Annual Report, U. S. Geol. and Geog. Survey of the Territories*, p. 443 [Jackson gave arroyo depth near Pueblo del Arroyo as 16 feet; it is now more than 20 feet in depth in this locality.—D. D. B.]

was eventually to carry this trench from wall to wall of the canyon, but for the first season a small section was selected between points 250 feet and 300 feet south of Station I, which is four feet from the south wall enclosing the great kiva of Chetro Ketl. The line of the trench runs thirty degrees east of south, between that station and the arroyo, 1,164 feet distant. (See map I.)

The cut, fifty feet long and twelve feet wide, was carried down six feet through the surface sand. At this depth the excavation was narrowed down to a width of six feet, and the length was shortened to twenty-five feet, between points 250 and 275 feet from Station 1. The trench was carried down another six feet. The excavation was now narrowed to three feet in width and carried down six feet farther, providing a vertical face eighteen feet below the surface and twenty-five feet long. At the bottom was sand showing no trace of culture material. (See fig. 5.)

All potsherds encountered in this trench were saved, marked with their level, and classified. Sack numbers were entered in their places on the chart drawn of the wall profile, and classifications of the material in each sack were listed in the table of pottery. One complete vessel of Escavada Black on White was encountered at a depth of nine feet below the surface level in a layer of *cienega* clay in Deposit 2. (See table of shards, pp. 137-138.)

The interpretation of the history of the formations uncovered on the side of this cut was checked by Dr. Ernst Antevs, of the Carnegie Institution of Washington.

History of Deposition and Erosion in Chaco Cut 1.

(1) Deposition. (Deposit 1). Lowest and earliest in the cut. Sandy silt; little clay. Culminates with a deposit of "*cienega* clay" about 5 inches thick. Contains no shards.

(2) Erosion. (Erosion Surface 1). Erosion has cut Deposit 1, completely removing the "*cienega* clay" except for the north nine feet of the face of the exposure. Occupation of Chetro Ketl may have begun somewhat before or during this stage of erosion or at the beginning of the deposition which followed it.

(3) Deposition. (Deposit 2.) Silt and clay. At one horizon, at least, the silt and clay occur in alternating laminae, perhaps varves, indicating deposition in standing water. Within this deposit, at a depth of fifteen feet, were found shards of Escavada Black on White. (See table, Sack 6.) Above this, in the deposit, Escavada Black on White was consistently associated with Gallup Black on White. (See sacks 3, 4, 5.) At the depth of nine feet, in a layer of "*cienega* clay," an Escavada Black on White jar (specimen Bc52 10/1 was found. The silty clay of this deposit merges into

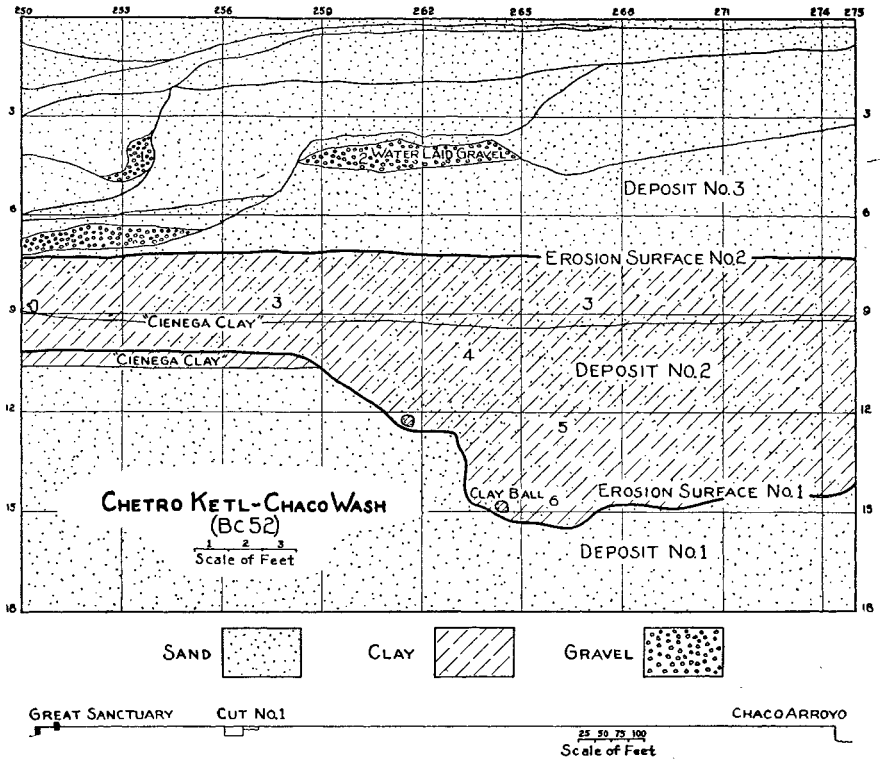

FIG. 5—PROFILE OF CHETRO KETL-CHACO WASH STRATIGRAPHIC CUT

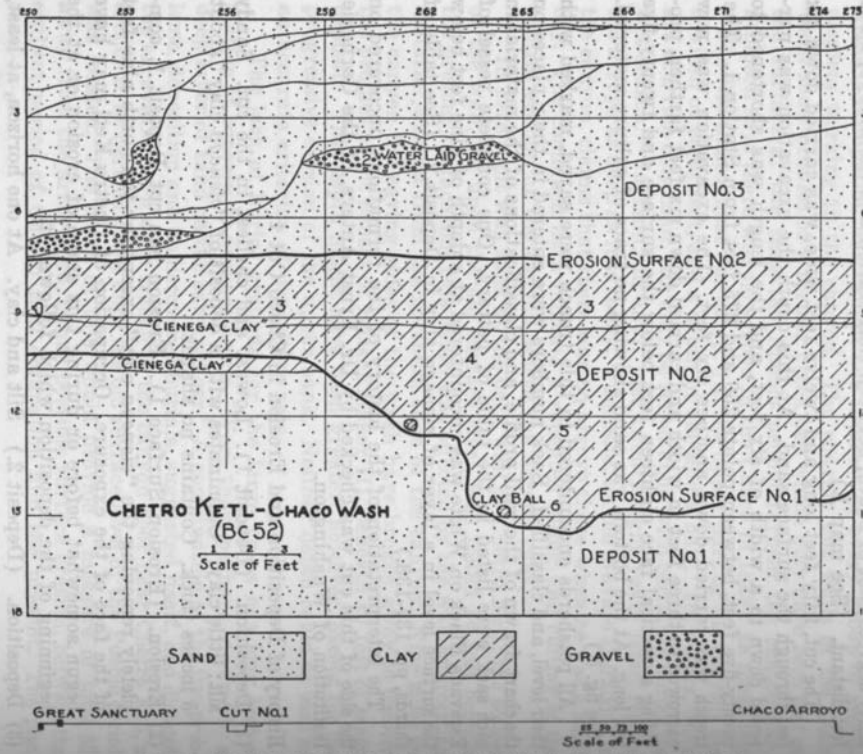

FIG. 5—PROFILE OF CHETRO KETL-CHACO WASH STRATIGRAPHIC CUT

the "*cienega* clay" at the depth of nine feet in a layer between two and four inches thick. Thereafter the material increases in coarseness to fine sand, and then decreases in coarseness to clayey silt. This clayey silt seems to have formed a land surface, for it shows in place a thin greyish layer of ash, and is distinctly different from the overlying material.

(4) Erosion. (Erosion Surface 2.) As stated under (3), the top of the clayey silt seems to have been a land or erosion surface which rests fairly horizontally at the present level of about seven feet below the surface.

(5) Deposition. (Deposit 3.) The deposit in the uppermost seven feet is of sandy silt and gravel lenses. The gravel lenses represent a river deposit. Most of the sand and silt are probably of river deposit, but a part of them may have been laid down by the wind. It is possible that the river cut into the surface at places, but no definite period of erosion is evident. From a lens of gravel lying from four to five feet beneath the surface were taken shards which were identified as preponderantly Gallup Black on White.

(6) Erosion. Modern arroyo cutting. The main river, or the tributary, which had laid down Deposit 3, disappeared. In late time, the river cut its present arroyo.

Potsherds from Chaco Cut 1

Sack No. 1 (Gravel Lens in Deposit 3)

Chaco Corrugated	22	42%
Chaco Black on White	17	34%
Gallup Black on White	7	14%
Wingate Black on Red	1	2%
Escavada Black on White	3	6%
Red Mesa Black on White	1	2%
	51	100%

Sack No. 2 (Gravel Lens in Deposit 3)

Gallup Black on White	12	38%
Escavada Black on White	7	22%
Chaco Corrugated	6	19%
Chaco Black on White	4	14%
McElmo Black on White	2	7%
	31	100%

Sack No. 3 (Deposit 2)

Escavada Black on White	12	80%
Exuberant Corrugated	1	7%
Gallup Black on White	2	13%
	15	100%

Sack No. 4 (Deposit 2)		
Escavada Black on White	11	50%
Gallup Black on White	3	13%
Exuberant Corrugated	3	13%
Red Mesa Black on White	2	11%
La Plata Black on White	3	13%
	22	100%
Sack No. 5 (Deposit 2)		
Escavada Black on White	37	55%
Exuberant Corrugated	27	39%
Gallup Black on White	4	6%
	68	100%
Sack No. 6 (Deposit 2)		
Escavada Black on White	39	91%
Exuberant Corrugated	3	7%
Affinis Gila Redware	1	2%
	43	100%

Chaco pottery types have[3] been dated from the charcoal found associated with the shards in the Chetro Ketl refuse mound[4] and from the types found associated with the successive building periods uncovered in Mound 50. The dates listed in the following table must be understood to be flexible and to represent periods of popularity of these types but neither the beginning nor the end of the period during which such vessels were made.

Chaco Black on White	1050-1130 A. D.
Gallup Black on White	950-1100 A. D.
Escavada Black on White	850- 950 A. D.
Red Mesa Black on White	800- 850 A. D.
La Plata Black on White	700- 800 A. D.

CONCLUSIONS

Deposit 1, at the bottom of the cut, was sterile of cultural material. This was cut by Erosion Surface 1, likewise sterile. In Deposit 2 were shards of Escavada Black on White, indicating that the period of erosion represented by Surface 1 probably came sometime before, or early in, the tenth century.

Erosion Surface 2 was apparently caused by a period of cessation of deposition if not of extreme erosion, antedating the deposition of Gallup and of Chaco Black on White shards in Deposit 3, directly above it. The date for Erosion Surface 2, then, would appear to be somewhere in the eleventh century.

3. Hawley: "Field Manual of Southwestern Pottery Types."

4. Hawley: "The Significance of the Dated Prehistory of Chetro Ketl, New Mexico," p. 63.

This approximate chronology of dry and wet periods in the Chaco as indicated by the profile of erosion and of deposition surfaces and as dated by the incorporated potsherds coincides with the tree ring chronology for the area. Much of Chetro Ketl remains to be excavated, but it seems probable, from the evidence of wall types and pottery, that it was occupied some time before the extreme drouth of 900 to 907 A. D. This drouth may be that responsible for the erosion of Surface 1, after which the shards of Escavada Black on White made in the pueblo were carried or washed onto the surface now listed as Deposit 2 but which was the ground level about 950 A. D.

Between then and 1035 the years, as indicated by the tree rings, were of average rainfall, with some dry seasons, but between 1035 and 41 there was another drouth, less severe than the one in the early 900's. It does not appear to have affected the expansion of the pueblos. Erosion Surface 2 is probably representative of this period.

Deposit 3 represents a post-drouth period, probably from about 1059 or 1100 A. D. onward. It contains the Gallup and the Chaco Black on White, which were both being made at the end of the century.

The successive erosion and deposition surfaces suggest increasing dryness in the canyon, although the tree ring growth indicates that there was no change in weather but merely a succession of wet and of dry periods. The increasing denudation of the canyon floor was, perhaps, because of deforestation and of farming, perhaps because of farming alone. Interpretation of the profiles on the cut of the canyon floor accords with the Douglass theory of recession of the forest border, after human despolation, and of consequent erosion of the light soil by wind and water.[5]

5. Douglass: "The Secret of the Southwest Solved by Talkative Tree Rings," and *Dating Pueblo Bonito and Other Ruins of the Southwest.*

APPENDIX II

BURIALS FROM MOUND 50 AND MOUND 51

By DONOVAN SENTER

The physical anthropologist must work hand in hand with the archaeologist in solving the problems of the migrations of peoples and of cultures. Every skeleton should be worked up as an integral part of the data of archaeology to aid in solving the problems of cultural relations. Certainly a physical type will change less than a pottery type in a given stretch of time. Eventually, the cross finds of skeletons as well as cross finds of pottery will figure in reports. Each skeleton should be treated as an "artifact" to be studied in its relations to the rest of the archaeological data pertaining to the site, period, and complex.

As a study grows and we reach the point of planning our digging to fill in hiatuses in our knowledge of relationships in sequences of pottery, wall types, other material cultural manifestations, and physical types, we shall fill in the chapters of the culture history of a region with more precision and with infinitely less loss of time than is possible in earlier and more hit or miss work. Why should the culture carrier not be studied as closely as his manifestations? Each excavation report should include measurements and other physical anthropological data, with an analysis, as an integral part of the problem, and the archaeologist should consider it as one of the factors to be considered in his distribution studies. It is not true that "men interbreed but pots do not," but certainly when there is a blending of techniques of pottery making, future pots are much less likely long to show the results of that amalgamation than are the carriers of the two techniques, who likewise blended. The physical combination may be analyzed and associated with the two pottery techniques, or at least with the culture complexes that accompanied those techniques.

The few skeletons which may appear from a small excavation do not constitute an adequate series for conclusions, but the archaeologist should measure and observe those skeletons and publish the raw measurements, at least, with a clear statement of their cultural association. Later, when sufficient data on any culture aspect have been accumulated in this manner, the raw data may be collected from the smaller publications and analyzed. One cannot analyze three skeletons but he can at least present their measurements so that they may be statistically analyzed by someone when a sufficient series has been collected, even though it be by small bits here and there. There is, of course, possibility of divergence of techniques in anthropometry but

any honest measurements and observations are far better than nothing at all. Anthropometrical techniques are not difficult and most archaeologists have had the elements of this training, so that a few days taken from the study of pottery or of stone work would be sufficient to work up a few otherwise neglected bones.

There is much to be said for the "validity of the argument in favor of the delayed publication of a final report,"[1] but many times these withheld data published in preliminary form would aid many workers in continuing their own research problems. Often two or more heads are better than one if they are working separately with all possible data toward the solution of a problem.

One may look forward to the day when excavations will be made especially to find the relations between certain physical types and to fill in their gaps, just as excavations were made at the previously carefully selected site of Showlow[2] to fill in a troublesome gap in the tree ring chronology.

DISPOSAL OF THE DEAD IN THE CHACO

Ever since the first excavations were begun in Chaco ruins, archaeologists have wondered at the amazing dearth of burials there. The canyon was the home of thousands of people at one time, as is proved by the number of rooms of the same building date in the large pueblos, and an archaeologist acquainted with the burial customs of the northern prehistoric Southwestern Pueblo people would expect to find thousands of graves. Instead, entire seasons have passed without the uncovering of a single skeleton, and the location of sixteen at Tseh So in 1936, fragmentary as they were, was reason for rejoicing.

As early as Jackson's expedition a skull was taken from a stratum sixteen feet below the surface near Pueblo del Arroyo.[3] At this point the profile of the canyon showed the ancient river bed, since filled, and "an undulating stratum of broken pottery, flint-chippings, and small bones firmly embedded in a coarse gravelly deposit" which represented "the ancient surface of the grounds about the pueblo, and was probably the sloping bank of the stream, which during the occupancy of the pueblo may have been a considerable river. Since the desertion of this region the old bed has become filled to the depth of at least fourteen feet, and through this the arroyo has made its present channel. A system of thorough excavation would undoubtedly reveal many interesting things and is probably the only method by which anything satisfactory will ever be learned of the industrious people who once filled this narrow valley."[4]

1. Guthe: Review of *The Pottery of Pecos.*
2. Douglass: *Dating Pueblo Bonito and Other Ruins of the Southwest,* pp. 33-41.
3. Jackson: *Report on the Ancient Ruins Examined in 1875 and 1877,* p. 443.
4. *Ibid,* p. 443, 444.

During the August, 1936, session in the Chaco, the University dug a trench south of Chetro Ketl, with two main objects in view: (1) to explore the possibility of a burial ground deep below the present surface of the canyon, and (2) to ascertain some indications of the precise profile of the landscape between Chetro Ketl and the present arroyo. No burials were found, but dated erosion surfaces show that many a Chaco burial ground could be so well covered with silt deposits, sixteen feet above the old surface at this point, that even if indications of it were found by trenching, a major excavation project would be required to remove the skeletons.[5] Other evidences of the deep fill which has covered the Chaco floor since the time burials would have been interred into it was the fourteen-foot fill found at the back wall of Chetro Ketl,[6] the twelve-foot fill observed in 1936 over a pit house cut in half by a break of the arroyo bank below Shabik'eschee Village, the twelve-foot fill observed by Judd in 1922 above a pit house cut in half by falling arroyo banks one mile east of Pueblo Bonito,[7] and the two to six-foot fill around the low mound on which Pueblo Bonito itself was built as indicated by Judd's three trenches cut to a depth of twelve feet.[8] Whatever burials may have been made in the canyon floor must await uncovering by teams and scrapers or by another period of erosion.

To the southwest of Chaco Canyon but in the Chaco culture district, a cemetery was pilfered a few years ago by the Navajos and the vessels sold to a trader. The pottery indicated its period as Pueblo III and possibly as Pueblo II, as well. No large ruin was near, but potsherd areas were found on the surfaces of low mounds near the burials.

The principal reason for supposing that the ancient people of the Chaco buried their dead in cemeteries on the canyon floor is that this was the general custom for the majority of people in the northern part of the Pueblo area. There is evidence, however, that more than one type of burial was made in the Chaco.

Pepper removed about 30 skeletons from a mound near Peñasco Blanco and a mound just south of the gap which opens out from the Chaco south and west of Pueblo Bonito.[9] These may have represented any period from Pueblo I to Pueblo III. He also removed a few burials from the room fills of Pueblo Bonito,[10] and Judd uncovered seventy-one burials in four rooms of the same village.[11] Most of Judd's burials were disturbed and the bones mixed, the vessels overturned and often broken.

5. Senter: Preliminary report "Tree Ring Analysis and Deposition," *Tree Ring Bulletin*, Vol. 3, No. 3, 1937; full report in Appendix I to this report.

6. *Ibid.*

7. Judd: *Archaeological Investigations at Pueblo Bonito*, p. 136, 1923.

8. *Loc. cit.*

9. Pepper: *Pueblo Bonito.*

10. *Ibid.*

11. Judd: "Archaeological Investigations at Pueblo Bonito," p. 85-6, 1925 and "Everyday Life in Pueblo Bonito," p. 245.

He suggests prehistoric grave robbery as the motive for this vandalism; the burials found undisturbed by Pepper were rich in turquoise, and turquoise was as valuable to prehistoric thieves as diamonds to those of today. Both Judd's and Pepper's series are now in the National Museum at Washington.[12]

A series of thirteen skeletons from Chetro Ketl, Talus Unit No. 1,[13] Rinconada, and near Una Vida were removed by the University of New Mexico and the School of American Research before 1936; they are at present in the Museum of New Mexico, Santa Fe.[14] Of these, all but two came from rooms. One was found in the refuse dump of Chetro Ketl,[15] and one was discovered partly washed out from its position beneath the edge of a large boulder of the talus slope about one-half mile east of Una Vida. Both the latter were flexed and accompanied by offerings, and most of those from Pueblo Bonito and from Chetro Ketl appear to have been flexed, although a few were extended and many were so badly disturbed as to give no indication of their original position. Almost all were accompanied by mortuary offerings of pottery, and many had jewelry of turquoise and of shell beads, turquoise inlay, and jet, shell, and pink stone carved into small animals (perhaps fetishes). Morris found most of the Aztec Ruin burials flexed, wrapped with matting, accompanied with pottery, and frequently disturbed. With Judd, he suggests ancient grave robberies as the cause.[16]

Pepper noted a number of burials of children beneath the floor of rooms in Pueblo Bonito and concluded that this "must have been a custom among the people who inhabited this pueblo."[17]

This gives six types of burials: burials in the valley floor, burials in mounds, burials in room fills, burials in refuse heaps, burials beneath the boulders of talus slopes, and child burials beneath room floors. There are two other possibilities to be considered in the disposal of the Chaco dead, and those are that cremation and perhaps cannibalism were practised.

Pepper found "a number of worked human bones"[18] in one room of Pueblo Bonito and cracked and calcined bones in another.[19] In one room of Peñasco Blanco he uncovered calcined bones which appeared to have been split open, and he concluded that these people may have

12. Hrdlicka: "Catalog of Human Crania, Pueblos, South Utah Basket Makers, and Navajo."

13. Woods: "Burial No. 4, Talus Unit No. 1, Chetro Ketl," pp. 61-62, and "Talus Unit No. 1, Chetro Ketl," pp. 144-146.

14. Paul Reiter, personal communication, 1937.

15. Hawley: "The Significance of the Dated Prehistory of Chetro Ketl," p. 63, and Fig. 3, Plate XIV.

16. Morris: "Burials, in the Aztec Ruin," p. 222-3.

17. Pepper, *op. cit.*, p. 264.

18. *Ibid*, p. 267.

19. *Ibid*, p. 378.

eaten human flesh occasionally either for religious purposes or because they were starving.

Hewett referred to the ash and charcoal filling the vaults of the great kiva of Chetro Ketl, but he found no identifiable bones there. He suggests that the vaults are "large enough to have served for the roasting of a whole buffalo, and they would have served perfectly for the incineration of the dead."[20] There is no reason to suppose that they used these vaults for the cremation of the dead, however, except that their size would have been adequate, that some burned human bones had been found in the other ruins, and that inhumations are scarce. The possibility that burial grounds have been deeply covered with drift since the period of prhistoric occupation of the pueblo has been discussed, and it seems that bones from burials which must have been disturbed when new graves were made, or which were disturbed at one time or another by thieves, might have been worked and utilized, or cracked open and burned. Ceremonial cannibalism and hunger remain as alternative explanations, but in the district where almost every burial uncovered shows disturbance in ancient times, the scattering of human bones and their occasional use scarcely seems to require those explanations. Cremation was the custom for southern Arizona, but inhumation was customary for the northern area, in spite of a few rare evidences of cremation reported from Hawikuh and the Jeddito district[21] and from around Flagstaff, where Hohokam dwellings and shards indicate strong influence from the South.[22]

The sixteen burials removed from Tseh So and from the one room opened in the adjoining ruin, Mound 51, were all from room fills, with the exception of one infant interred just above a Pueblo I wall and later covered by the Pueblo II wall of the western edge of the site. All of the five Pueblo I burials had been so disturbed that the original position of the body could not be ascertained. Of the eleven burials of Pueblo II from the two sites, the group of seven adult and one adolescent skeleton showed five flexed, one extended, and three too disturbed to indicate original position. Of the three infants, two were extended, and one too disturbed for data.

On the basis of what is known concerning Chaco burials at present, we can conclude that adult bodies were usually flexed but frequently extended for inhumation in open cemeteries or in room fills, and that occasionally they were placed along the talus slopes or in a refuse mound. Infants were frequently buried extended, although the number observed is too small to indicate what the general custom may

20. Hewett: "The Chaco Canyon in 1921," p. 123, 125.

21. Fewkes: "An Archaeological Collection from Young's Canyon, near Flagstaff, Arizona," p. 12.

22. Hargrave: "The Museum of Northern Arizona Archaeological Expedition, 1932," p. 28.

have been. They were placed in room fills or beneath the floor of a room. Cremation for disposal of the dead or for preparation of the body for ceremonial or for simple cannibalism may have occurred, but we are yet without data to substantiate such a theory.

BURIAL REMOVAL AND PRESERVATION OF BONES

The present tendency is for archaeologists to know enough about metric and morphologic observations so that they may work up the skeletal material from their excavations. With the exception of measurements such as skull capacity, these usually can be done in the field. Thus one determines just what material should be saved, and the bulk of the "scrap" can be discarded without first carrying it back into town, thus saving both storage space and shipping expenses.

It is highly desirable to preserve and to catalog all skeletons in the field, if the conditions permit. Alvar,[23] a commercial preparation, has been found to be very well adapted to the preservation of friable bones, and with it many which could not otherwise be used are saved for measurements. Sizing glue in a rather thin, warm solution may be brushed over bones or may serve as a liquid into which to dip and thus to preserve bones which are chalky or fairly friable.

All bones should be cleaned of as much dirt and mud as possible at the time of their removal from the ground. The transportation of skulls full of earth should be avoided. Should a skull crack and break, it should not be fitted together again before transportation, for the broken edges are easily shattered by motion during transportation. Each broken portion should be wrapped separately in newspapers to protect it so that eventual restoration is facilitated. Many bones, and especially skulls, may be treated with a preservative *in situ*, thus avoiding any fractures at the time of removal.

Most important from the point of view of the archaeologist is the culture stratum with which the skeleton and burial goods may be correlated. Therefore, in the excavation of a skeleton two things must be determined: (1) does the burial appear to have been intruded into the deposit within which it rests, or (2) was it laid down with the deposit? If it was intruded into the deposit, from what archaeological level did it come? Such problems as these are solved only by carefully searching for the outline of a pit into which the burial was laid and for the level from which the pit originated. If the burial is accompanied by mortuary offerings of pottery, these may aid in determining its horizon.

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23. Woodbury: "The Use of Polymerised Vinyl Acetate and Related Compounds in the Preservation and Hardening of Bones," p. 449-450.

BURIAL NUMBER	AGE OF INDIVIDUAL				POSITION OF BODY		ORIENTATION	PLACE OF BURIAL				WRAPPINGS	ACCOMPANYING OBJECTS				POTTERY TYPES	PERIOD
	ADULT	ADOLESCENT	CHILD	INFANT	EXTENDED	FLEXED		ROOM NUMBER	TRENCH	P.I ROOM FILL	P.II ROOM FILL		BONE	STONE	BASKETRY	ORNAMENTS	POTTERY	
Bc50 60/1			X 6		DISTURBED		N-S		WEST PREH. TRENCH	X	UNDER P.II WALL						1 JUG	RED MESA Bc50 10/2	P.I
Bc50 60/2				X 1-2	DISTURBED			7		X									P.I
Bc50 60/3a				X	DISTURBED			N.E. COR. 22			X						1 BOWL	WINGATE Bc50 10/36a	P.II
Bc50 60/3b	X				DISTURBED		E-W	N.E. COR. 22			X						1 JUG	UNDECORATED Bc50 10/17	P.II
Bc50 60/4				X	X		E-W	22			X	FRAG. REED MAT				SHELL EAR PLUG			P.II
Bc50 60/5	X ♂					X	N-S	22			X	TWILLED MAT	1 AWL	2 BALLS			4 BOWLS	WINGATE Bc50 18/1 TUSAYAN POLY Bc50 18/15 ESCAVADA Bc50 18/4 GALLUP Bc50 18/3	P.II
Bc50 60/6				X ?	X		N-S	11			X	GRASS MAT	14 BONE BEADS			NUTS	1 BOWL	McELMO Bc50 10/23	P.II
Bc50 60/7a				X	MIXED		E-W	3		X		GRASS MAT					1 BOWL	RED MESA Bc50 16/2	P.I
Bc50 60/7b				X	MIXED		E-W	3		X		TWILLED GRASS MAT					1 BOWL	McELMO Bc50 10/38	P.I
Bc50 60/8				X	DISTURBED			3		X		TWILLED MAT							P.I
Bc50 60/9	X ♂					X RIGHT ANGLE	E-W	6			X						2 PIECES	McELMO BOWL Bc50 18/6 ESCAVADA JUG Bc50 18/5	P.II
Bc50 60/10	X ♂					X	N-S	6			X						1 BOWL	GALLUP Bc50 10/8	P.II
Bc51 60/1	X				DISTURBED			1			X			1 AXE			X	SHERDS	P.II
Bc51 60/2		X			DISTURBED			1			X		3 AWLS				X	SHERDS	P.II
Bc51 60/3	X					X	N-S	1			X	MAT AND NETTING					X	SHERDS	P.II
Bc51 60/4	X					X	SE-NW	1			X	GRASS ON LEFT PARIETAL					1 BOWL	McELMO Bc51 10/3	P.II

FIG. 6—BURIAL RECORDS FROM MOUNDS 50 AND 51

BURIAL NUMBER	AGE OF INDIVIDUAL				POSITION OF BODY		ORIENTATION	PLACE OF BURIAL				WRAPPINGS	ACCOMPANYING OBJECTS					POTTERY TYPES	PERIOD
	ADULT	ADOLESCENT	CHILD	INFANT	EXTENDED	FLEXED		ROOM NUMBER	TRENCH	P.I ROOM FILL	P.II ROOM FILL		BONE	STONE	BASKETRY	ORNAMENTS	POTTERY		
Bc50 60/1			X 6		DISTURBED		N-S		WEST PREL. TRENCH	X	UNDER P.II WALL						1 JUG	RED MESA Bc50 19/42	P.I
Bc50 60/2				X 1-2	DISTURBED			7		X									P.I
Bc50 60/3a				X	DISTURBED			N.E. CORNER			X						1 BOWL	WINGATE Bc50 19/36a	P.II
Bc50 60/3b	X				DISTURBED		E-W	N.E. CORNER			X						1 JUG	UNDECORATED Bc50 19/37	P.II
Bc50 60/4				X	X		E-W	22			X	FRAG. REED MAT				SHELL EAR PLUG			P.II
Bc50 60/5	X ♂					X	N-S	22			X	TWILLED MAT	1 AWL	2 BALLS			4 BOWLS	WINGATE Bc50 19/35 TUSAYAN POLY Bc50 19/34 ESCAVADA Bc50 19/24 GALLUP Bc50 19/49	P.II
Bc50 60/6				X 3	X		N-S	11			X	GRASS MAT	14 BONE BEADS			NUTS	1 BOWL	McELMO Bc50 19/23	P.II
Bc50 60/7a				X	MIXED		E-W	3		X		GRASS MAT					1 BOWL	RED MESA Bc50 19/22	P.I
Bc50 60/7b				X	MIXED		E-W	3		X		TWILLED GRASS MAT					1 BOWL	McELMO Bc50 19/38	P.I
Bc50 60/8				X	DISTURBED			3		X		TWILLED MAT							P.I
Bc50 60/9	X ♂					X RIGHT ANGLE	E-W	6			X						2 PIECES	McELMO BOWL Bc50 19/32 ESCAVADA JUG Bc50 19/31	P.II
Bc50 60/10	X ♂					X	N-S	6			X						1 BOWL	GALLUP Bc50 19/48	P.II
Bc51 60/1	X				DISTURBED			1			X			1 AXE			X	SHERDS	P.II
Bc51 60/2		X			DISTURBED			1			X		3 AWLS				X	SHERDS	P.II
Bc51 60/3	X					X	N-S	1			X	MAT AND NETTING					X	SHERDS	P.II
Bc51 60/4	X					X	SE-NW	1			X	GRASS ON LEFT PARIETAL					1 BOWL	McELMO Bc51 19/3	P.II

FIG. 6—BURIAL RECORDS FROM MOUNDS 50 AND 51

BURIAL CUSTOMS OF MOUNDS 50 AND 51

Of the sixteen burials (fig. 6) removed from the two mounds, six were oriented north-south, and two east-west; the others were too disturbed for observations. All of the five Pueblo I burials were infants, three found in Room 3 and one in Room 7, Mound 50, and the other beneath the Pueblo II west wall of the same pueblo. All were disturbed: hence their body position is unknown. Remains of twilled grass mats which wrapped two were evident; three had never been wrapped in matting or the matting had disappeared through decay. Two were accompanied by one Red Mesa bowl apiece; three burials yielded no grave goods, but the femur from one of these was encircled with six stripes of dark paint.

These Pueblo I burials were given period identification by their accompaniment of Red Mesa Black on White bowls and by their position in the Pueblo I fill of Room 3 and, in one case, location beneath the wall of a Pueblo II room.

Seven burials representing Pueblo II were found in Mound 50 and four in Mound 51. Of the former, four were adults, two males, one female, and one undetermined. Three were flexed; one was disturbed. Of the whole group, two were found in Room 6, four in Room 22, and one in Room 11. Two of the adults were wrapped with matting, one section showing its twilled weave. One infant was wrapped in a twilled mat. Morris found most of the Aztec Ruin burials similarly wrapped.[24]

All were accompanied with pottery offerings. One adult had only a crude undecorated jar, one had a vessel of McElmo Black on White and one of Escavada Black on White, one had a vessel of Gallup Black on White, and one had a vessel each of Tusayan polychrome, of Wingate Black on Red, of Escavada Black on White, and of Gallup Black on White. With the body were also one bone awl and two small malachite balls.

Of the infants, one was accompanied by a large shard of Wingate Black on Red, one with a small shell earplug, and one with a McElmo bowl, fourteen bone beads, and some walnuts which appear to have been beads.

Four burials were removed from the single room opened in Mound 51. Three were adults, one an adolescent, one male, one female, and two unidentified. Two were flexed, two disturbed. One was lying on coarse yucca cord matting. One showed a clump of grass adhering to his left parietal, perhaps having been placed beneath the head as a cushion. One adult was accompanied with vessels of McElmo Black on White, of Kana-a Gray, and of Exuberant Corrugated. The others were without pottery except for shards.

24. Morris, *op. cit.*, p. 223.

TABLE IV

MEASUREMENTS AND OBSERVATIONS ON BURIALS FROM MOUNDS 50 AND 51

Cranial Observations

	Bc50 60/5	Bc50 60/9	Bc50 60/10	Bc51 60/1	Bc51 60/4
Sex	Male	Female	Female	Female	Male
Condition	frag.	frag.	frag.	frag.	frag.
Sex Criteria	certain	certain			uncertain
Muscularity	large	small			medium
Age	56-75	18-20			21-35
Weight	light	light			
Deformation	lambdoid	lambdoid			lambdoid r.
Degree	pron.				medium
Cause	artificial	artificial			artificial
Frontal Region					
Brow Ridges					
Type	divided	median			median
Size	medium	small			small
Glabella	medium	small			
Height	medium	medium			medium
Slope	medium	slight			slight
Metopism	traces	traces			
Postorbital Costr.	medium	medium			small
Bosses	medium	small			medium
Median Crest	abs.	abs.			
Breadth	large	large			
Parietal Region					
Saggital Elevation	small	small			small
Postcoronal Dep.	small	small			medium
Bosses					small
Foramina	small				small
Temporal Region					
Fullness	large				
Mastoids	medium	small			medium
Supramastoid Crest	large	small			medium

Sphenoid Depression	medium		
Occipital Region			
Curve	pron.	small	pronounced
Inion	none	none	none
Torus size	medium	small	medium
Torus shape	mound	mound	mound
Lambdoid Flattening	pron.	medium	pron.
Transverse Suture	trace	absent	absent
Serration			
Lambdoid	medium	medium	submedium
Coronal	simple	simple	simple
Saggital	?	simple	submedium
External Occlusion			
Coronal	complete	open	open
Saggital	complete	open	open
Lambdoid	advanced	open	open
Os Incae	absent	absent	absent
Wormian Bones	few	few	few
Pterion Form	H		
Median Occipital Fossa	absent	absent	
Condyles Elevation			large
Basion			
Styloids	small		small
Pharyngeal Tubercle	absent		small
Pharyngeal Fossa	absent		absent
Lacerate Foramina			small
Glenoid Fossa Depth	small	small	medium
Postglenoid Process	small	small	absent
Tympanic Plate	medium		thin
Auditory Meatus	oval		oval
Petrous Depression			
External Pterygoid Plate	small		
Internal Pterygoid Plate	medium		
Pterygo-basal Foramina	indicated		
Orbits Shape	rhomboid		
Inclination	medium		

MEASUREMENTS AND OBSERVATIONS ON BURIALS FROM MOUNDS 50 AND 51

Cranial Observations (Continued)

	Bc50 60/5	Bc50 60/9	Bc50 60/10	Bc51 60/1	Bc51 60/4
Lacrimo-ethmoid Art.	medium				
Infra-orbital Suture	none				
Suborbital Fossa	absent	slight			
Os Japonicum		absent			
Malar					
Size	medium	small			
Lateral Projection	large				
Anterior Projection	medium				
Marginal Process	absent	absent			
Zygomatic Process					
Nasion Depression	medium	small			
Nasal Root Height	medium	low			
Breadth	medium	large			
Nasal Bridge Height	medium				
Breadth	large				
Nasal Profile	concavo-conv.				
Nasal Sills	dull	sharp			sharp
Nasal Spine	medium	small			
Subnasal Grooves	small	absent			absent
Mid-facial Prognathism	absent				
Alveolar Prognathism	slight				
Total Prognathism	slight				
Alveolar Border Absorb.	pron.	none			
Preservation	poor				
Palate Shape	parabolic				
Palate Height	low	low			
Palatine Torus Form	absent	absent			
Size					
Transverse Suture	anterior				
Postnasal Spine	medium				

Mandible				
Size	medium	medium		
Chin Form				median
Chin Projection	medium			
Alveolar Prognathism	slight			
Genial Tubercles	small			slight
Mylo-hyoid Ridge	pron.			medium
Gonial Angles				
Pterygoid Attachment	medium			medium
Eversion	small			
Tooth Eruption	complete			
Lost	29-32			
Mandibular Torus	none			absent
Teeth Wear		slight		pron.
Quality		good		
Accessory Cusps				
Caries		none		pres.
Abscess	4-X			4-X
Size	medium			small
Pyorrhea	present	none		
Shovel Incisors				
Bite		edge		
Crowding				
Molar Cusps				

Measurements, Indices, and Observations

	Bc50 60/5	Bc50 60/9	Bc50 60/10	Bc51 60/1	Bc51 60/4
Cranial Index					
Height-Length					
Height-Breadth					
Fronto-parietal					
Auricular Height-Length					
Cranial Module					

Measurements, Indices, and Observations (Continued)

	Bc50 60/5	Bc50 60/9	Bc50 60/10	Bc51 60/1	Bc51 60/4
Facial					
Upper Facial					
Cranio-facial					
Nasal	53				
Left Orbital	79.4				
Nasalia-Transverse	65.				
Interorbital	22.2				
External Palatal					
Mandibular					
Zygo-gonial					
Fronto-gonial					
Zygo-frontal					
Horizontal Circumference					
Nasion-Opisthion					
Transverse Arc					
Glabello-occipital Length					
Maximum Width					
Basion-Bregma Height					
Mean Thickness L. Parietal	5				
Minimum Frontal Diameter	92				
Auricular Height					
Frontal Height					
Frontal Angle					
Total Facial Angle					
Mid-facial Angle					
Alveolar Angle					
Bizygomatic Diameter					
Nasion-Menton Height					
Nasion-Prosthion Height	71				
Basion-Nasion Length					
Basion-Prosthion Length					

Nasal Height	51			
Nasal Breadth	27			
Orbital Height—Left	31			
Orbital Breadth—Left	39			
Orbital Height—Right	31			
Orbital Breadth—Right	40			
Nasalia—Upper Breadth	13			
Nasalia—Lower Breadth	20			
Interorbital Breadth	22			
Biorbital Breadth	99			
Palate—External Length				
Palate—External Width				
Condylo-symphysial Length				103
Bicondylar Width				117
Height of Symphysis				
Bigonial				89
Minimum Br. Ascending Ramus		35		39
Mean Angle Mandible		118		113
Stature (Pearson Formula)				
Cranial Capacity				
Right Humerus				
Shape of Shaft	Plano-convex			
Perf. of Olecranion Fossa	absent			
Supracondyloid Process	absent			
Maximum Length				
Maximum Middle	22			
Minimum Middle	15			
Max. Diam. Head				
Middle Index	68			
Humero-fem. Index.				
Left Humerus				
Shape of Shaft	Plano-convex		Prismatic	
Perf. of Olecranion Fossa	absent		present	
Supracondyloid Process	absent		absent	
Maximum Length			322	

Measurements, Indices, and Observations (Continued)

	Bc50 60/5	Bc50 60/9	Bc50 60/10	Bc51 60/1	Bc51 60/4
Maximum Middle	22			18	
Minimum Middle	15			14	
Max. Diam. Head				42	
Middle Index	68			33	
Humero-fem. Ind.					
Right Radius					
Bowing					
Shaft Shape					
Interosseous Crest					
Maximum Length					
Humero-rad. Ind.					
Left Radius					
Bowing	slight				
Shaft Shape	prism				
Interosseous Crest	medium				
Maximum Length					
Humero-rad. Ind.					
Right Ulna—Max. Length					
Left Ulna—Max. Length					
Right Scapula					
Superior Border	concave				
Notch	submedium				
Vertebral Border	straight				
Teres Insertion	small				
Shape of Acromion					
Clavicular Facet					
Age Plaque					
Glenoid Shape					
Glenoid Lipping				beginning	
Pleating				medium	

Buckling		present
Atrophic Patches		pronounced
Left Scapula		
Superior Border	concave	
Notch	submedium	
Vertebral Border	convex	
Teres Insertion	small	
Shape of Acromion	interm.	
Clavicular Facet	lipped	
Age Plaque	pron.	
Glenoid Shape	oval	
Glenoid Lipping	beginning	
Pleating	medium	
Buckling	present	
Atrophic Patches	pron.	
Right Scapula		
Total Height	152	
Inferior Height	119	
Breadth	103	
Total Index	67.7	
Inferior Ind.	86.5	
Left Scapula		
Total Height	152	
Inferior Ht.	118	
Breadth	100	
Total Index	65.3	
Inferior Ind.	84.7	
Right Clavicle		
Maximum Length		
Left Clavicle		
Maximum Length		
Claviculo-Humeral Ind.		
Right		
Left		
Sternum		
Fusion		

Measurements, Indices, and Observations (Continued)

	Bc50 60/5	Bc50 60/9	Bc50 60/10	Bc51 60/1	Bc51 60/4
Foramen					
Suprasternal Ossif.					
Sternal Ribs					
Right Femur					
Third Trochanter	absent			medium	
Crista	medium			medium	
Fossa	absent			absent	
Torsion					
Poirier's Facet	present				
Bowing				medium	
Shaft Section	oval			oval	
Bicondylar Length					
Maximum Length					
Max. Diam. Hd.	44				
Subtrochanter AP.	26			29	
Subtrochanter Lat.	30			34	
Middle AP	30			27	
Middle Lateral	24			28	
Platymeric Index	86.6			55.8	
Middle Index	80			96	
Left Femur					
Third Trochanter	absent				
Crista	medium				
Fossa	absent				
Torsion					
Poirier's Facet	present				
Bowing					
Shaft Section	oval				
Bicondylar Length					
Maximum Length					

Max. Diam. Hd.	44
Subtrochanter AP.	
Subtrochanter Lat.	
Middle AP.	
Middle Lateral	
Platymeric Index	
Middle Index	
Right Tibia	
Proximal Retroversion	medium
Shape of Shaft (Hrd.)	III
Squatting Facets	absent
Maximum Length (l. s.)	
Middle AP.	
Middle Lat.	
Nutrient For. AP.	
Nutrient For. Lat.	
Middle Index	
Platycnemia Ind.	
Left Tibia	
Proximal Retroversion	medium
Shape of Shaft (Hrd.)	III
Squatting Facets	present
Maximum Length (l. s.)	
Middle AP.	
Middle Lat.	
Nutrient For. AP.	36
Nutrient For. Lat.	20
Middle Index	
Platycnemic Ind.	55.5
Right Fibula	
Max. Length	
Left Fibula	
Max. Length	
Tibio-Femoral Indices	
Right	
Left	

Measurements, Indices, and Observations (Continued)

	Bc50 60/5	Bc50 60/9	Bc50 60/10	Bc51 60/1	Bc51 60/4
Right Innominate					
Phases of Symphysis	IX				
Bony Outgrowths	absent				
Ischiatic Notch					
Preauricular Sulcus					
Ilium					
Ischiatic Spine					
Innominate Height	209				
Innominate Breadth					
Innominate Index					
Left Innominate					
Phases of Symphysis	IX		IX		
Ischiatic Notch					
Preauricular Sulcus	absent		large		
Ilium	flaring				
Ischiatic Spine	broken				
Innominate Height	211				
Innominate Breadth	152				
Innominate Index	72				
Pelvis as a Whole					
Subpubic Angle	narrow		large		
Brim Shape	heart				
Pubic Rami	lipped				
Total Brd. (bi-iliac)					
Max. Brd. (superior str.)	133				
AP. Diam (sup. strait)	103				
Bi-ischiatic Brd.					
Interspinous Diam.	93				
Brim Index	77				
Total Pelvic Index					

Sacrum			
Segments	5		
Sacral Curve	pron.		
Curve Begins	three		
Simian Notch			
Sacral Type	homobasal		
Spinal Closure Begins	five		
Hiatus			
Arthritic Changes	present		
Height	117		
Breadth	117		
Index	100		
Lumbars			
Centra Hts. (ant.)	132		
Centra Hts. (post.)	150		
Lumbar Vert. Ind.	88.8		
Right Calcaneum			
Axis of Tuberosity			
Tendon Attachment			
Lateral Process			
Astragalar Facets			separate
Max. Length		64	
Max. (s. t.) Brd.		33	
Length-Brd. Ind.		51.5	
Left Calcaneum			
Axis of Tuberosity	medium		
Tendon Attachment	medium		
Lateral Process	submed.		
Astragalar Facets	fused		
Max. Length	74	64	
Max. (s. t.) Brd.	39	34	
Length-Brd. Ind.	52.7	53	
Right Astragalus			
Angle of Diversion			small
Squatting Facets			absent

Measurements, Indices, and Observations (Continued)

	Bc50 60/5	Bc50 60/9	Bc50 60/10	Bc51 60/1	Bc51 60/4
Obliquity External Facet					
Torsion Head					
Max. Length					
Max. Breadth					
Height					
Length-Ht. Ind.					
Left Astragalus					
Angle of Diversion	small				small
Squatting Facets	absent				absent
Obliq. Ext. Facet	medium				small
Torsion Head	medium				large
Max. Length	51				
Max. Breadth	39				
Height	30				
Length-Ht. Ind.	58.7				

The Pueblo II burials were distinguished for period by their accompanying pottery types and complexes, by their position in Pueblo II fill in rooms (which probably places them as late rather than as early Pueblo II in these ruins) and by the obvious high levels of origin of the graves.

CONCLUSIONS ON BURIAL CUSTOMS

The burials from these two mounds were predominantly in room fills, predominantly flexed, wrapped in or placed upon matting, and accompanied by pottery. Infants may have been buried in the extended position rather than flexed. Most of the graves were disturbed, the bones were out of place, and bones from two skeletons were frequently mixed together. Other skeletons were represented by but a few bones or fragments. Prairie dogs, grave robbers, or superposition of burials may have been responsible for the general state of disturbance of burials.

CONCLUSIONS ON BONE MATERIAL

This season's series, if we may grace this fragmentary group of bones with that title, offers little scope for the wielding of calipers. The empty spaces in the above schedule clearly point to the unsatisfactory condition of the skeletons, but those filled in call attention just as strikingly to the fact that although a skeleton may be crushed, its usefulness is not entirely lost.[25] "Morphological features which can be observed and described but cannot be measured are probably of greater anthropological significance than diameters and indices."[26] A majority of these observations can be taken on skeletal material which in the old days would have been considered osteometrically hopeless.

"Unfortunately the personal equation of the observer inevitably enters into the graduation of such morphological observations. It has long been my custom to grade and record morphological features with respect to their development as compared with my judgment of average development in adult male Europeans. The reader may inquire, 'What kind of "adult male European" is referred to?' My conception of the adult male European is essentially that of a Northwestern European of stature 170 cm. or more, of moderate muscularity, with a cranium neither markedly dolicocephalic nor pronouncedly brachycephalic, and with a face neither short and broad nor long and narrow, but of medium proportions. Other features, such as are individually observed and graded, would conform to the mode. Brow-ridges would not be very strongly marked, for example, nor would the chin eminence be poorly developed. Taking this hypothetical average male European as a standard, I grade features on the following scale: absent, small or

25. Bc51 60/3 was removed *in situ* to the museum for exhibit as a Chaco burial. It was in perfect condition but was not measured.

26. Hooton: *The Indians of Pecos*, p. 80.

submedium, medium, large or pronounced, and very pronounced. I am confident that an experienced anatomical observer who has practised this method for many years, as I have done, can attain to a considerable degree of accuracy and consistency in making these morphological observations. Of course, sets of observations made by different observers are not necessarily strictly comparable. However unsatisfactory one may consider such qualitative observations, he must admit that they are better than nothing at all. They lend themselves to a measure of statistical treatment and are certainly superior to the vague and general descriptions of skull 'types' which many craniologists append to their metrical studies."[27]

In view of T. Dale Stewart's recent note[28] concerning "different types of cranial deformity in the pueblo area," it is interesting to find that, where the skulls of this group were not too broken for observations, the lambdoid type of deformation prevailed. He pointed out that this type of deformity seems to be limited to Southwestern Colorado, Chaco Canyon, and the Zuñi and Allentown regions. It is in these same areas that we find a spread of the Chaco type culture. Thus a skeleton becomes just as much an artifact as a potsherd is an artifact. Wherever the Chaco people migrated after 1100 A. D., they probably carried with them their custom of lambdoid deformation.

Arthritis was a common ailment in Chaco, if we can judge by this fragmentary collection. Skeleton No. Bc 50 60/5 had an arthritic foot and showed compression fractures in the dorsal vertebrae. Bc 51 60/1 exhibited the head of a radius with arthritic lesions.

No. Bc 51 60/4 displays an ossification of the *ligamentum apicis dentis epistrophei.*

In themselves the observations above prove nothing. They represent, however, all that could be done in a physical anthropological way to what appeared to be on first sight nothing but a pile of broken bones. A sufficient number of seasons' analyses will compile into a series adequate for conclusions, where otherwise existed a vacuity. Such a small series of fragmentary skeletons, even though from a single identified culture level, Pueblo II, offers little in significant results, but its immediate importance lies in the possibility of comparisons of data from other larger groups. T. Dale Stewart, Assistant Curator of Physical Anthropology in the National Museum, has ready for publication his measurements and observations on a series of about 100 skeletons from the Chaco Canyon, and this material may be expected to throw considerable light upon our problems.[29]

27. *Loc. cit.*
28. Stewart: "Different Types of Cranial Deformity in the Pueblo Area," p. 169.
29. Stewart: *op. cit.*, p. 170.

APPENDIX III

THE REFUSE DUMP OF MOUND 50

By FLORENCE M. HAWLEY

DESCRIPTION AND TECHNIQUE

The refuse heap of Mound 50 measured on the present surface roughly sixty by one hundred feet (Fig. 7); but its original extent was probably somewhat larger, for the edges were lost under the blanket of drift deposited since prehistoric times. The mound was marked off into six foot squares, designated from north to south as Trenches and from east to west as Sections. Excavation began on the north end, Section I, in nine trenches, each square being worked by two students at a time. The students supervised the excavation in six inch absolute levels, designated by numbers running from the bottom upward and measured by transit from a base line laid at the bottom of the northern edge of Section I, where a preliminary trench was cut. The actual digging was done mostly by Navajo laborers, but the students removed the shards from the soil as it was shoveled up or as they slowly shoveled it up themselves. Screens were not used because it was thought that in the large amount of soil to be removed from each square the small number of shards probably missed by the quicker technique of picking over the material would not be significant. It was found to be more difficult to teach the students to be practical than to be careful; they were inclined to section the dump, inch by inch, with trowels!

The shards collected were sacked and the sacks marked with the Section, Trench, Level, date and initials of the worker. Most levels required several shifts of work, morning and afternoon, and more than one bag for the shards. The shards were brought to the laboratory tent at the end of each shift, and there they were washed and classified by the laboratory classes.

After the shards had been classified, the classification checked, and percentages computed, these percentages were entered on large charts marked into Sections, Trenches, and Levels, representing the dump, as well as on individual blanks mimeographed for the purpose. The study of associations of types of pottery by Section and Level indicated that the complexes for each period were consistent except for the overlapping of some types from period to period, as might be expected in any continuously occupied site. In the Chetro Ketl dump, holding over of types was marked; there was never a strict demarkation of period by presence or absence of certain types but only by preponderance of certain types. Types first made in small percentages in one period grew to be the most popular and characteristic types of the next period and

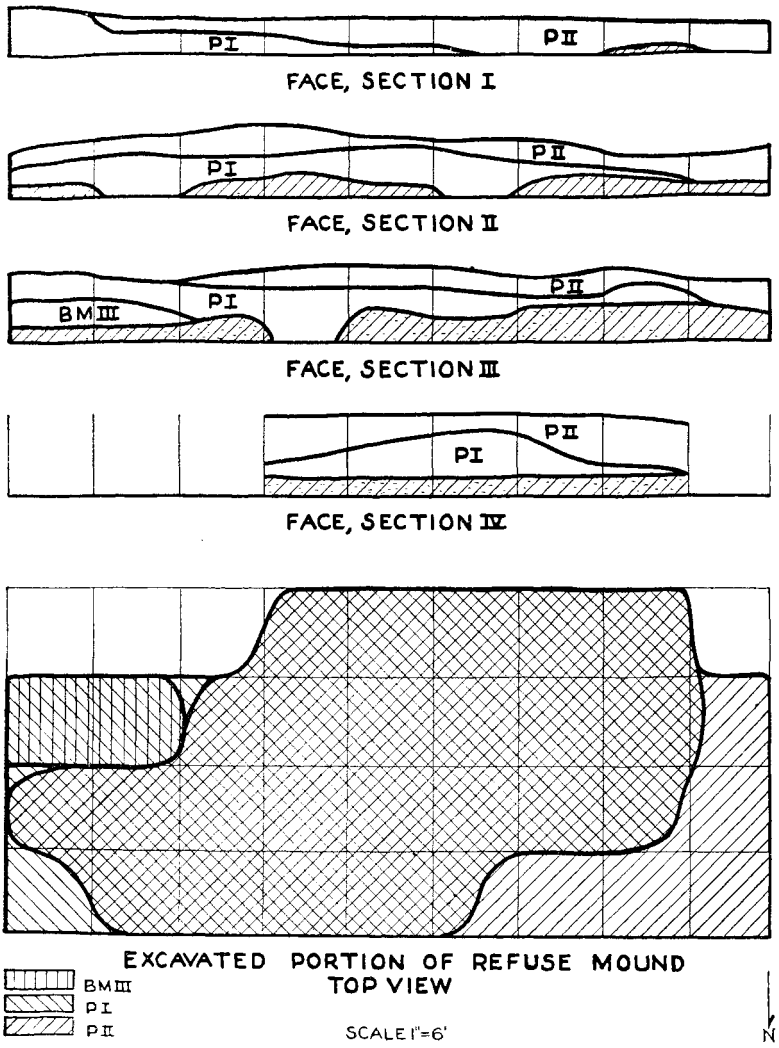
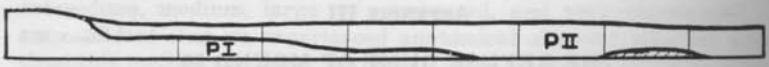
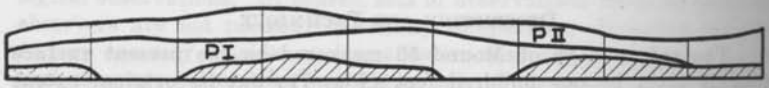


FIGURE 7
GRAPHS OF REFUSE MOUND

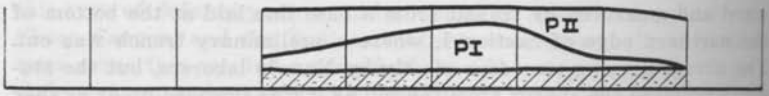


FACE, SECTION I

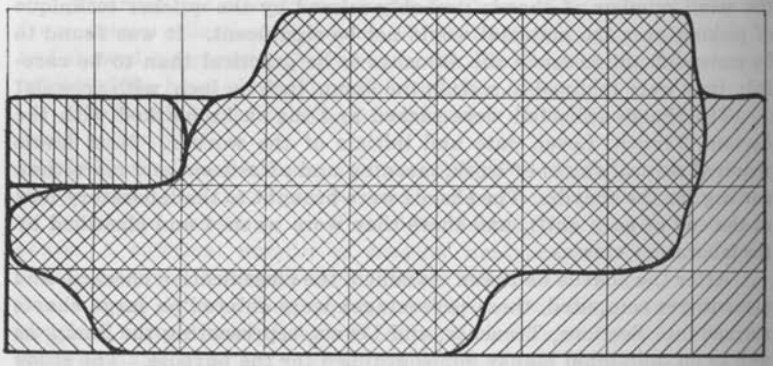


FACE, SECTION II

FACE, SECTION III



FACE, SECTION IV



EXCAVATED PORTION OF REFUSE MOUND
TOP VIEW

BM III
PI
PII

SCALE 1"=6'

N

FIGURE 7
GRAPHS OF REFUSE MOUND

fell to small percentages again as they died out in the succeeding period. Hence, periods and their strata can not be identified by one pottery type any more than a skeleton may be classified racially on one characteristic; a study of the predominating characteristics, however, will mark off strata by period, and the lines of these strata were drawn onto the charts for each section. Comparison of the outlines of the topography of the strata for each period through all the sections provided an outline of the shape and slopes of the refuse mounds of the three period represented, as far as they were uncovered. No indication of division of the dump by strata was apparent in the trench profiles.

EXTENT OF DUMP INVESTIGATION

The nine trenches were carried to such a depth that no more shards or charcoal were found at the bottom through three Sections, or eighteen feet, from north to south. At that point it was apparent that there would not be time to proceed much farther into the dump during the season, so work was concentrated on Trenches 2, 4 and 6, and all others in Section 4 were abandoned. In the four sections the outline and slope of the various strata of the three periods, Basket Maker III, Pueblo I, and Pueblo II, can be drawn from the shard data. No datable charcoal was found in the dump, hence the dates for the strata must be inferential, from the dates on the house structures.

RESULTS AND CONCLUSIONS

The dump is made up of the refuse from the superimposed villages of Mound 50 and probably from some adjacent pit houses, the periods of Basket Maker III, Pueblo I, and Pueblo II, being represented. Constant occupation of the site and use of the dump is indicated by the merging of the periods one into the other and by the lack of period profiles. Because of this merging, the outlines of the dump for each period can be no more than approximate, but as such they give the general height, shape, and slope, and consequently, the direction of growth. It is possible that refuse from Mound 51, just to the east of the dump, is likewise represented in the refuse shards. Shards in Mound 51 rooms indicated the site to be Pueblo II.

Refuse of Basket Maker III.

The only pure deposit of Basket Maker III material is in the southeast corner of the area excavated, in Trenches 7 and 8, Section III. (Fig. 7). The shards are Lino Gray (Hargrave[1] and La Plata Black

1. Hawley: "Field Manual of Prehistoric Pottery Types," p. 21 (Reference is made to this manual because in many instances several men have written upon one type of pottery. References to the original descriptions of these pottery types may be found in the bibliography appended to the Manual).

on White (Gladwin).[2] The small mound of this material suggests one or more pit houses in the near vicinity and perhaps covered by the later deposits.

In the northeast corner of the excavated area the proportions of Lino Gray and of La Plata Black on White are high enough to suggest that at least some of this debris may be of Basket Maker III but later mixed by surface wash with material from Pueblo I. Beneath Trenches 8 and 9 in Section I were found sandstone slabs so set into the ground that their identification as the outline of one or more pit houses was possible.

Experimental attempts at a colored ware appear to be indicated in sporadic shards of an orange-red on dull light orange, shards which may possibly be merely over-fired Black on White but which on close examination shows such uniformity as to suggest intentional use of the colors as they stand at present.

Refuse Mound of Pueblo I.

Pueblo I is represented here by a pottery complex in which Lino Gray and Red Mesa Black on White (Gladwin)[3] rank highest in proportion, with Escavada Black on White (Hawley)[4] and Exuberant Corrugated (Roberts)[5] as the next two highest, and Gallup Black on White (Hawley)[6] as a low percentage. The first three are predominant in Pueblo I; the latter two, predominant in Pueblo II and into the early part of Pueblo III, were evidently being made for the first time. The designs of the La Plata Black on White are found to be carried over, in part, to Red Mesa and to the Escavada Black on White, and the designs of the Escavada are found to be carried over, in part, to the Gallup Black and White. In so far as a type piece of pottery carries the designs chiefly characteristic of a preceding or of a succeeding period, it is probable that that piece was made earlier or later within the period to which it is assigned by its most important characteristics, but this observation cannot be used as a strict criterion of age or of period, although, with other indications, it may aid in such time identification.

Red Mesa Black on White was originally marked by Gladwin as in the Mancos Mesa phase of Pueblo II, and it was identified with the

2. *Ibid.*, p. 23.

3. Gladwin: "A Method for the Designation of Cultures and Their Variations," Fig. 8.

4. Hawley: *op. cit.*, p. 32.

5. *Ibid.*, p. 33.

6. *Ibid.*, p. 42. The concluding sentence "closely resembles Gladwin's Red Mesa Black on White of Pueblo II from the Red Mesa district" is appended to the description of Gallup Black on White by a mistake in proof reading; the sentence pertains to Escavada Black on White, p. 32.

Chaco Transitional Black on White (Roberts)[7]. The Chaco Transitional has now been broken up into the Red Mesa Black on White of Pueblo I and of early Pueblo II, and the Escavada Black on White of late Pueblo I and of Pueblo II. The former stands close to the Kiatuthlanna Black on White (Gladwin)[8] in typology, with thin walls, polished slip, and designs which indicate development from the La Plata Black on White, while the latter is distinguished by walls which average slightly thicker, by an unpolished slip, and by heavier designs which carry over some of the elements of Pueblo I but with the thicker lines of Pueblo II. The stratigraphy and associated trade shards of Mound 50 dump indicate that while Red Mesa lasted into Pueblo II, it was paramount in Pueblo I, in the Chaco, while the Escavada was second, but the Escavada was more popular than Red Mesa in early Pueblo II. The Escavada is more of a borderline transitional type then the Red Mesa, although both ran from one period into the other.

It should be noted, also, that the shards designated as Lino Gray might equally well be shards from the lower portion of a Kana-a Gray (Hargrave) vessel typical of Pueblo I. This situation has been kept in mind throughout the study. Moreover, since the so-called Lino Gray has been found in appreciable amounts all through the dump, in every stratum, it is possible that either the true Lino Gray or the neck-banded Kana-a Gray[9] were made through Pueblo II at this site, but another consideration must accompany such a question. Since the Red Mesa Black on White and the La Plata Black on White are likewise found scattered throughout the dump in minor percentages, we must either postulate considerable holding over of these styles into later periods or considerable mixing of the dump material through such agents as gophers or the washing of the steep sides of the earlier deposits and the consequent mixing of shards from these deposits with those of the later period. The latter would seem the more reasonable explanation. The steepness of the mound of Pueblo I and the large association of Basket Maker III shards in this mound in the northeastern corner, over the pithouses (?), would certainly make for considerable mixing, during the wash of heavy rains, of Pueblo I and Basket Maker III shards with those being deposited during Pueblo II just to the west of the steep peak of the earlier mound. (Fig. 7.)

Trade relations of this period are indicated by scattered shards of Deadman's Black on Red (Colton),[10] by the unnamed thin walled Pueblo I ancestor of the red ware with black burnished interior found in the Upper Gila and Mogollon districts, by a shard which was identified by

7. Gladwin: *op. cit.*, p. 20, Fig. 8.
8. Hawley: *op. cit.*, p. 27.
9. Hawley: *op. cit.*, p. 25.
10. *Ibid.*, p. 26.

Haury[11] as belonging with those from the White Mound site on the Arizona Puerco, dating about 700 A. D., by Lino Black on Gray (Hargrave)[12] and Kana-a Black on White (Hargrave)[13] from the Flagstaff district, by the gray with black smudged interior found by Roberts in the Stollsteimer Mesa ruins of the Piedra district.[14]

One small bowl of peculiar black on red ware of Pueblo I design and finish was taken from a Pueblo I grave, and a number of shards of similar type were found in the dump. This vessel is of gray paste, fairly coarse in texture, and is slipped on outside and inside with a dull red which is only bright enough in color to indicate that the shade was not due to over-firing. The color is not of the ruddy shade on later bowls of the various types of black on red known in the Southwest, however, and suggests that the vessel represents an early experiment with red slip by a people who were more accustomed to making black on white vessels. The bowl was examined by J. O. Brew of the Peabody Museum, who has kindly allowed his comments to be quoted.

"At first glance in the interior it suggests in color possible relationship with the early black on white which Morris finds so prevalent in the La Plata region and of which I find a few shards on Alkali Ridge. However, the paste and the exterior color are sufficiently different from any of my Alkali stuff at least to prohibit classing the two together, even aside from the design. The panelled band of the design with the parallel lines division, which is characteristic of the later developmental Pueblo Black on White on Alkali, does not occur in the red on orange. Such a piece found on Alkali I should expect to be associated with very early type kivas and small houses of wattle and daub or one and two room coursed masonry. Such an attempt at placing the piece is based entirely on the design as that is the only thing that is strictly comparable to specimens from my sites on Alkali."[15]

The steep western and lower eastern slopes of the mound of Pueblo I (Fig. 7) indicate that it grew up from the west, the people walking out from their homes, climbing to the top of the growing mound, and throwing their sweepings over onto the eastern side. The location of the dump on the eastern side of the house mound, as at Chetro Ketl, was probably the result of their observation of the prevailing westerly winds and the desire not to have the trash blown back into their faces and into their houses. It will be noticed that the northern end of the Pueblo I dump is entirely on the east side of the excavated portion of the refuse mound; the peak is in Trench 9. The peak in Section II is

11. Personal communication.
12. *Ibid*, p. 22.
13. *Ibid.*, p. 27.
14. Roberts: *Early Pueblo Sites in the Piedra District, Southwestern Colorado*, p. 79.
15. Personal communication, May 22, 1937.

in Trench 5, with a fairly even distribution east and west of that trench but in a very steep slope on the west and a low gradual slope on the east. In Section III the peak is in Trench 9, with a low slope toward the west, and in Section IV the peak is in Trench 4, with a very steep slope on the west and a slope only slightly less steep on the east. By this tracing of peaks and slopes we may outline the original dump of Pueblo I, a somewhat serpentine curving of the ridge, with the central section closer than the ends to the house mound and wider than the nine trenches excavated. (Fig. 7.) This Pueblo mound covered the Basket Maker III hummock and extended beneath the Pueblo II dump and roughly catercornered to it, to somewhere beyond the present excavations, so that neither end has been uncovered and hence cannot be plotted. The relative narrowness of the early mound in Section IV suggests, however, that we are fairly close to the south end.

Refuse Mound of Pueblo II.

The mound of Pueblo II extends everywhere outside the limits of the present excavation and beneath the top soil which covers its edges. The excavations probably approach the edge most closely on the north side. The trenches were carried only to somewhere near the center of the mound as visible from the surface. The top of the dump as seen at present rises in a gentle slope toward the center and falls away on all sides; any sharp peak it once may have had has been eroded away by the flattening effects of centuries of winds and rains. (Fig. 7.)

The Pueblo II deposition is made up of the Pueblo I complex with the addition of appreciable amounts of Gallup and of Chaco Black on White. Thus the Pueblo II complex may be outlined as containing Gallup, Escavada, and some Chaco Black on White, Exuberant Corrugated and the finer Chaco Corrugated,[16] plus the gray ware that is either Lino or the bases of Kana-a vessels, and a small proware that is either Lino or the bases of Kana-a vessels, and a small proportion of Red Mesa Black on White. Mesa Verde influence is indicated by finds of shards which appear to be preponderantly McElmo Black on White (Gladwin).[17] The Mesa Verde sequences have never been worked out in detail; descriptions on the types which precede the McElmo are not available, and even those of the McElmo leave something to be desired when one is attempting to differentiate between shards of the Mesa Verde Black on White (Kidder) and the earlier McElmo type. As nearly as could be determined, however, the shards here listed as McElmo legitimately fall into that classification by their heavy and simple design elements; that they belong in the Mesa Verde line, at least, is certain.

16. *Ibid.*, p. 44.
17. *Ibid.*, p. 31.

Wingate (Haury)[18] and Puerco (Gladwin)[19] Black on Red and Wingate Corrugated (Mera)[20] shards indicate relations with the areas slightly to the south, where those types were common, and sporadic pieces of Tusayan polychrome (Gladwin)[21] corroborate the evidence of whole vessels of this type in graves that trade with the area to the west was not uncommon. A very few shards of the fine Upper Gila Corrugated (Kidder) with black burnished interior[22] and of the San Francisco Red (Haury)[23] of the Mogollon area point to trade with the southern part of New Mexico, and red shards with the cinder temper common in the Flagstaff district suggest that they originated there, although with a heavy outer red slip and no inner slip they are identical with neither the unslipped Sunset Red (Colton)[24] nor the slipped Flagstaff Red (Colton)[25] with its red interior slip and slipped burnished black interior. Shards which might be Flagstaff Red except that their temper is sand rather than cinder, and which might be Gila Red (Gladwin)[26] except for the lack of pronounced striation on the outer red slip obviously indicate trade somewhere to the south and west.

Apparently there never was much Chaco Black on White made during the occupation of Mound 50; a few pieces were made, but this ware was to grow into prominence, accompanied by the hold-over of Gallup Black on White, in the Pueblo III complexes of Chetro Ketl and of the other major ruins. It should be noted that where the Exuberant Corrugated supposed to mark Pueblo II is prominent, Lino Gray follows as a close second. Evidently the plain gray ware lasted over a considerable period.

Other types of pottery supposedly limited to earlier periods are found in the Pueblo II stratum, as listed above, and their presence may be attributed to the two reasons already stated, wash from the high ridge of Pueblo I material onto the growing mound of Pueblo II just to the west and hold-overs of one type into the period of the next complex. The pottery associations found in the dump are checked by those found accompanying burials in the two main periods of occupation of the house mound.

SUMMARY

The refuse mound just to the east of Chaco Mound 50 represents the sweepings of three periods, Basket Maker III, Pueblo I, and Pueblo

18. *Ibid.*, p. 48.
19. *Ibid.*, p. 48.
20. *Ibid.*, p. 48.
21. *Ibid.*, p. 38.
22. *Ibid.*, p. 53.
23. *Ibid.*, p. 104.
24. *Ibid.*, p. 30.
25. *Ibid.*, p. 41.
26. *Ibid.*, p. 55.

II. The only spot in which the Basket Maker III material is conspicuously free from later contact is the small mound in the southeast corner of the portion excavated. The Pueblo I sweepings cover over this mound and extend roughly from the northeast to the southwest, with a sharp ridge at the two ends and a wider slope in the center. The peak of this dump in Section I is at the most eastern edge of the present excavations. Material from this peak was undoubtedly washed onto and mixed with the growing refuse of Pueblo II at the foot of and just to the west of the peak of earlier material and accounts for the mixture of material of the two periods which is more marked in Section I than elsewhere.

The refuse of Pueblo II finally covered that of Pueblo I and spread out beyond it, but the exact peripheries of this later mound are beneath the drift which has since accumulated over it. The peak of the Pueblo II refuse has been eroded until the top of the present mound is a gentle slope on all sides.

The complexes of pottery types representing the three periods are distinctive, although types from earlier periods are held over and types prominent in later periods are found in small percentages in earlier sweepings. The lack of marked profiles in the dump and this merging of one period into the other in pottery types indicates continuous occupation of the mound over the periods of Pueblo II and I and probably through Basket Maker III, this first occupation being certain in the near environs of Mound 50 if not directly upon it.

The complex which marks Basket Maker III here is made up of Lino Gray and of La Plata Black on White.

That which marks Pueblo I is made up of Lino Gray, Red Mesa Black on White, a smaller proportion of Escavada Black on White, and some Exuberant Corrugated and a small amount of Gallup Black on White.

The complex marking Pueblo II here consists of that of Pueblo I plus a preponderant proportion of Gallup and Escavada, some Chaco as well as Exuberant Corrugated, and a small amount of Chaco Black on White.

Trade for Pueblo I is indicated by shards from the Mogollon districts, from the Little Colorado and the Arizona Puerco, and from the Flagstaff district.

Trade for both Pueblo I and Pueblo II is indicated by shards from the Upper Gila and the Mogollon areas, from the Mesa Verde, Kayenta, and Flagstaff districts of the San Juan, and from the Little Colorado.

There is no evidence that Mound 50 was occupied during the main part of Pueblo III nor that the dump was used during Pueblo III. Although it is impossible to state the exact date of abandonment of the site, that should be set as at the end of Pueblo II or during the very

beginning of Pueblo III in the Chaco. The wall series and the pottery complexes of Mound 50 tie in perfectly with those of Chetro Ketl and thus amplify the sequences to extend from Basket Maker III to the abandonment of Chetro Ketl after 1116 A. D. in Pueblo III.

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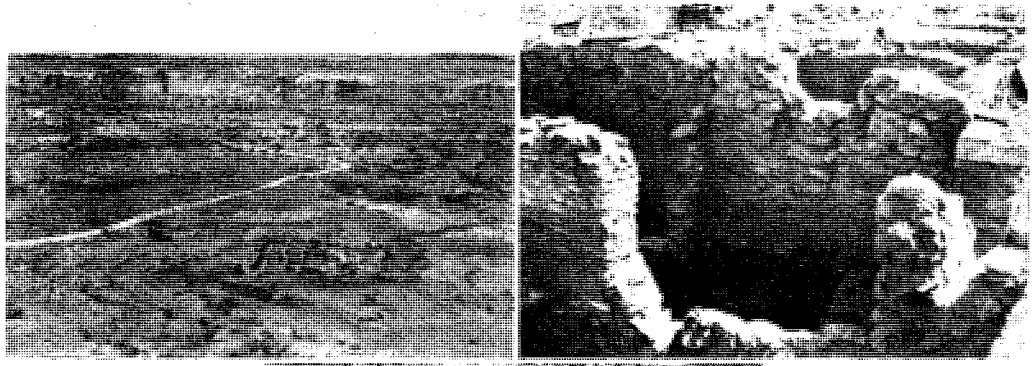
Plates

PLATE I



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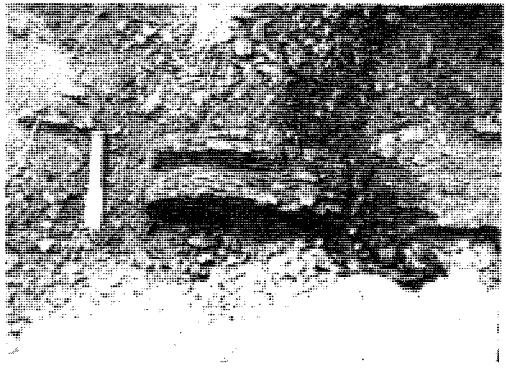

c

a. General View of Tseh So from the Cliffs to the South of the Ruin. Pueblo Bonito Lies in the Left Background.

b. View of Central Portion of the Pueblo Showing Pueblo II and Pueblo I Layers Beneath.

c. The Section of a Viga from Room 15 Which Yielded a Date of 922+.

a

b

c

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c. The Section of a Viga from Room 15 Which Yielded a Date of 922+.

PLATE II

a. The Ruin and the Refuse Mound at the Beginning of Operations. The Line of Students in the Foreground Marks the Northern Edge of the Stratigraphy Test. Those in the Background Are Tracing out Wall Lines on the Pueblo.

b. The Students of the Field School Listening to a Lecture on Burial Removal.

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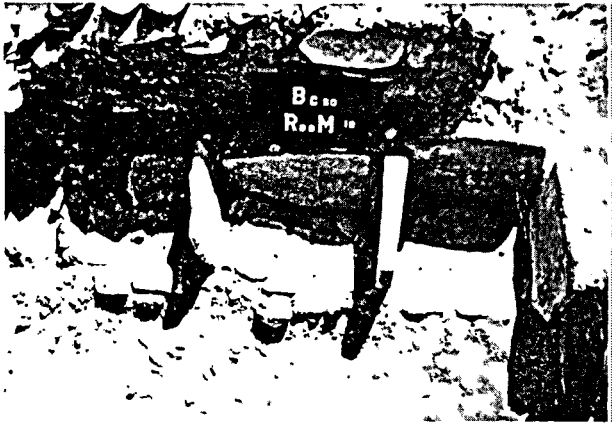
b. The Students of the Field School Listening to a Lecture on Burial Removal.

PLATE III



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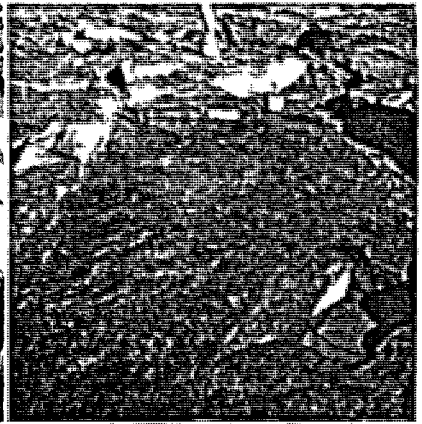

b

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a. A Set of Bins on the Floor of Room 19.

b. The First Stage in the Excavation Process. The tops of the walls are beginning to show below the surface. The fireplace in the foreground indicates the last period of occupancy, when the Pueblo II structure was already a mound.

c. A Corner of Room 20 Showing a Large Utility Pot in Place.

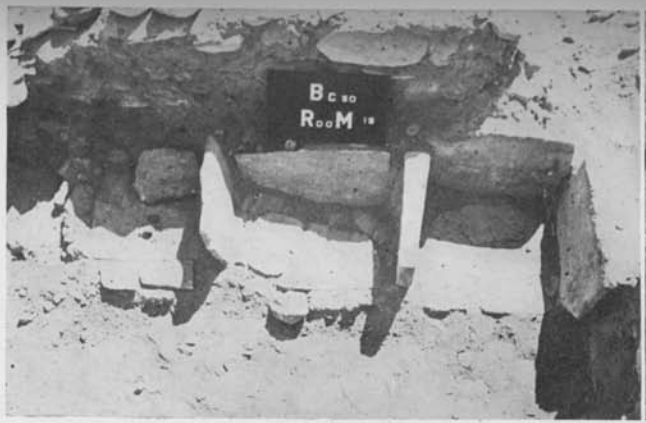

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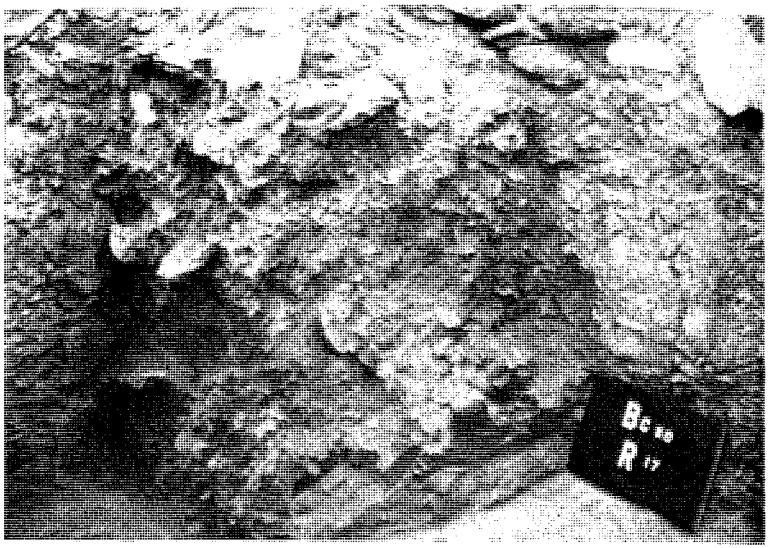
PLATE IV



a. The Stratigraphy Column in the Corner of Room 17.

b. The Stratigraphy Column in the Corner of Room 7. Some of the sand layers may may be distinguished at its base.

PLATE IV

a. The Stratigraphy Column in the Corner of Room 17.

b. The Stratigraphy Column in the Corner of Room 7. Some of the sand layers may may be distinguished at its base.

PLATE V

a. The Stratigraphy Column in Room 4 Which Contained a Section of the Original Roof.

b. The Same Piece of Roof After the Removal of the Upper Portion of the Column. The cross members of the roof are plainly visible.

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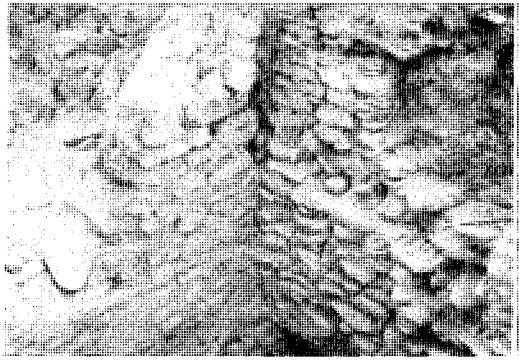
b. The Same Piece of Roof After the Removal of the Upper Portion of the Column. The cross members of the roof are plainly visible.

PLATE VI



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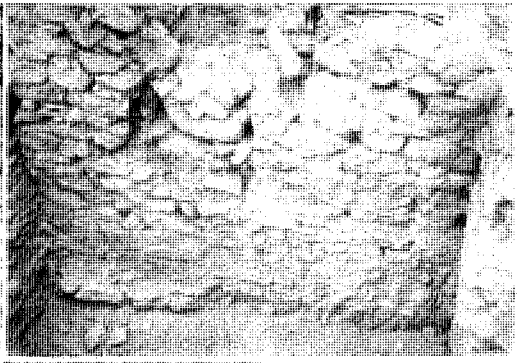

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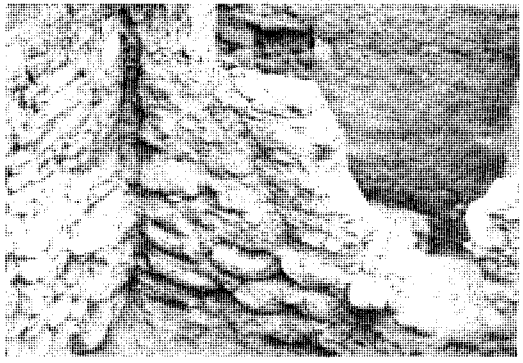

c

a. The Masonry of Room 3, Pueblo II.
b. Masonry in Room 1, Pueblo II.
c. Masonry in Room 4, Pueblo II.

a

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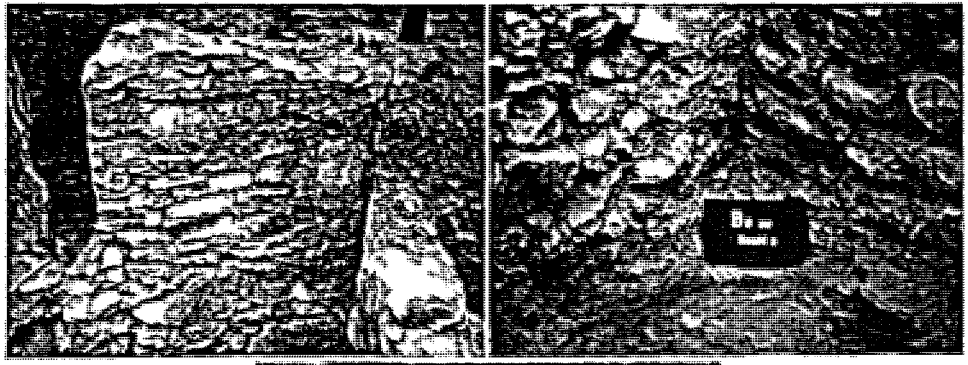
a. The Masonry of Room 3, Pueblo II.
b. Masonry in Room 1, Pueblo II.
c. Masonry in Room 4, Pueblo II.

PLATE VII



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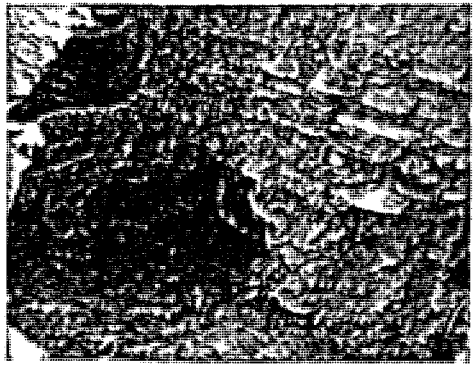

c

a. Masonry in Room 10, Pueblo II.
b. Masonry in Room 3, Pueblo I and Pueblo II.
c. Masonry in the Substructure to the West. The Pueblo I wall is shown extending beneath the Pueblo II wall of Room 22.

a

b

c

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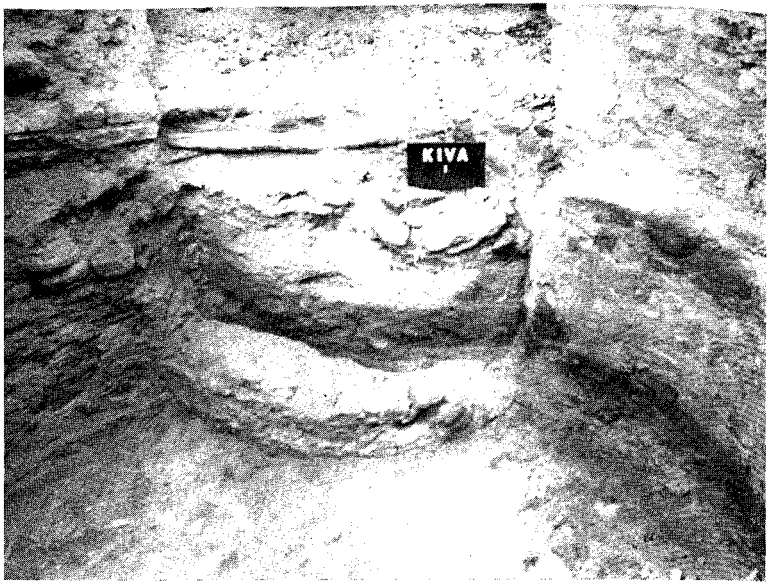
PLATE VIII



a. Kiva 1 Looking Towards the South. The semi-circular fire screen has just appeared. Layers of aeolian and water laid sand yet conceal the ventilator and the shelf of the southern extension behind.

b. Kiva 1 After the Removal of all Debris. The figure in the background is standing in the southern extension of Kiva 3. By this it may be seen that the kivas are similarly oriented.

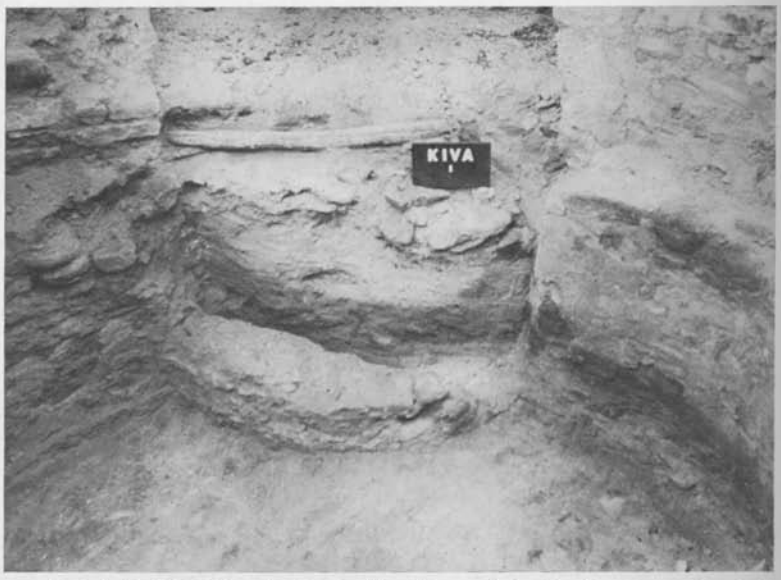


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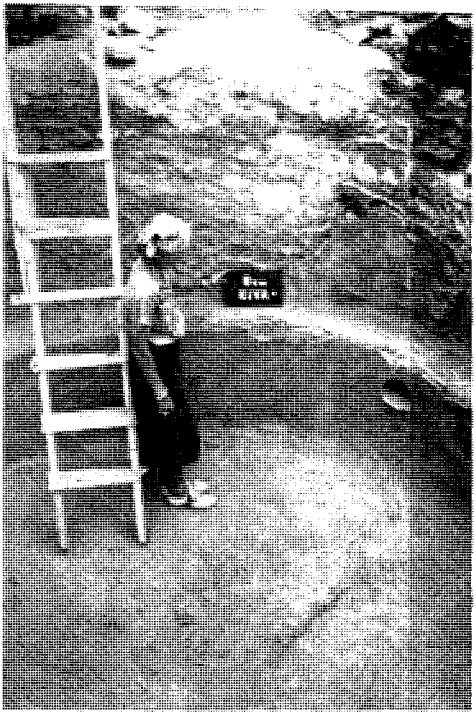
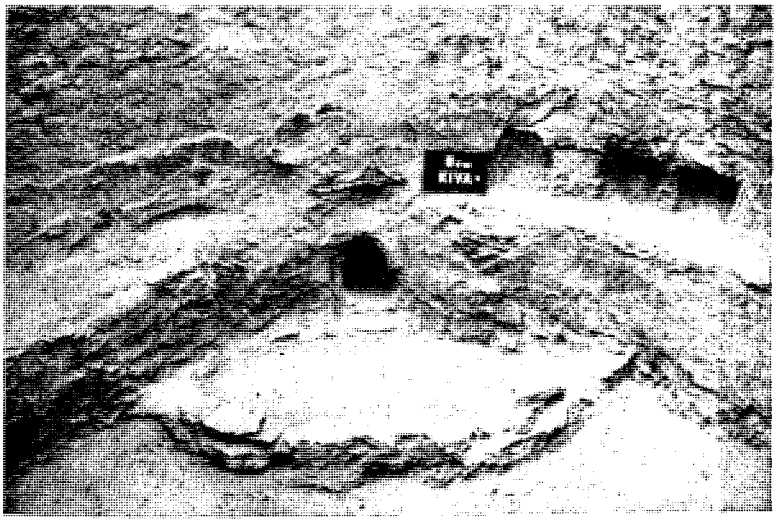
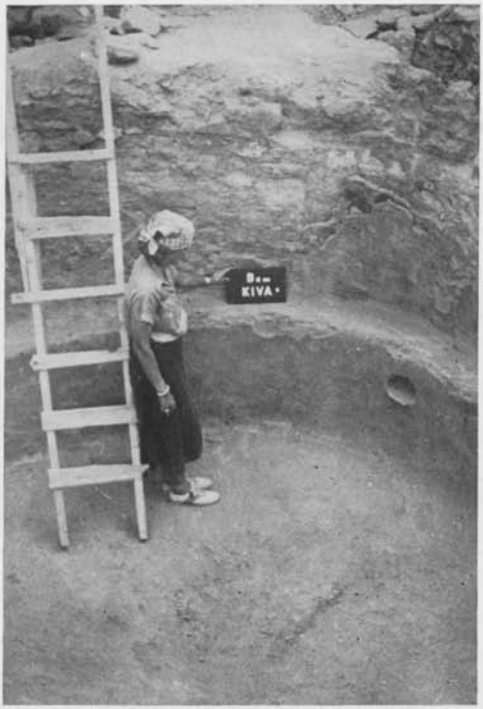
PLATE IX



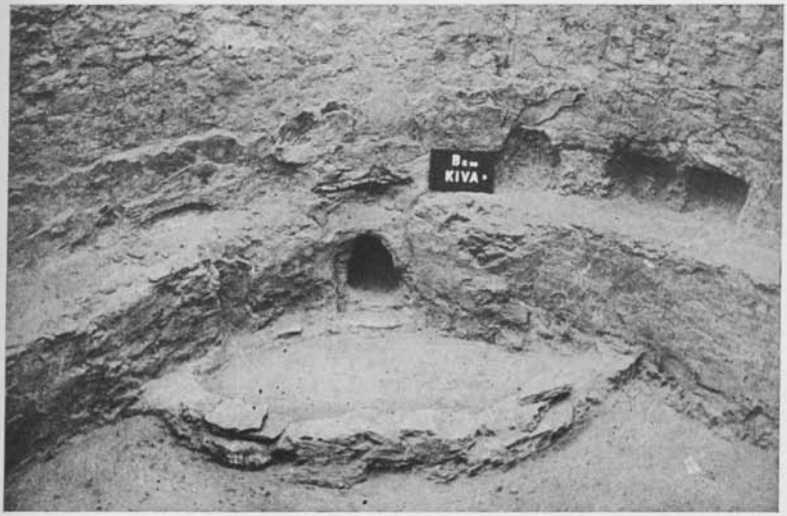
a. Kiva 2 Looking Towards the Northwest. The small niche in the north side of the bench appears to the right.



b. Kiva 2 Looking Towards the South. The semi-circular fire screen shown in the foreground. Three niches appear on top of the bench to the right.

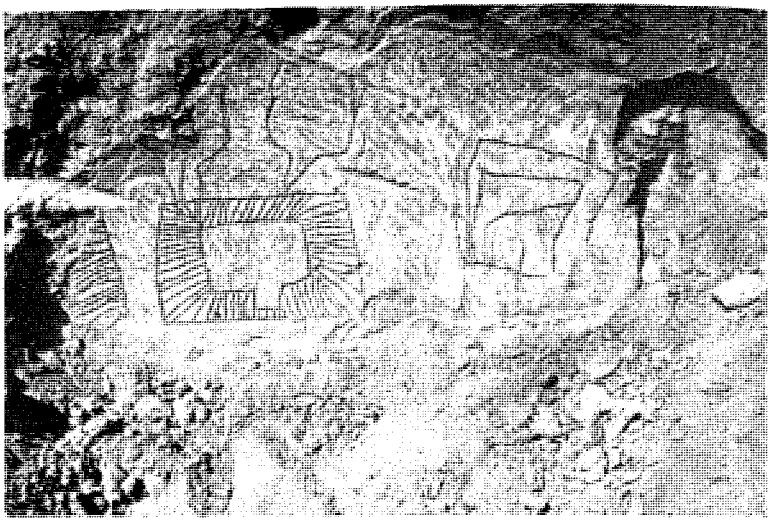


a. Kiva 2 Looking Towards the Northwest. The small niche in the north side of the bench appears to the right.

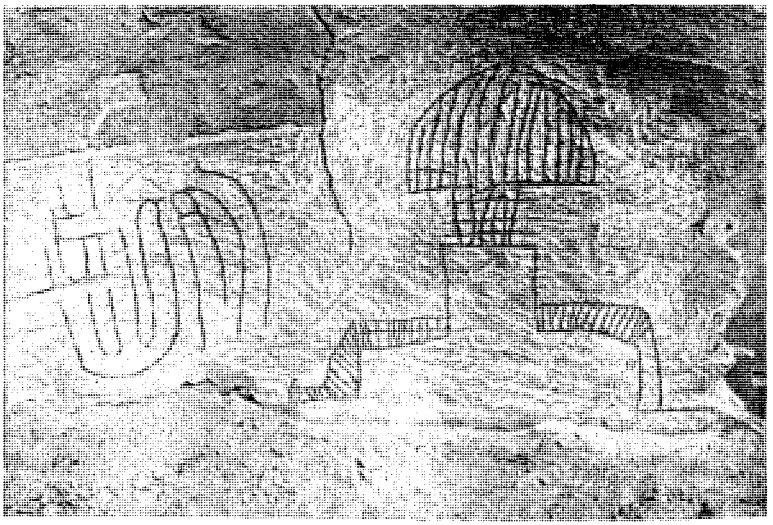


b. Kiva 2 Looking Towards the South. The semi-circular fire screen shown in the foreground. Three niches appear on top of the bench to the right.

PLATE X

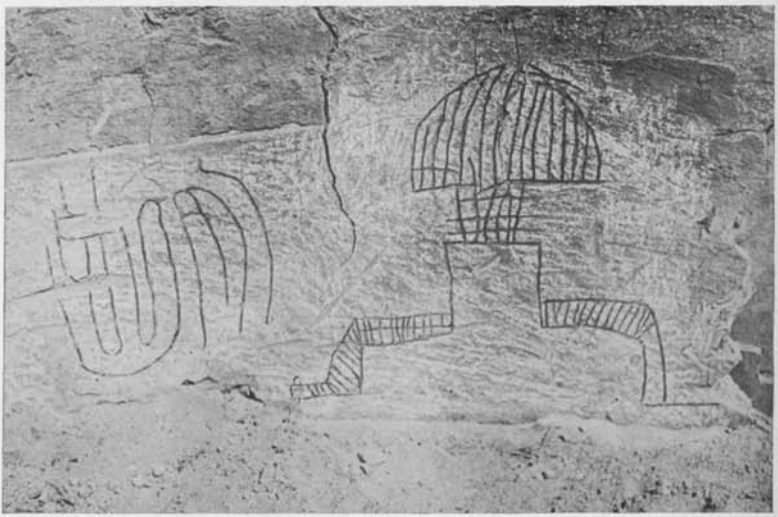


a. The Incised Designs in the Plaster Coating of Kiva 3. The central figure is tentatively identified as a house design. It may possibly be an altar.



b. Two Additional Figures From the Plaster Coating on the Walls of Kiva 3. That to the left is an interlocked maze such as intrigues the Hopis of today. That to the right a possible vegetable symbol.

a. The Incised Designs in the Plaster Coating of Kiva 3. The central figure is tentatively identified as a house design. It may possibly be an altar.



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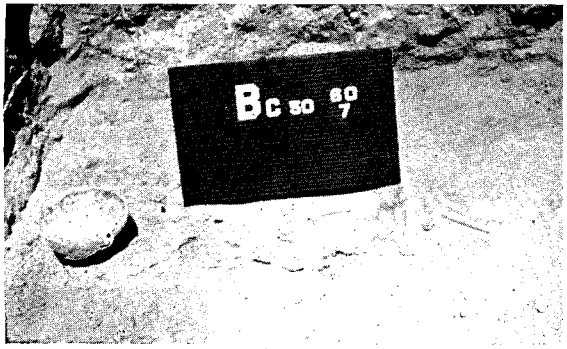

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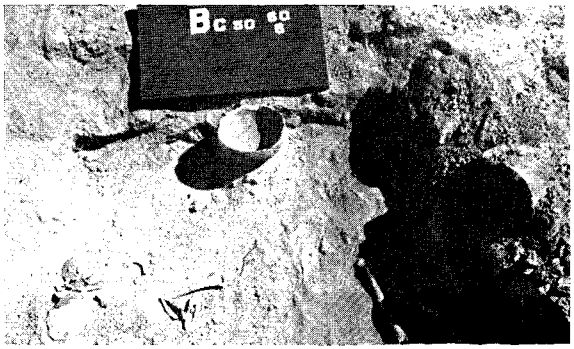

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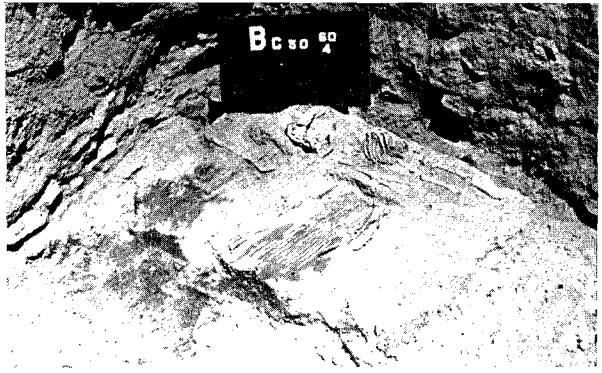
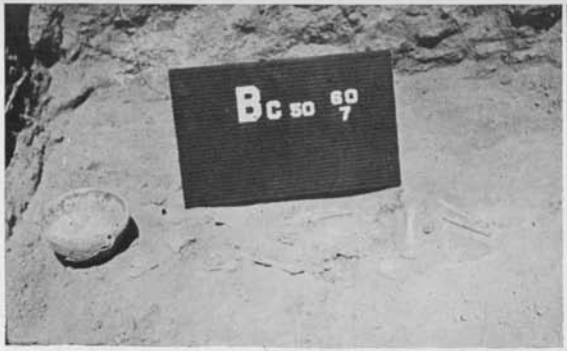


c

a. Burial 7. An immature near the surface of Room 13. The burial is accompanied by a bowl of McElmo Black on White.

b. Badly Disturbed Burial 6, also from Room 13. This burial is also accompanied by a bowl of McElmo Black on White.

c. Burial 4, also an Immature, from Room 22. Note the grass matting which extends from beneath the burial.



a

b

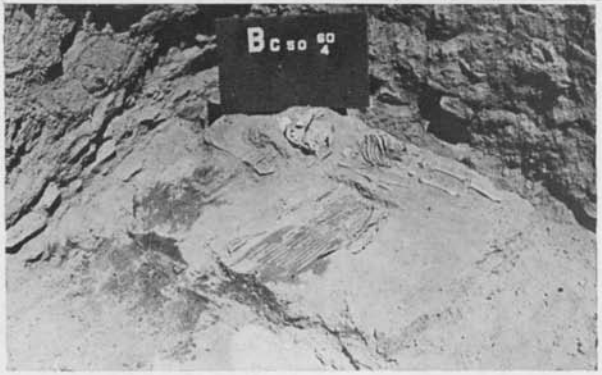


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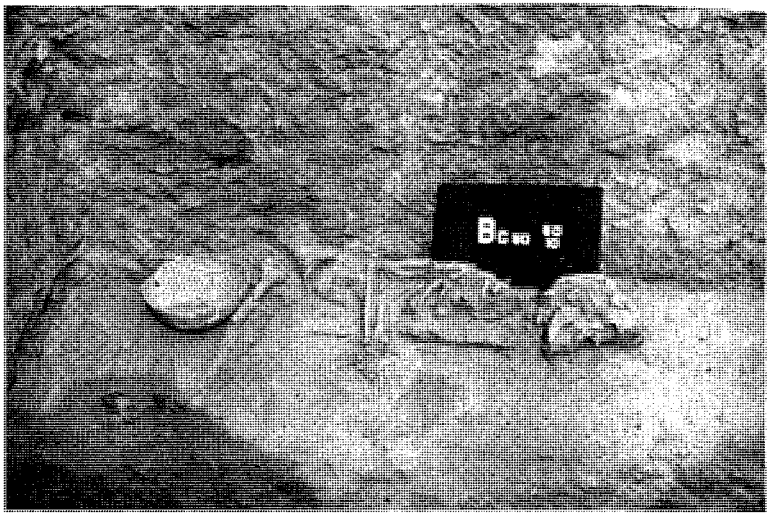
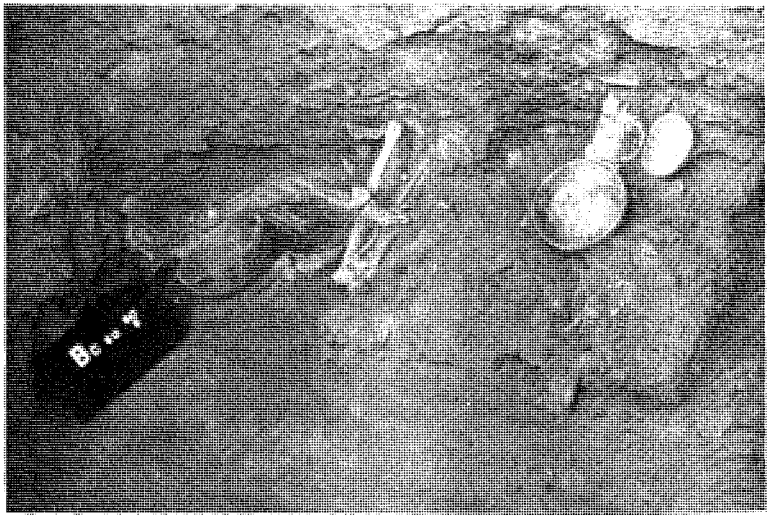
PLATE XII



a. Burial 10, Adult from Room 5. Burial oriented south.



b. Burial 5 from Room 22. Burial oriented south. Pottery accompanying; Wingate Black on Red, Tusayan Polychrome, Gallup Black on White, and Escavada Black on White. A large Exuberant Corrugated shard covers the head. Two lumps of malachite and a large bone awl lie near the right knee.

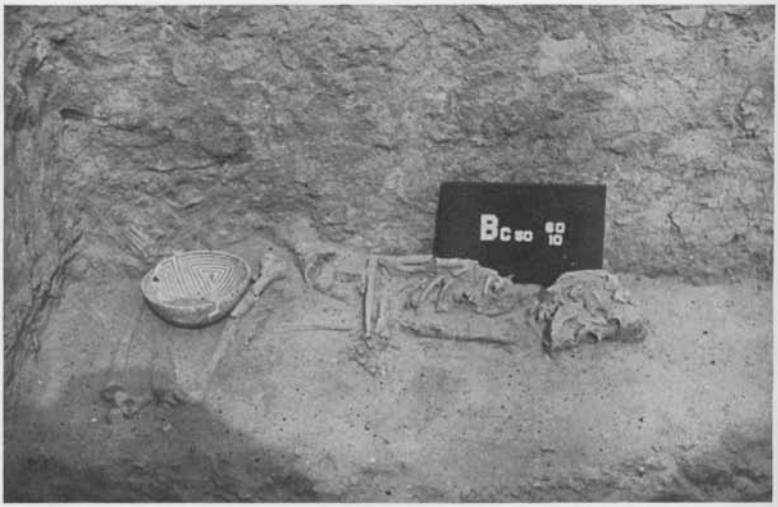


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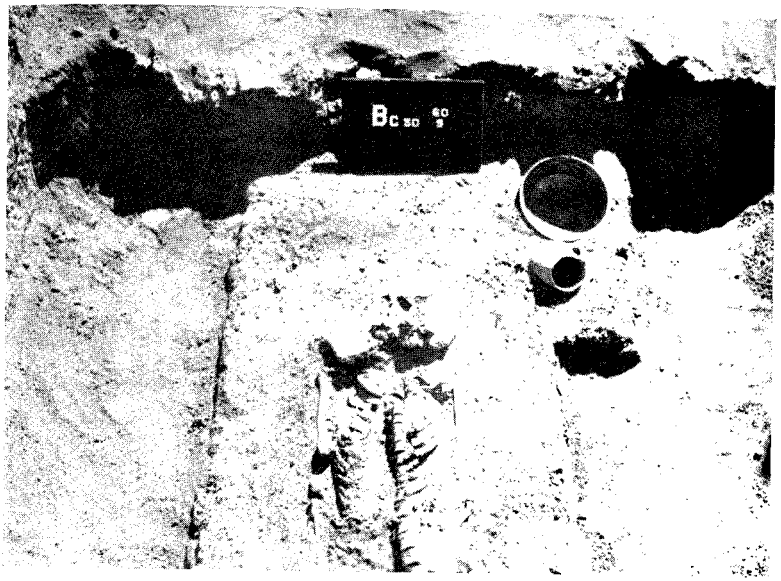
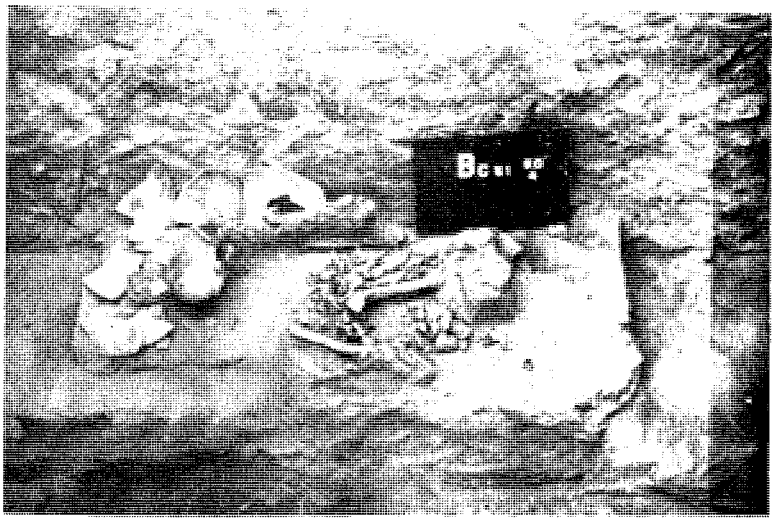
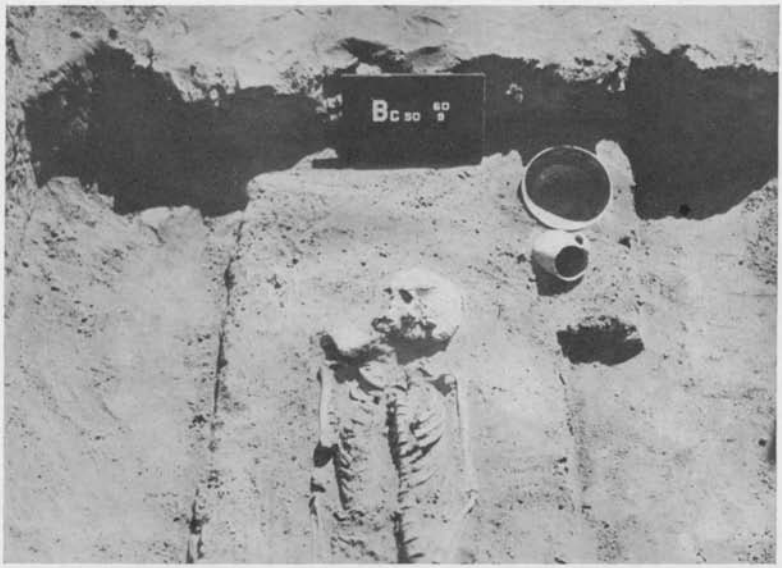
PLATE XIII



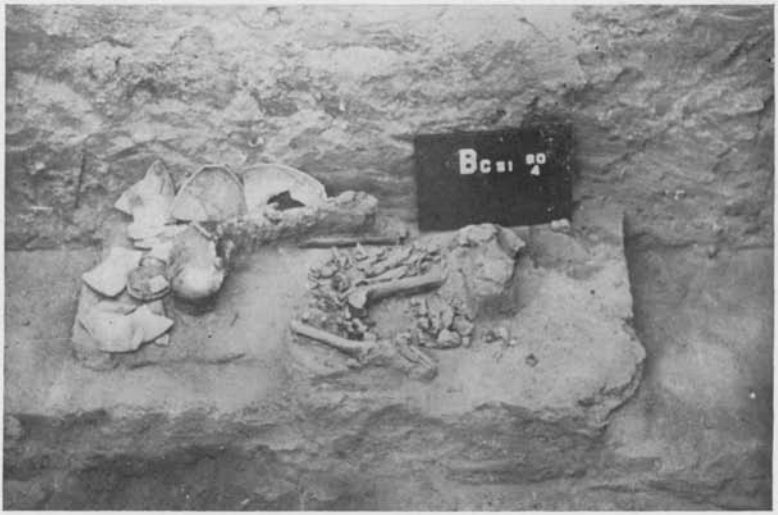
a. Burial 9, Adult, Oriented East. Pottery Accompaniments: McElmo bowl, Escavada pitcher.



b. Burial 4, in Bc51. Disturbed flexed burial originally oriented east. Large McElmo bowl has been removed from original position over the skull.



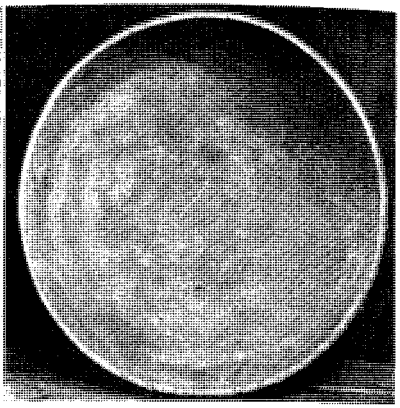
a. Burial 9, Adult, Oriented East. Pottery Accompaniments: McElmo bowl, Escavada pitcher.



b. Burial 4, in Bc51. Disturbed flexed burial originally oriented east. Large McElmo bowl has been removed from original position over the skull.

PLATE XIV

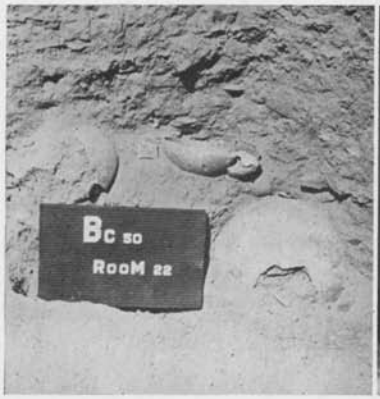
a



b

c

a. A Pottery Cache in Level 3, Room 22, in the Northeast Corner.
b. A Well-worn Tusayan Polychrome Bowl from Burial 5 in Room 22.
c. View of Level 3, Room 22, with Cache of Pottery Vessels in Southeast Corner.



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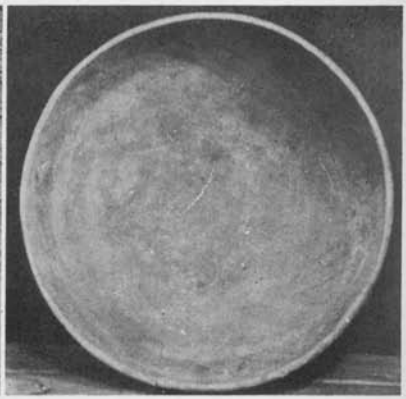
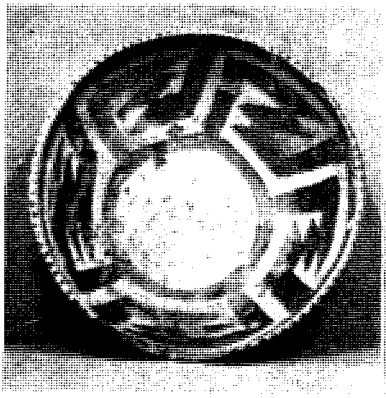


b

c

a. A Pottery Cache in Level 3, Room 22, in the Northeast Corner.
b. A Well-worn Tusayan Polychrome Bowl from Burial 5 in Room 22.
c. View of Level 3, Room 22, with Cache of Pottery Vessels in Southeast Corner.

PLATE XV



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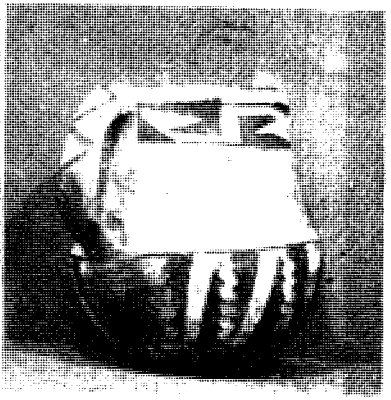


b

c

d

a. Small McElmo Bowl from Cache in Room 22.
b. Red Mesa Pitcher from Burial 9 in Room 5.
c. Small Corrugated Pot in Situ from Level 1, Room 22.
d. Upper Portion of Large Corrugated Pot with Double Lugs and Incised Decoration.

PLATE XV

a

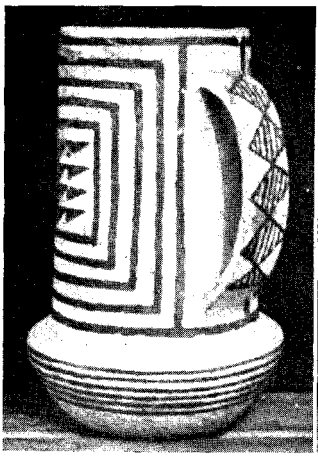
b

c

d

a. Small McElmo Bowl from Cache in Room 22.
b. Red Mesa Pitcher from Burial 9 in Room 5.
c. Small Corrugated Pot in Situ from Level 1, Room 22.
d. Upper Portion of Large Corrugated Pot with Double Lugs and Incised Decoration.

PLATE XVI



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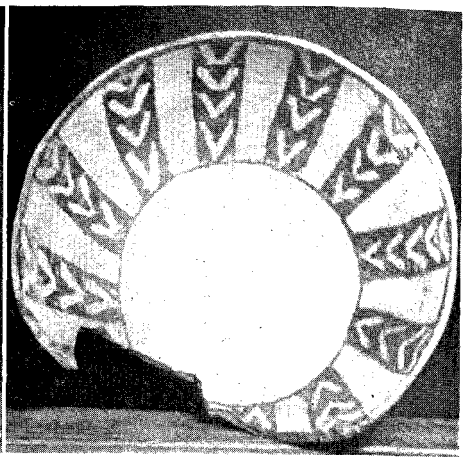


b

c

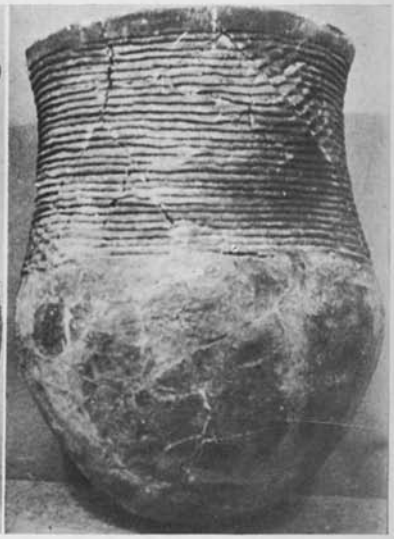
d

a. Gallup Black on White Jug Which Accompanied Burial 5.
b. McElmo Black on White Bowl with Burial 4.
c. Large Corrugated Pot Embedded in the Floor of Room 20.
d. Large Corrugated Vessel from Sub-floor Level of Room 3.

a

b

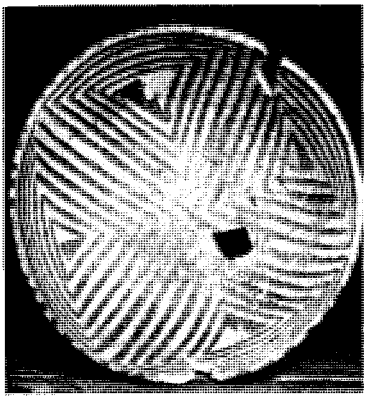
c



d

a. Gallup Black on White Jug Which Accompanied Burial 5.
b. McElmo Black on White Bowl with Burial 4.
c. Large Corrugated Pot Embedded in the Floor of Room 20.
d. Large Corrugated Vessel from Sub-floor Level of Room 3.

PLATE XVII



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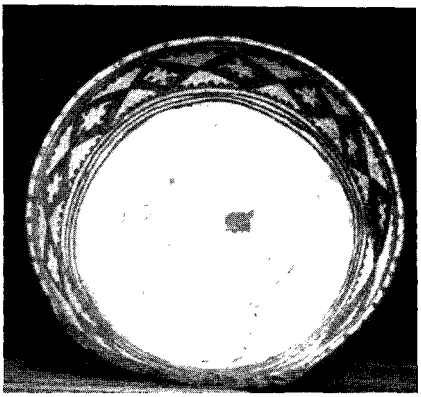

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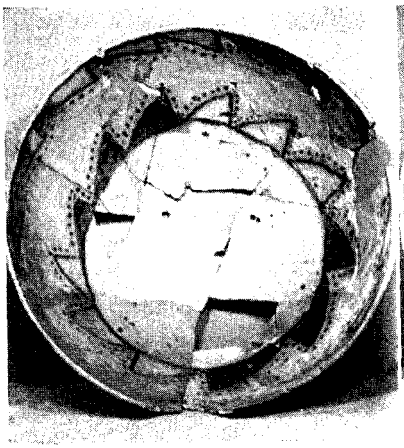

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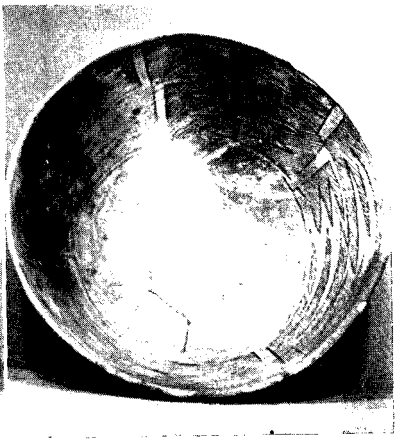
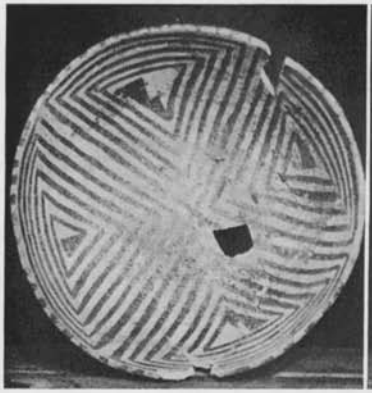


d

a. McElmo Black on White Bowl Which Accompanied Burial 10.
b. McElmo Black on White Bowl Which Accompanied Burial 9.
c. McElmo Black on White Bowl of Large Size Which Was Inverted Over the Head of Burial 4 of Bc51.
d. Gallup Black on White Bowl from a Cache in Level 4 in Room 5.



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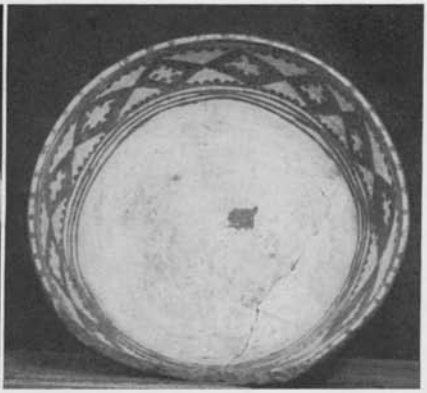

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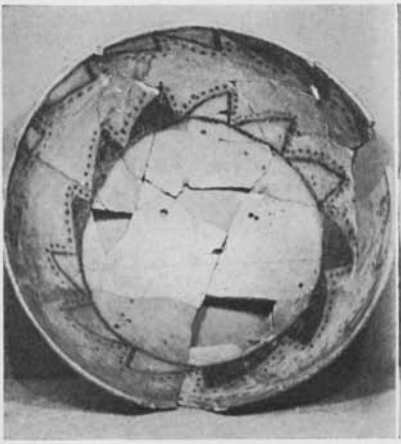

c

d

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b. McElmo Black on White Bowl Which Accompanied Burial 9.
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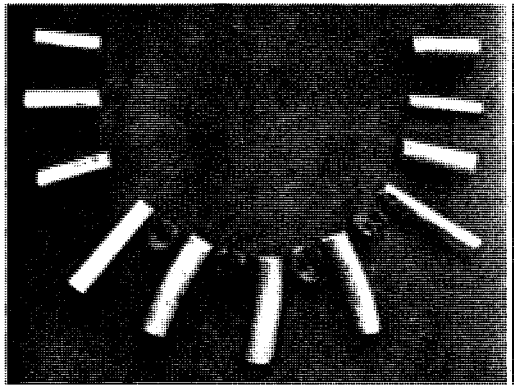

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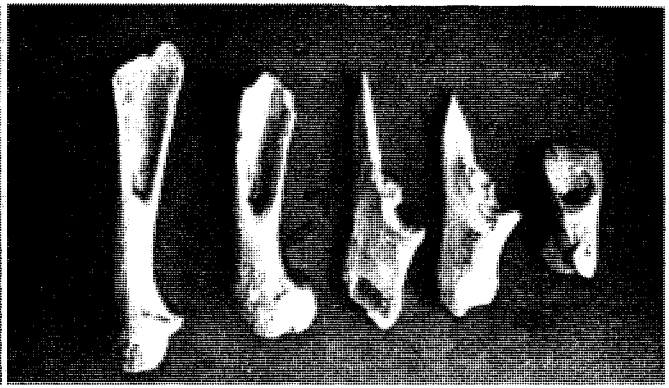

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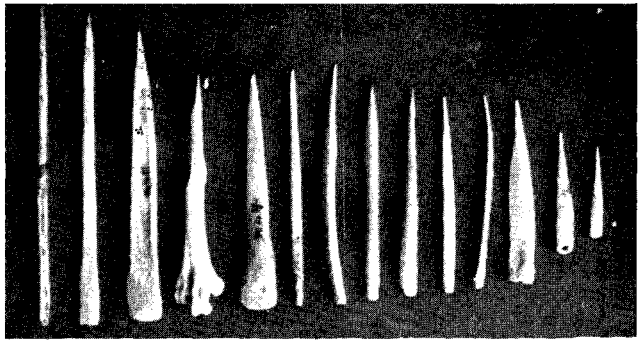
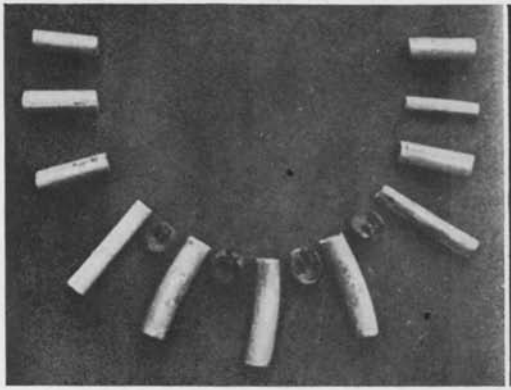


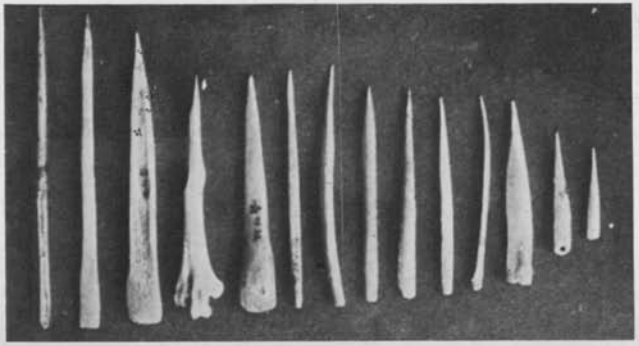
c

a. Bone and Walnut Necklace Which Adorned Burial 4.
b. Awls and Scrapers of Bone Illustrating Common Types from the Ruin.
c. Series of Awls Illustrating Types Recovered from Tseh So.



a

b



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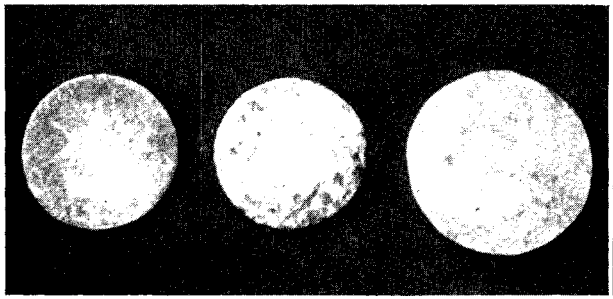

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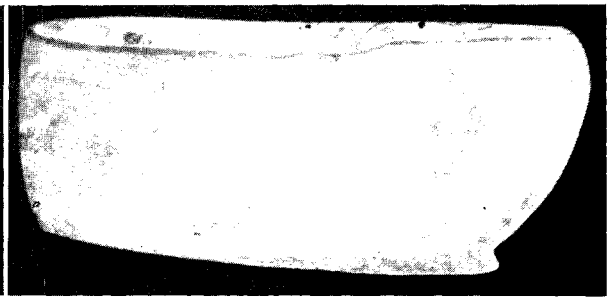

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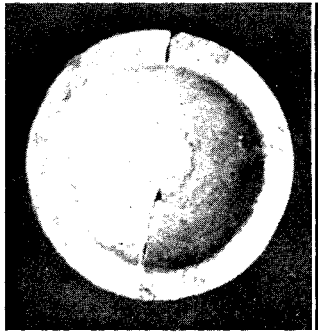

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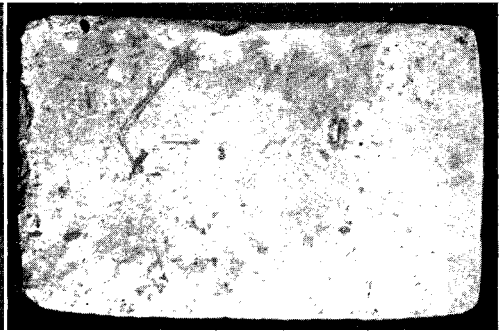
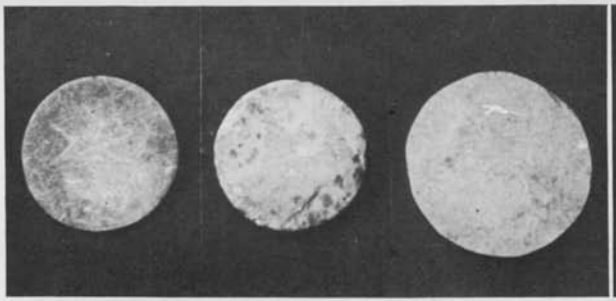


d

a. Problematical Sandstone Disks. Some of these show traces of pigment on both faces.
b. A Finely Worked Sandstone Sandal Last.
c. Sandstone Mortar with Traces of Red Pigment on the Surface.
d. A Painted Palette of Fine-grained Sandstone. The dark splotching on its surface is yellow pigment.



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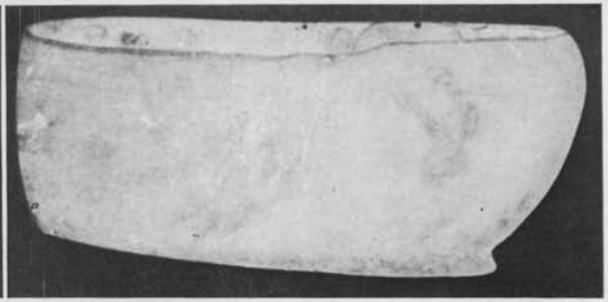

b

c

d

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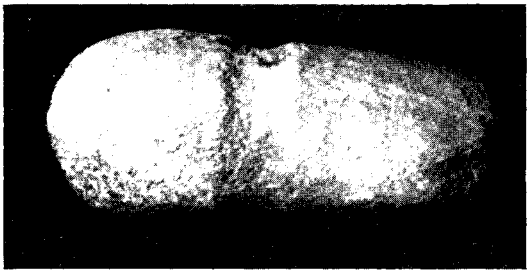
c. Sandstone Mortar with Traces of Red Pigment on the Surface.
d. A Painted Palette of Fine-grained Sandstone. The dark splotching on its surface is yellow pigment.

PLATE XX



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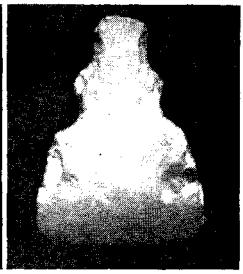
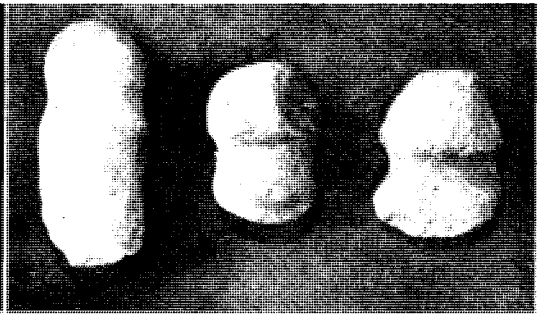


b

c

d



e

a. Large Axe of Gneiss Showing Use on Both Ends.

b. Polished Hoe of Rhyolite with Double Notches. The bit is sharp and finely polished from use.

c. Large Grooved Axe of Basalt.

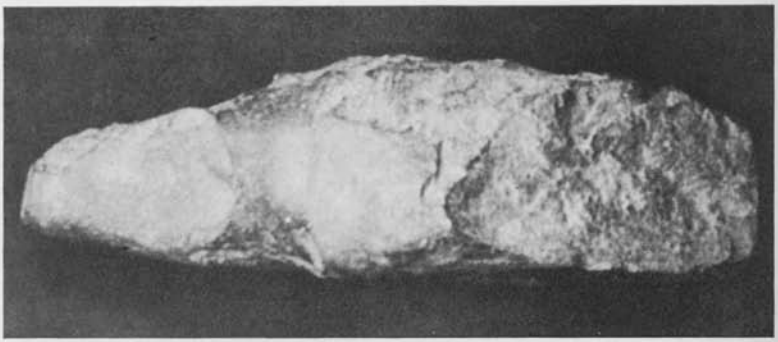
d. Double Grooved Axe of Basalt. The blade is narrow and curved and polished on one side only as though the piece had been used in an adze-like manner.

e. Various Types of Small Axes Popular at Tseh So.

PLATE XX

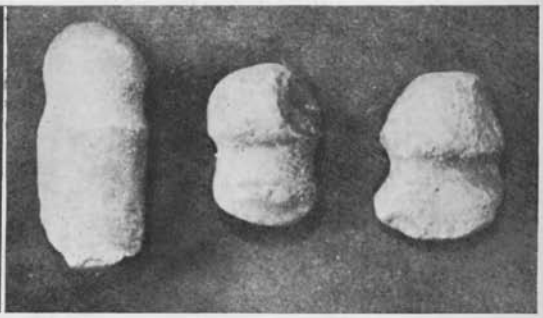
a

b



c

d



e

a. Large Axe of Gneiss Showing Use on Both Ends.

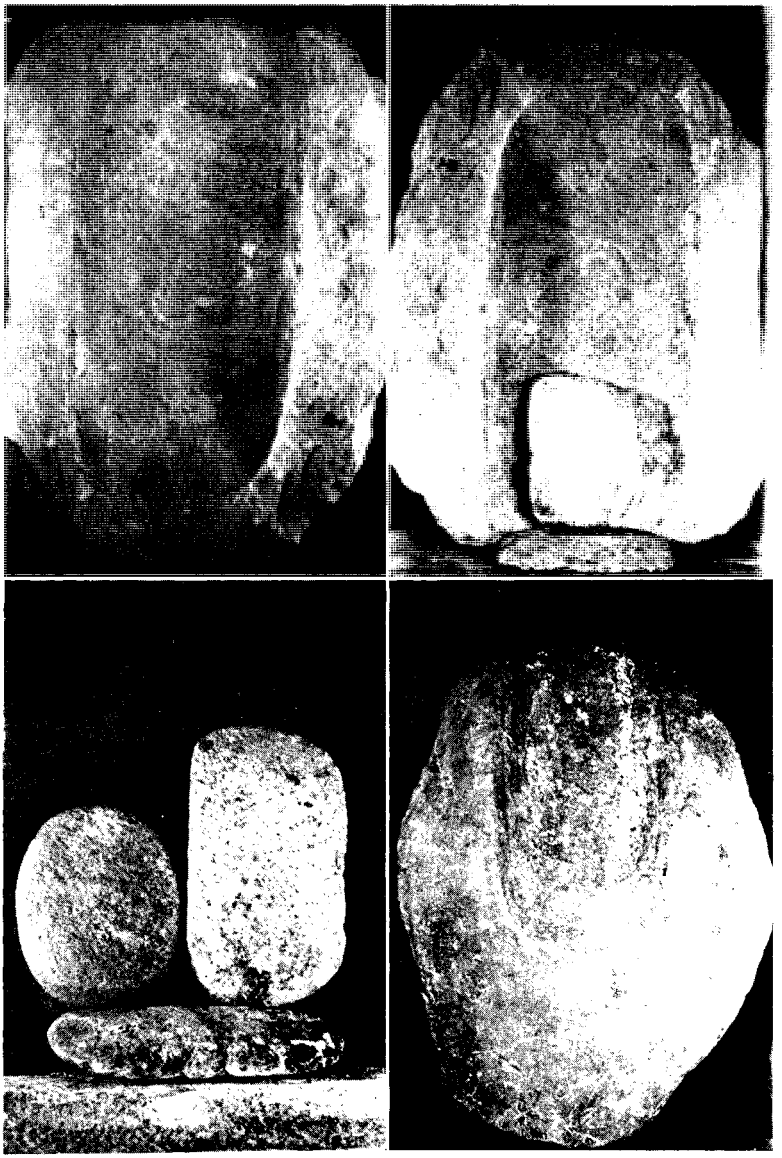
b. Polished Hoe of Rhyolite with Double Notches. The bit is sharp and finely polished from use.

c. Large Grooved Axe of Basalt.

d. Double Grooved Axe of Basalt. The blade is narrow and curved and polished on one side only as though the piece had been used in an adze-like manner.

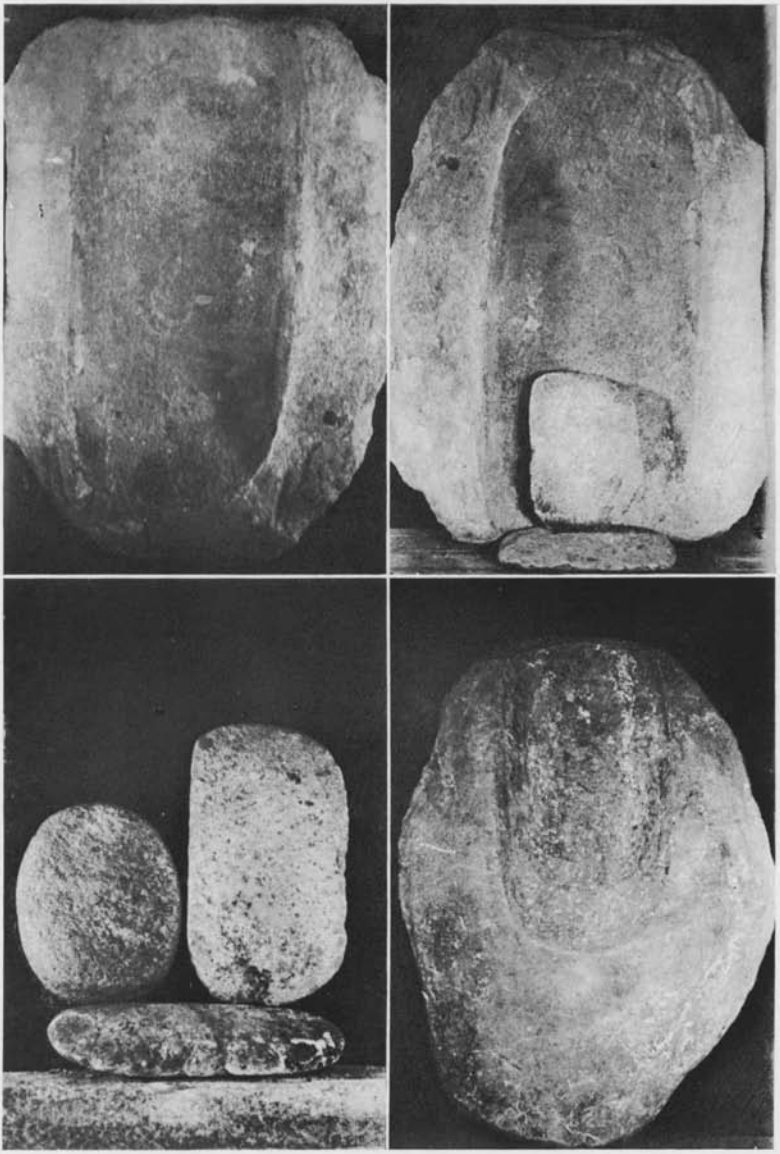
e. Various Types of Small Axes Popular at Tseh So.

PLATE XXI



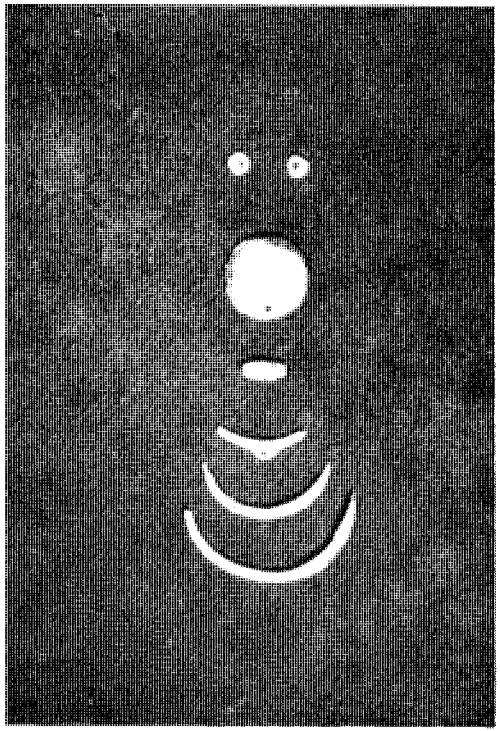
Metates (of the open end trough type) and Manos

PLATE XXI

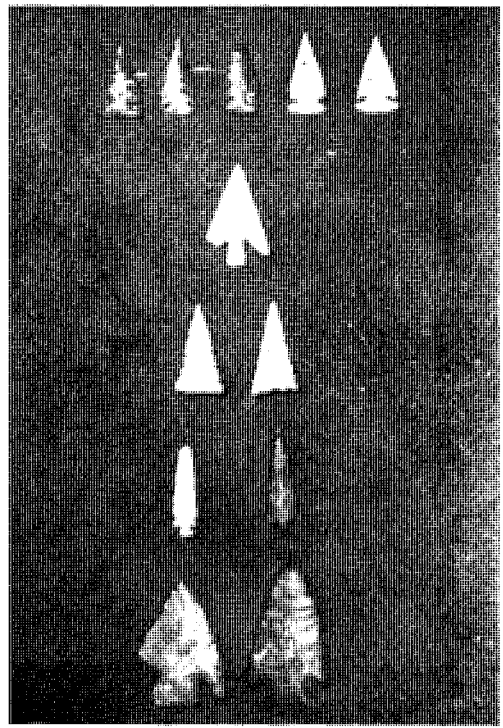


Metates (of the open end trough type) and Manos

PLATE XXII

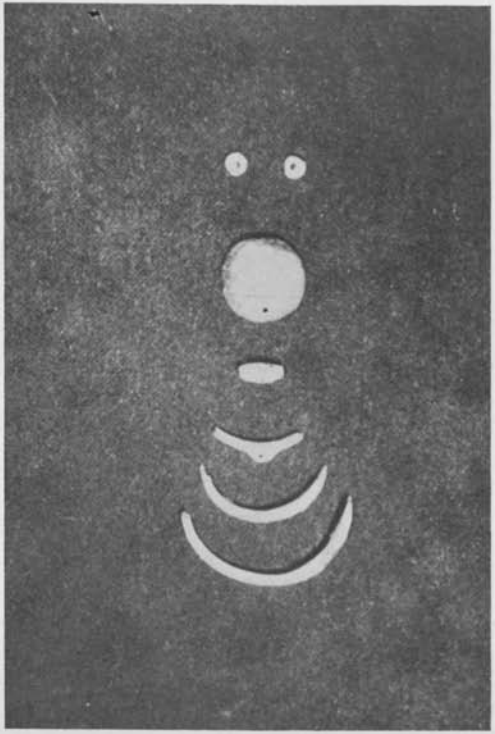


a. Worked Shell

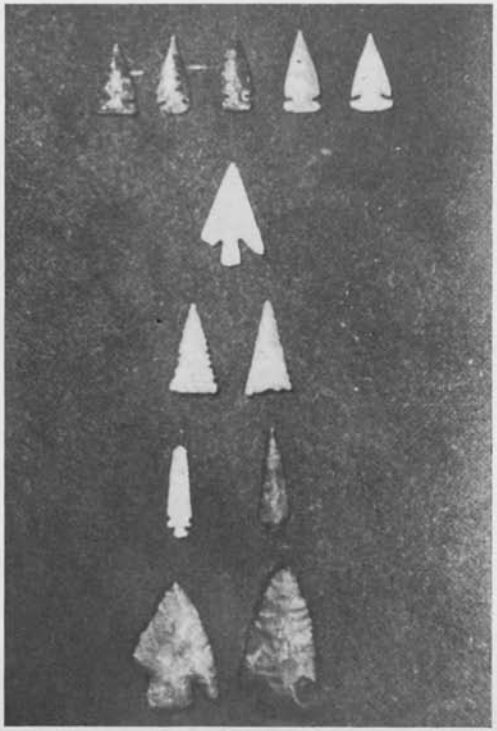


b. Arrow Heads.

PLATE XXII



a. Worked Shell



b. Arrow Heads.

This is the placeholder for map 1

TABLE I

SHARD PERCENTAGES BY ROOMS AND LEVELS

Rooms	Floor Level	Sub Floor 0-1′	Sub Floor 1′-2′	Surface 0′-2′	2-3	3-4	4-5	Artifacts in Sub Floor	Shards in Wall	Shards in Doors	Artifacts in Fill
1	Exuberant 61 Red Mesa 10 Escavada 5 Lino 5 Gallup 5	Exuberant 28 Lino 26 Red Mesa 18	Red Mesa 46 Lino 18 Exuberant 16	Chaco Cor. 18 Exuberant 14	Exuberant 42 Chaco B on W 17 Mesa Verde 17	Escavada 24 Exuberant 19 Chaco Cor. 11	Exuberant 32 Chaco Cor. 17 Chaco B on W 11			Exuberant 17 Escavada 28 Wingate 28	2 metates 7 hammer-stones 1 carved bone painted plaque wooden tray
2	Escavada 18 Exuberant 12 Red Mesa 11 Gallup 10	Exuberant 17.5 Escavada 14 Red Mesa 10	Exuberant 33 Escavada 18 Lino Grey 15	Gallup 45 Exuberant 29 Escavada 11	Gallup 28 Exuberant 23 Chaco 9	Exuberant 25 Escavada 14 Chaco B on W 15	Gallup 20 Escavada 19 Lino 17	Red Mesa Bowl Hammer Stone Turquoise bit		Escavada 8 Gallup 15 Red Mesa 15	4 hammer-stones 4 bone awls 2 arrowheads
3	Gallup 31 Red Mesa 21 Exuberant 18	Lino 35 Red Mesa 23 Pueblo II Cor. 17		Chaco Cor. 21 Escavada 18 Wingate 18	Gallup 16 Exuberant 27 Escavada 14	Exuberant 37 Escavada 17 Chaco Cor. 17	Chaco Cor. 42 Escavada 11 Exuberant 13	Two Exuberant ollas One Kana-a ollita			2 metates 5 manos 2 hammer-stones 1 axe 1 sandal 1 knife 1 pendant 2 arrows
4	Exuberant 49 Gallup 11 Chaco 10 Escavada 10	Exuberant 43 Escavada 14 Gallup 10		Chaco 19 Escavada 14 Lino 12	Gallup 31 Escavada 21 Exuberant 10	Exuberant 21 Chaco Cor. 19 Gallup 18	Chaco B on W 19 Chaco Cor. 18 Gallup 17		Exuberant 23 Red Mesa 21 Escavada 14		8 bone awls 1 axe 4 manos 1 pigment stone 2 arrows 1 worked shard stone tray
5	Gallup 32 Escavada 24 Exuberant 17	Lino 37 Escavada 22 Red Mesa 21		Exuberant 32 Mesa Verde 34 Wingate 8		Exuberant 34 Escavada 22 Lino 18					2 burials with pottery (9 & 10) 1 awl
6	Exuberant 30 Red Mesa 17 Gallup 17			Chaco 22 McElmo 20 Exuberant 14					Escavada 32 Red Mesa 11 Lino 8		2 palettes 1 mortar 2 arrow heads
7	Gallup 42 Escavada 13 Exuberant 13 Lino 7	Lino 27 Red Mesa 26 Escavada 11	Lino 89 Red Mesa 11	Exuberant 29 Chaco 15 Escavada 13 Gallup 13	Chaco 23 Escavada 22 Gallup 13	Exuberant 17 Escavada 16 Chaco 15			Exuberant 21 Red Mesa 17 Escavada 17		chert adze bone awl
8	Escavada 20 Exuberant 20 Gallup 18 Red Mesa 12			Escavada 20 Gallup 14 Exuberant 18	Exuberant 32 Chaco 15 Gallup 9	Chaco Cor. 21 Gallup 18 Escavada 12					4 bone awls 2 hammer-stones 1 bone scraper
9	Exuberant 29 Escavada 25 Gallup 16		Escavada 20 Lino 18 Chaco Cor. 17 Red Mesa 7	Exuberant 29 Escavada 17 Gallup 15	Exuberant 27 Escavada 17 Chaco 14				Escavada 45 Red Mesa 18 Lino 13		1 bone awl 1 axe
10	Exuberant 100 (14 shards)	Red Mesa 29 Lino 22 Exuberant 11		Gallup 30 Escavada 22 Chaco 15	Chaco 24 Red Mesa 21 Lino 14	Gallup 44 (4 shards)	Escavada 31 Exuberant 28 Chaco 13	Bone awl (Deer ulna)		Exuberant 31 Red Mesa 17 Wingate 17	1 axe 2 metates 4 manos
11	Escavada 27 Exuberant 13 Red Mesa 12			Chaco 42 Gallup 26 Tusayan Poly. 6					Escavada (4 shards) Red Mesa (4 shards)	Escavada 31 Gallup 30 Exuberant 30	3 metates 2 manos
12	Kiva enclosure (No. 1) surface record only			Burials 6-7-8 with Escavada & Red Mesa bowls							2 bowls Red Mesa and Escavada
13	Kiva enclosure (No. 3) surface record only			Escavada 48 Gallup 31 Mesa Verde 19							1 paint palette
14	Escavada 20 Red Mesa 16 Chaco 14			Escavada 23 Chaco Cor. 21 Exuberant 10	Escavada 20 Exuberant 16 Chaco 16	Exuberant 22 Gallup 18 Escavada 15	Escavada 22 Red Mesa 20 Exuberant 9		Exuberant 20 Escavada 14 Red Mesa 10		1 bone awl 1 arrow head
15	Red Mesa 17 Escavada 16 La Plata 16			Chaco 21 Gallup 18 Escavada 18		Chaco 15					2 bone awls 1 turquoise pendant
16	Escavada 40 Exuberant 14 Red Mesa 9	Escavada 53 Exuberant 15 Red Mesa 10		Exuberant 29 Gallup 24 Escavada 18	Escavada 26 Lino 23 Gallup 14						1 sandal last 1 palette 6 manos 2 metates
17	Escavada 17 Exuberant 16 Red Mesa 15			Escavada 41 Gallup 32 Chaco B on W 9							2 flint knives 1 arrowhead
18	Gallup 27 Exuberant 11 Escavada 9			Red Mesa 21 Gallup 17 Chaco 17							1 bone awl
19	Escavada 38 Gallup 17 Exuberant 16			Chaco 26 Gallup 17 Wingate 16							1 sandstone disk 1 double groove axe
20	Exuberant 29 Escavada 19 Red Mesa 19	Exuberant 41 Lino 19 Red Mesa 19		Escavada 42 Exuberant 21 Gallup 21				Two Exuberant ollas			1 bone ring 1 selenite pendant 2 bone awls 1 sandstone disk
21	Gallup 26 Escavada 17 Red Mesa 9	Lino 62 Red Mesa 17 Escavada 10		Exuberant 19 Chaco 18 Lino 9							1 sandstone disk 1 selinite pendant
22	McElmo 18 Escavada 17 Gallup 16	Red Mesa 29 Lino 14 Escavada 11		Exuberant 28 Gallup 23 Wingate 22	Exuberant 28 Gallup 16 Lino 13	Chaco Cor. 27 Exuberant 13 Escavada 9	Mesa Verde 18 Gallup 17 Escavada 16				Burials 3, 5, 6, 7, 8, with accompanying pottery
Kiva 1	Gallup 41 Escavada 39 McElmo 24	Lino 50 Red Mesa 50 (10 shards)		Gallup 37 Escavada 21 Red Mesa 11							
Kiva 2	Escavada 27 Lino 22 Exuberant 22 Gallup 11	Lino 27 Escavada 26 Red Mesa 19		Chaco 27 Mesa Verde 22 Lino Grey 19			Wingate 33 McElmo 21 Chaco 19				
Kiva 3	Lino 42 Exuberant 27 Gallup 27 Red Mesa 6	Red Mesa 41 Exuberant 26 Mesa Verde 9		Gallup 41 Exuberant 33 Lino 22			Escavada 42 Gallup 35 Chaco Cor. 19		Escavada 71 Wingate 10 Exuberant 10		
Kiva 4	Escavada 51 Chaco Cor. 31 Gallup 17 Lino Grey 6	Exuberant 29 Lino Grey 29 Escavada 20 Red Mesa 7		Escavada 53 Chaco Cor. 31 Lino Grey 11			Exuberant 25 Lino 20 Escavada 19		Escavada 50 Red Mesa 50 (10 shards)		
Sub Struct. West	Red Mesa 62 Kana-a Grey 17 Lino 11	Lino 53 Red Mesa 26 Kana-a B. on W. 17	Lino 100 (17 shards)	Red Mesa 69 Lino 22 La Plata 9							

This is the placeholder for map 2

TABLE II
ARTIFACTS

Levels	Substructure West	ROOM NOS. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	Test Trench
0-3		Polishing Stone Bc50 20/21 Palette Bc50 20/35 Hammer stone Bc50 20/46 Bone awl Bc50 30/25	Hammer stone Bc50 20/7	Hammer stone Bc50 20/64 Flint knife Bc50 22/12 Deer long bone awl Bc50 30/11	Grooved axe Bc50 20/9 Grooved axe Bc50 20/20 Stone tray Bc50 20/66 Arrowhead Bc50 22/25 Long bone awl Bc50 30/8 Long bone awl Bc50 30/9	Arrowhead Bc50 22/2	Mortar Bc50 20/72 Palette Bc50 20/78 Palette Bc50 20/82 Hoe Bc50 20/81 Bone awl Bc50 30/48	Stone disk Bc50 20/23	Stone disk Bc50 20/96 Arrowhead Bc50 22/10 Arrowhead Bc50 22/14 Bone end scraper Bc50 30/8 Elk end scraper Bc50 20/10 Turkey bone awl Bc50 30/26 Bone awl Bc50 30/59 Bone awl Bc50 30/71	Grooved axe Bc50 20/33 Arrowhead Bc50 22/11 Arrowhead Bc50 22/13 Bone bead Bc50 30/27	Grooved axe Bc50 20/134 Bone awl Bc50 30/58	Grooved axe Bc50 20/86	Hammer stone Bc50 20/24 Red Mesa shard Bc50 10/4	Hammer stone Bc50 20/175 Hammer stone Bc50 20/176 Red Mesa shard Bc50 10/21	Hammer stone Bc50 20/142 Arrowhead Bc50 22/39	Stone disk Bc50 20/129	Hammer stone Bc50 20/178	Stone disk Bc50 20/104 Stone disk Bc50 20/105 Flint knife Bc50 22/15 Bone awl Bc50 30/31 Bone awl Bc50 30/32	Hammer stone Bc50 20/169 Arrowhead Bc50 22/40 Exuberant olla Bc50 10/28	Rubbing stone Escavada shard Bc50 10/46 Bone awl Bc50 30/61	Selenite pendant Bc50 20/45 Bone awl Bc50 30/29	Turquoise bead Bc50 20/52 Arrowhead Bc50 22/17 Arrowhead Bc50 22/21	Grooved axe Bc50 20/95 Bone bead Bc50 30/70 Bone bead Bc50 30/65 Escavada dipper Bc50 10/3	Hammer stone Bc50 20/8 Grooved axe Bc50 20/57 Stone ring Bc50 20/99 Selmite pendant Bc50 20/130 Arrowhead Bc50 22/19 Bone awl Bc50 30/54
3-4		Bone needle Bc50 30/24	Hammer stone Bc50 20/32 Rubbing stone Bc50 20/37	Hematite pendant Bc50 20/24		Arrow straightener Bc50 20/182			Hoe fragment Bc50 20/13 Turkey bone awl Bc50 30/18 Turkey bone awl Bc50 30/19 Bone bead Bc50 30/69 Bone awl Bc50 30/75			Palette Bc50 10/70		Turkey bone awl Bc50 30/57	Bone awl Bc50 30/50 Turquoise pendant Bc50 20/54	Bone awl Bc50 30/44	Hammer stone Bc50 20/143	Hammer stone Bc50 20/107	Palette Bc50 20/108	Bone awl Bc50 30/62	Stone disk Bc50 20/44	Bone awl Bc50 30/67 Olla (plainware) Bc50 10/12 Mesa Verde bowl Bc50 10/13 Mesa Verde bowl Bc50 10/14 Escavada bowl Bc50 10/15 Mesa Verde jug Bc50 10/16	Stone bead Bc50 20?2 Pipe Bc50 20/4 Turquoise pendant Bc50 20/43 Turquoise pendant Bc50 20/55 Arrowhead Bc50 22/26
4-5			Rubbing stone Bc50 20/36 Stone maul Bc50 20/56 Grooved axe Bc50 20/85 Bone awl Bc50 30/15 Exuberant olla Bc50 10/37	Grooved axe Bc50 20/87	Hoe Bc50 20/65 Bone awl Bc50 30/28	Arrow straightener Bc50 20/98		Stone bead Bc50 20/51	Stone disk Bc50 20/79 Stone disk Bc50 20/80 Arrowhead Bc50 22/29 Shell bead Bc50 30/37 Bone awl Bc50 30/39		Bone awl Bc50 30/59											Arrow straightener Bc50 20/91 Bone awl Bc50 30/72
5-6		Turquoise bead Bc50 20/53		Arrowhead Bc50 22/34	Hammer stone Bc50 20/60 Chipped axe Bc50 20/62 Bone awl Bc50 30/70 Escavada shard Bc50 10/7	Hematite cylinder Bc50 20/63 Wingate shard Bc50 10/8															Exuberant Corrugated pot Bc50 10/24 Escavada olla Bc50 10/25	Escavada bowl Bc50 10/19 Escavada olla Bc50 10/20 Arrowhead Bc50 22/33 Shell bead Bc50 30/36 Shell plug Bc50 30/40	
Floor		Lignite button Bc50 20/92	Hammer stone Bc50 20/61 Arrowhead Bc50 22/27 Red Mesa bowl Bc50 10/44		Palette Bc50 20/67 Hammer stone Bc50 20/90 Arrowhead Bc50 22/23 Turkey bone awl Bc50 30/12 Bone awl Bc50 30/17 Bone awl Bc50 30/33 Bone bead Bc50 30/41	Hammer stone Bc50 20/148	Hammerstone Bc50 20/144	Hoe Bc50 20/26	Bone awl Bc50 30/32 Bone awl Bc50 30/45 Ulna awl Bc50 30/76 Exuberant bowl Bc50 10/27	Rubbing stone Bc50 20/138	Hammer stone Bc50 20/137	Hammer stone Bc50 20/140			Hammer stone Bc50 20/141 Escavada bowl Bc50 10/29		Rubbing stone Bc50 20/28 Sandal last Bc50 20/94	Arrowhead Bc50 22/29 Bone bead Bc50 30/23	Hammer stone Bc50 20/139 Bone awl Bc50 30/56	Double grooved axe Bc50 20/133		Selenite pendant Bc50 20/58 Stone disk Bc50 20/59		
Sub b-1	Turquoise bead Bc50 20/132 Olivella shell Bc50 30/51	Incised bone awl Bc50 30/47	Arrowhead Bc50 22/30 Ulna awl Bc50 30/38		Flint knife Bc50 22/41 Bone awl Bc50 30/46						Arrowhead Bc50 22/42										Arrowhead Bc50 22/38 Bone awl Bc50 30/55 Deer bone awl Bc50 30/13 Bone awl Bc50 30/53			Pottery figurine Bc50 10/9
Sub 1-2 Floor	Polishing Stone Bc50 20/1 Turquoise pendant Bc50 20/73 " Bc50 20/74 " Bc50 20/75 " Bc50 20/76 " Bc50 20/77 Arrowhead Bc50 22/31 Arrowhead Bc50 22/32				Bone awl (rib) Bc50 30/16																		Lino dipper Bc50 10/8

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