Journal of the Arkansas Academy of Science

Volume 25 Article 8

1971

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covered and the extent of coverage.

3. Although they complained about the problems and were not sure if the problems aided their comprehension, they agreed that they were well explained and were of the right level of difficulty and number.

Though the grades ran reasonably high, many students requested more tests (there were two) and more ecology in the course.

As we will have all of the faculty back on campus next year, we will be able to offer the courses separately next spring. This will enable us to infuse more physics into the Elements of Physics course and more ecology into the Environmental Studies course. However, we will incorporate a great deal of the study of environmental problems and quality which had not been done prior to this innovation. This time the physics course was somewhat squeezed into the environmental mold. The next time the introduction of pollution topics will serve as a relevant starting point from which to move readily into contributing areas of physics.

A Consideration Of Macro-Climatic And Macro-Biotic Change In The Ozark Highlands During Post-Glacial Times

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ABSTRACT

Climatological, pedological and faunal investigations conducted in the Upper Midwest and the Ozark Highlands indicate that the environment to which man in the Ozarks was adapting over the past 12,000 years has undergone several major shifts, beginning with a cool-moist boreal forest situation followed by a period of warming and aridness resulting in prairie and deciduous forest climaxes and subsequently, in the last 4000-5000 years, change to the pattern reflected by present conditions.

INTRODUCTION

Paleoecology and climatological episode investigations for the Ozark Highlands physiographic, geographic and archeologic province are a necessary prerequisite in understanding the cultural development and variability manifest in archeological assemblages derived from the Ozarks. Studies of this nature have been prevalent in the Upper Midwest and northern Ozark periphery for the last decade. Notable undertakings are: 1) Cleland's study of "The Prehistoric Animal Ecology and Ethnozoology of the Upper Great Lakes Region" (1966) and Yarnell's related report of "Aboriginal Relationships Between Culture and Plant Life in the Upper Great Lakes Region" (1964); 2) the multi-disciplinary investigations of bogs and archeological sites, particularly Rodgers Shelter, in western Missouri as part of the program focusing on "The Archeology and Paleoecology of the Western Ozark Highlands" and involving the geochronologist C. Vance Haynes, the mammalogist Paul W. Parmalee, and the palynologist Peter J. Mehringer, Jr. (Wood and McMillan 1967); 3) Klippel's investigation of "Prehistory and Environmental Change along the Southern Border of the Prairie Peninsula during the Archaic Period (1971); 4) Falk's study of unmodified animal bone from a stratified cave in the Northern Missouri Ozarks (1970); and 5) the recently funded National Science Foundation project to undertake a paleoenvironmental study of the Sangamon River Valley in Illinois. These and the multitude of other paleoecology investigations not mentioned are indicative not only of what is being done but what can be learned relative to prehistory through research directed toward the interrelationship between man and his environment.

The purpose of this paper is to consider some of the statements made about the paleoecology of the Ozarks. Involved will be summarization of several current interpretations of broad geographic and chronologic scope overlapping the geographic Ozarks and the period of Indian occupancy in an attempt to state knowledge of post-Pleistocene physiographic, meteorologic, zoic and floristic change, integrate what is known, and relate it regionally.

GEOGRAPHY

The Ozark Plateau physiographic province, variously called the Ozark Highlands or simply the "Ozarks", falls geographically into portions of five states. The Illinois, Kansas, and Oklahoma units are small in areal extent and are considered only incidental to the Arkansas and Missouri portions of the Plateau. Sauer (1920: 3) estimates that only 6% of the Ozarks are contained within the northeast corner of the political division of Oklahoma, and only 2% are contained within the combined areas of the extreme southeast corner of Kansas and the Shawnee Hills of Illinois (cut off from the main units of the Ozarks by the Mississippi River). Sixty-six percent of the plateau falls within Missouri, and 26% of the territory is contained within Arkansas. Limits of the Ozarks are best defined by river breaks between physiographic units — the Spring, Neosho, and Arkansas River system on the extreme west in Oklahoma, Kansas, and Missouri; the Cherokee Plains, or Sac and Osage rivers on the Northwest; the Missouri River Valley along the north; the Mississippi River Valley along the northeast; the tertiary alluvial deposits of the Mississippi Embayment along the southeast; and the Arkansas River Valley along the south (Figure 1). An estimated 50,000 square miles are delimited by these peripheral units, forming a parallelogram running roughly northeast-southwest in maximum linear direction (Sauer 1920: 3). The Missouri unit covers almost the entire southern half of the state, and the Arkansas unit covers the northwest quadrant of that state. Within this border are numerous areas defined on the basis of topographic-biotic features, the primary ones being the Boston Mountains, Springfield Plateau, Salem Plateau, St. Francois Mountains, and Huntsville Prairie.

MODERN BIOTIC PROVINCES

Dice (1943) has included the Ozarks as a portion of his Carolinian Biotic Province yet recognizes that it does possess biotic district status, indicating some dissimilarity with the major unit of the province located east of the Mississippi River in the northeastern United States. Carolinian is characterized as a deciduous forest zone of diversified hardwood (mainly oak-hickory in the Ozarks with a subclimax of pines). Within the district, at least three phases of oak-hickory or oak-pine occur — dry ridge phase, slopes phase, and lowland phase — with xeric glade situations characterized by buckthorn and juniper occurring in certain areas (Moore 1960: 6; Gary Tucker, personal communication). Prairies also exist within the Ozark district of the Carolinian Province, and are basically tall-grass habitats comparable to those of Oklahoma and Kansas.

The Carolinian Biotic Province is distinguishable from the Illinoian mixed prairie-deciduous forest province to the northwest, with the transition gradual in some places and abrupt in others. The Texan prairie-mixed-with-hardwood province to the west, with its distinctive fauna, and the Ouachita and Mississippi districts of the Austroriparian province, with their pine and hardwoods, provide the remaining surrounding zones, although, again, biotic boundaries are diffuse and the Ozark district is best defined physiographically. Climatic shifts could easily lead to encroachment of the three surrounding biotic provinces into the Ozarks, or vice-versa.

Figure 1. Map of the Ozark Highlands geographic, physiographic, biotic and archeologic province.

Bryson and Wendland, approaching climatic patterns from a meteorological direction, assume that "within the past ten or fifteen millenia a mix of air masses occurring in the same frequency and annual sequence as at present would be associated with a similar biotic system to that with which it is now associated" (1967: 277) and that "past climates differed from present climates in quantity, but not in kind" (1967: 277). Approaching paleoenvironmental conditions from a biotic

viewpoint, the paleobiotic provinces need not necessarily be identical with modern Dician biotic provinces, but are generally considered to be similar enough so that modern correlates can be used to provide a more complete environmental picture for the past.

MACRO-CLIMATIC EPISODES IN THE MIDWEST

Several schema of climatic episode patterns with corresponding faunal-floral conditions have been formulated for the upper Midwest, focusing primarily on the Great Lakes Region or the northern portion of the upper Midwest — Griffin (1961), Bryson (1965), Baerreis and Bryson (1965), Bryson and Wendland (1967), Cleland (1966), and Wright (1968). Although concerned primarily with geographic zones north of the Ozarks, Baerreis and Bryson (1965) consider that if an identified climatic episode and related biota exist in one geographic area, a corresponding episode, not necessarily the same, will be occurring elsewhere, and that, in fact, the climatic conditions of the past are globally interrelated. Therefore, climatic fluctuations recorded in the archeological-paleoenvironmental record for the upper Midwest must be reflective of conditions and chronology in the Ozarks, especially since the latter area lies on the southern border of the meteorologically defined regions of the north.

Since no satisfactory record of climatic succession exists for the Ozarks, outside of the one presently being formulated for northern Ozark border zones, these schema of episode information of various mentioned authors are presented only in summary form (Figure 2) and correlation is graphically established. The correspondence of these episodes with the only investigated Ozark area, the northern periphery, has been considered elsewhere (Klippel 1971: 43-46) and satisfactory correlations determined.

NEOTHERMAL	UPPER GREAT LAKES REGION Cleland (1965) and Griffin (1961)		UPPER MIDWEST Bryson (1965), Bryson and Wendland (1969)
	BOREAL WOODLAND PERIOD: 12000-9000 B.C. Glacial retreat and advance; cold glacial climate; spruce dominated forest with trace of deciduous forms; cold weather fauna including extinct forms.		**LATE GLACIAL CLIMATE EPISODE** 11000-8000 B.C. Cool-Moist Boreal forests
ANATHERMAL Cool moist	**BOREAL FOREST PERIOD:** 9000-7000 B.C. Warmer climate; closed boreal forest with deciduous elements.		**BOREAL EPISODE** 8000-6000 B.C. Warm-dry; grassland with pine changing to oak savannah (forest-prairie)
5500 B.C.	**PINE FOREST PERIOD:** 7000-3500 B.C. Climate becoming warmer, passing present level (Xerathermic); spruce-pine forest changing to pine with oak-pine in the south.		**ATLANTIC EPISODE** 6000-3000 B.C. Warm-dry; climax forest
ALTITHERMAL (HYPSITHERMAL)	**OAK AND PINE PERIOD:** 3500 B.C. to Present Warmer-dryer climate; Carolinian Biotic Province establishment; oak-hickory forest dominant in south with associated fauna.		**EARLY SUB-BOREAL EPISODE** 3000-1500 B.C. Warm-dry
hot	**Griffin**	**Cleland**	
dry	2300-1800 B.C. — Warm Middle Archaic Florescence	Xerothermic Maximum	**LATE SUB-BOREAL EPISODE** 1500-550 B.C.
2000 B.C.	1800-1300 B.C. — Cool	Cool Episode	
MEDITHERMAL	1300-800 B.C. — Warm Late Archaic Expansion	Late Archaic Episode	**SUB-ATLANTIC EPISODE** 550 B.C.-A.D. 400 Wet; oak-hickory climax forest
relatively	800-300 B. C. — Cool	Cool Episode	
cool	300 B.C.-A.D. 300 — Warm Middle Woodland Expansion	Hopewell Episode	
moist	A.D. 300-800 — Cool Middle Woodland Decline	Scandic Episode	**SCANDIC** A.D. 400-900 — amelioration
	A.D. 800-1200 — Warm Middle Mississippi Expansion	Neo-Atlantic Episode	**NEO-ATLANTIC** A.D. 900-1200 — warm, wet **PACIFIC I** A.D. 1200-1450 — cool, dry **PACIFIC II** A.D. 14-50-1550 — Warmer
	A.D. 1200-1700 — Cool Upper Mississippi Decline	Proto- and Historic Episode	**NEO-BOREAL** A. D. 1550-1850 — cool Recent A. D. 1850 to present — warmer

Figure 2. Macro-climatic schema for western and Upper Midwestern North America.

Specific data supportive of the pattern of post-Pleistocene climatic succession are rare for the Ozarks. Boney Spring from western Missouri has produced the only usable pollen spectrum overlapping the time period of concern. The late deposits (300 B.C. or less) indicate a biotic situation similar to the current Carolinian-Illinoian border, with the forest situation being one of oak-hickory and associated plant and animal species (Wood and McMillan 1969: 10). Pollen and macrofossils produced by a Boney Spring stratum with two radiocarbon dates — one 16,580 ± 220 BP and the other 13,700 ± 600 BP — produce a spectrum similar to that which existed in southwest Minnesota and northeast South Dakota during the interval 11,500 BP and 10,500 BP, and today is represented by isolated bog situations extending only as far south as central Wisconsin. Spruce (**Picea** sp.) dominates the spectrum, with Larch (**Larix laricina**) a present species (Mehringer **et al.** 1968: 567). Pollen samples from Trolinger Bog are too early for consideration. The samples recovered from Rodgers Shelter as part of the same Western Ozarks project have produced little information at present, but analysis continues on the samples of this well-dated archeological site.

Parmalee, Oesch, and Guilday (1969), approaching the paleoenvironment of the northern periphery of the Ozarks by using faunal data from cave contexts, conclude that:

> . . . with the gradual warming trend, and with eventual establishment of the warm and dry xerothermic period (ca. 3500-1500 B.C.), this boreal environment and its related fauna disappeared from the Ozarks.
>
> Associated with the termination of this moist, boreal environment and the beginning of the warm and dry xerothermic period was a major change in vegetation type. The coniferous forests were replaced with deciduous hardwoods, probably oaks and hickories being the dominant trees, and apparently large expanses of the Ozark Highlands became covered with short-grass prairie. Remains of pocket mice, grasshopper mice, and the kit fox recovered from Crankshaft Cave are indicative of a habitat now characteristic of the western and central Great Plains. These species probably survived in the Ozarks until the return of cooler and more moist conditions, which, in turn, permitted expansion of the hardwood forests and the establishment of tall-grass prairie and a mammalian fauna characteristic of the area today (Parmalee **et al.** 1969: 36).

Graham Cave, at the northern edge of the Ozarks, has recently been reinvestigated from a paleoecologic perspective. Klippel (1971) undertook pedological analysis of the cave deposits and correlated these with vertebrate fauna from the cave and the Prairie Peninsula to the north. Klippel's thesis is that changing environmental conditions are reflected in the cave deposits, erosional patterns influenced by climate resulting in more wind-blown material deposited in the cave during dryer periods. Mechanical sorting of the deposits and analysis of particle size difference led Klippel to conclude that about 9500 years ago the climate was more moist and sand built up in the cave as ceiling fall. Following this was a climatic change towards a more arid situation allowing for increased wind erosion and eventual deposition of eolian material in the cave. Beginning around 5000 years ago, the deposits indicate a third change consistent with present environmental conditions (1971: 123-124).

Falk (1970), working in Arnold Research Cave in the same general area of Missouri as Graham Cave, undertook factor analysis of the faunal remains from the archeological site and concurred with Klippel that a change is evident in the faunal record. Falk, however, prefers to attribute this variation over time to changes in the adaptive patterns of man, considering the cave context faunal assemblage to be primarily reflective of man's selection. While the vertebrate remains from the lower levels of the cave indicate an abundance of forest-habitat forms, and a forest-border fauna exists in the later Archaic and subsequent levels (1970: 31), we must be aware of the associated human parameters and not immediately conclude that the record is a product of biophysical environmental change.

Cleland (1965), concerned with the "reconstruction of the natural environment of an area as it was when this area was occupied by the culture in which we are interested", conducted faunal analysis of the resources recovered by the University of Arkansas between 1928 and 1934 from rock-shelters in Northwest Arkansas. He considers that "the great bulk of the material from the Ozark bluff shelters is probably a marginal and somewhat isolated manifestation of Late Middle Woodland and Middle Mississippi culture perhaps dating between A.D. 500 and A.D. 1400", and concludes that while forms of three habitats occur (all simultaneously for this area of the Ozarks) "no major change has taken place in either the composition or distribution of biotic communities since major occupation of the bluff sites" (1965: 70). Superficial evidence gained by recent investigations in the Ozarks indicates that the shelters were occupied over a much longer period of time than Cleland indicated, and that the remains used by him may reflect a longer time period characterized by greater micro-biotic variation and/or change.

These studies indicate how little we actually know about the paleoenvironment of the Ozarks except by inference from macro-schema or fringe area investigations.

CONCLUSIONS

Integration of the Ozark researches with the broader picture presented by the Midwestern paleoenvironmental schema leads to the following conclusions pertaining to

changing environmental and cultural patterns in the Ozark Highlands:

1) During man's initial occupancy of the Ozarks he was adjusting to an environment characterized by cool-moist climatic conditions and a boreal forest with associated fauna.

2) By 8000 B.C. the climate was becoming warmer and the boreal forests were being replaced by oak-hickory-pine phases with prairie expansion occurring in portions of the Ozarks. It was during this period that man was making his Archaic life-style adaptation to the Ozarks province.

3) Carolinian biotic province conditions were being established in the Ozarks by 3500 B.C., but of the Ozark district mixed-deciduous-forest-with-interspersed-prairie variety. Middle Archaic stage florescence was occurring during this period.

4) Following the Xerothermic maximum, a cooler, more moist climatic pattern prevailed in the Ozarks, typified primarily by a biotic situation comparable to that of the present but with numerous climatic fluctuations or perturbations occurring which would have altered the forest-prairie distribution. These perturbations are characterized as short-term fluctuations from cool to warm to cool. During this period of environmental fluctuation Woodland cultural elements diffused into the Ozarks, eventually being succeeded by Mississippian elements, possibly as a result of Middle Mississippi expansion occurring during the Neo-Atlantic Episode (A.D. 800-1200). Both adapted to the rugged terrain and mixed forest-prairie environment of the Ozarks.

5) Neo-Boreal cooling may have prompted migration of Mississippian populations out of the eastern Arkansas-Missouri area and into the Ozarks where, again, changes were made in the cultural pattern to adjust it better to the Ozarks.

6) All the above conclusions are based on data derived primarily from the northern Ozarks border with the prairie and are only tenable on this basis, subject to change as more basic environmental-cultural data accumulate for the remainder of the Ozarks.

REFERENCES CITED

Baerreis, David A. and Reid A. Bryson
1965 Climatic Episodes and the Dating of the Mississippian Cultures. **The Wisconsin Archeologist,** Vol. 46, No. 4, pp. 203-220. Milwaukee.

Bryson, Reid A.
1965 Recent Climatic Episodes in North America. **Proceedings of the Twenty-first Southeastern Archeological Conference, Bulletin 3,** edited by Stephen Williams, pp. 78-81. Cambridge.

Bryson, Reid A. and Wayne M. Wendland
1967 Tentative Climatic Patterns for Some Late Glacial and Post-Glacial Episodes in Central North America. **Life, Land and Water,** edited by W. J. Mayer-Oakes, pp. 271-298. University of Manitoba Press, Winnepeg.

Cleland, Charles E.
1965 Faunal Remains from Bluff Shelters in Northwest Arkansas. **The Arkansas Archeologist,** Vol. 6, Nos. 2-3, pp. 39-63. Fayetteville.

1966 The Prehistoric Animal Ecology and Ethnozoology of the Upper Great Lakes Region. **Anthropological Papers, Museum of Anthropology, University of Michigan,** No. 29. Ann Arbor.

Dice, Lee R.
1943 **The Biotic Provinces of North America.** University of Michigan Press, Ann Arbor.

Falk, Carl R.
1970 The Application of a Factor Analysis in the Interpretation of Unmodified Vertebrate Remains from an Archaeological Deposit in Central Missouri. Master's Thesis, University of Missouri, Columbia.

Griffin, James B.
1961 Post Glacial Ecology and Culture Change in the Great Lakes Area of North America. **Publication Number 7, Great Lakes Research Division Institute of Science and Technology.** The University of Michigan, Ann Arbor.

Klippel, Walter E.
1971 Prehistory and Environmental Change along the Southern Border of the Prairie Peninsula During the Archaic Period. Ph.D. Dissertation, University of Missouri, Columbia.

Mehringer, Peter J. Jr., Charles E. Schweger, W. Raymond Wood and R. Bruce McMillan
1968 Late-Pleistocene Boreal Forest in the Western Ozark Highlands. **Ecology,** Vol. 49, No. 3, pp. 567-568. Durham.

Moore, Dwight M.
1960 **Trees of Arkansas.** Arkansas Forestry Commission, Little Rock.

Parmalee, Paul W., Ronald D. Oesch and John E. Guilday
1969 Pleistocene and Recent Vertebrate Faunas from Crankshaft Cave, Missouri. **Reports of Investigations** No. 14, **Illinois State Museum.** Springfield.

Sauer, Carl O.
1920 The Geography of the Ozark Highland of Missouri. **Geographic Society of Chicago, Bulletin** No. 7. Chicago.

Wood, W. Raymond and R. Bruce McMillan
1967 Recent Investigations at Rodgers Shelter, Missouri. **Archaeology,** Vol. 20, No. 1, pp. 52-55. New York.

1969 Archeology and Paleoecology of the Western Ozark Highlands. **Final Report to the National Science Foundation.** University of Missouri Archeological Research. Columbia.

Wright, H. E., Jr.
1968 History of the Prairie Peninsula. **The Quaternary of Illinois, Special Publication,** pp. 78-88. University of Illinois, College of Agriculture, Urbana.

Yarnell, Richard Asa
1964 Aboriginal Relationships between Culture and Plant Life in the Upper Great Lakes Region. **Anthropological Papers, Museum of Anthropology, University of Michigan,** No. 23. Ann Arbor.

Environmental Adaptations: The Otomi Indians of the Mezquital Valley

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There was a trend in anthropology, between 1920 and 1950 to view culture as isolated from the biological aspects of man and the physical nature of the world around him. Most anthropologists followed the lead of Franz Boas who had reacted strongly against the evolutionary and environmental determinists of his day — determinists who held that the Western European race was more advanced because the envigorating climate of Europe caused the race to rise farther along the evolutionary scale. From Boas' time until the late 1950's when Julian Steward put forth his theory of multilinear evolution and Coon, Garn, and Birdsell related inherited anatomical and functional variations in man to selection by the physical, biotic and cultural system, few anthropologists viewed man as part of an ecosystem (Baker 1966: 19). During the last few years, however, anthropologists have become more concerned with man's responses to the environment in which he lives and the effect of these responses upon his culture.

The current view is that each environment offers to human occupation a different set of challenges. Therefore a different set of cultural responses, whether they be technical, social or religious may be expected. In facing the challenges, these responses tend to take the path of greatest efficiency in the utilization of the environment (Sanders 1966: 34). This paper describes the utilization of the environment for the collection and production of food and drink by the Otomi Indians of the Mezquital Valley, Mexico.

During the summers of 1969 and 1970 I spent several weeks engaged in ethnographic fieldwork in the Mezquital, a valley which comprises two million acres of the northwest portion of the state of Hidalgo. Situated to the northeast of Mexico City, it is actually a high, arid plateau lying 5000 feet above sea level, enclosed on the north and east by the Sierra Madre Oriental mountain range, on the south by the Sierra de las Cruces and the Valley of Mexico (in which lies Mexico City), and on the west by the Rio Moctezuma (Mendoza 1950-51; 473). Although a small portion of the southern part of the Valley has long been well-watered by natural flows from the higher (6000-7000 feet) Valley of Mexico, the bulk of the Mezquital is extremely dry with several small rivers such as the Rio Actopan and the Rio Tula failing to implement measurably the less than 12 inches total annual rainfall.

The city of Ixmiquilpan, 150 miles northeast of Mexico City on Federal Highway 85, is the heart of the arid northeastern section of the Mezquital. Situated on the Rio Tula, it is an oasis compared to the dry countryside. On the irrigated land close to the city, trees and flowering bushes border fields of alfalfa and vegetables. Most of the inhabitants of the irrigated zone are "Mexicans" and mestizos as opposed to Otomies. Around 85,000 Otomi inhabitants of the Mezquital live in small farming communities outside the irrigated zone. Here cacti and brushy xerophytic plants dot a hilly landscape, white with dust and cut by **barancas,** the deep, dry stream beds