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Notable Environmental Features in Some Historical Aerial Photographs from Ashley County, Arkansas

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Abstract.—A collection of 1939 aerial photographs from Ashley County, Arkansas was analyzed for its environmental information. Taken by the US Department of Defense (USDOD), these images show a number of features now either obscured or completely eliminated over the passage of time. One notable feature is the widespread coverage of "sand blows" in the eastern quarter of the county, suggesting a major soil liquefaction field consistent with strong seismic activity (magnitude $\geq$ 6.0 on the Richter Scale). Also seen in these photographs are the vestiges of the large prairies once found on the Pleistocene terraces of southern and eastern Arkansas. The former extent of these prairies can be clearly discerned, as can the encroachment of surrounding forests. Numerous "prairie mounds" are also visible across much of the county, especially in areas cleared for agriculture. Finally, nearly 15,000 contiguous hectares of virgin bottomland hardwoods along the Saline and Ouachita rivers are still apparent, which may have sheltered Ivory-Billed Woodpeckers in the 1930s. This work illustrates the value of old aerial photographs in the description of historical features by providing a snapshot of conditions that can help us understand present and future landscapes.

Key words:—Ashley County, Arkansas, aerial photographs, 1939, US Department of Defense, sand blows, soil liquefication, Pleistocene terrace, Saline River, Ouachita River, Ivory-Billed Woodpeckers.

Introduction

Contemporary society must continually address the legacy of previous environments. For instance, portions of the Mississippi Valley Alluvial Plain periodically experience catastrophic earthquakes. During the winter of 1811-1812, it is estimated that over 2,000 quakes occurred near New Madrid, Missouri, including at least three with Richter magnitudes of 8.0 or greater (Freeland and Ammons 2006). These powerful temblors occurred right at the cusp of Euroamerican settlement and prior to government agencies, universities, and other trained observers capable of systematically studying their impacts when they occurred. Today, there are few obvious signs of these seismic events—what we know about these quakes is largely taken from present-day analysis of eyewitness accounts (e.g., Johnston and Schweig 1996) or the adaptation of modern techniques to understand active seismic zones (e.g., Mueller et al. 2004).

While very useful in understanding certain phenomena, eyewitness accounts can be notoriously vague, sometimes contradictory, and of course, require a human being to record them for posterity. Analyses of modern-day events provides an indirect interpretation of what may or may not have happened in the past, but many unknown factors may have influenced these environments and produced different responses from those observed today. Fortunately, other sources of historical information can provide critical documentation of environmental features that are no longer apparent (Egan and Howell 2001). As an example, the invention of photography in the mid-1800s revolutionized how people viewed the world, and with the right approach, old photographs can provide a description of past environmental conditions.

One of the reasons that certain events can be best seen on historical sources of imagery is because these old photographs often show areas prior to decades of intensive land use. A group of old aerial photographs from Ashley County, Arkansas, was analyzed for its environmental information. Taken by the military in the late 1930s, these images show a number of features now either obscured or completely eliminated by changing land use. We present a preliminary examination of these photographs, which show interesting ecological patterns that may help contemporary land managers and planners better understand their environment.

Materials and Methods

History of the Photographs.—Aerial photographs were taken for the US Department of Defense (USDOD) over Ashley County, Arkansas, during the fall of 1939 (Fig. 1). These photographs were declassified in 1957 by the Directorate of Intelligence of the Air Force and were soon thereafter acquired by the USDA Soil Conservation Service as an aid to their soil mapping efforts. Although these photographs had been heavily marked with approximations of soil map units and other features, they were not used in the most recently published soil survey of Ashley County (Gill et al. 1979)—this publication used aerial photographs from a later period. Eventually, the 1939 images were given to Ed and Patsy White of Hamburg, Arkansas, operators of the Ashley County Historical Museum.

In 2005, the Whites offered this collection of aerial

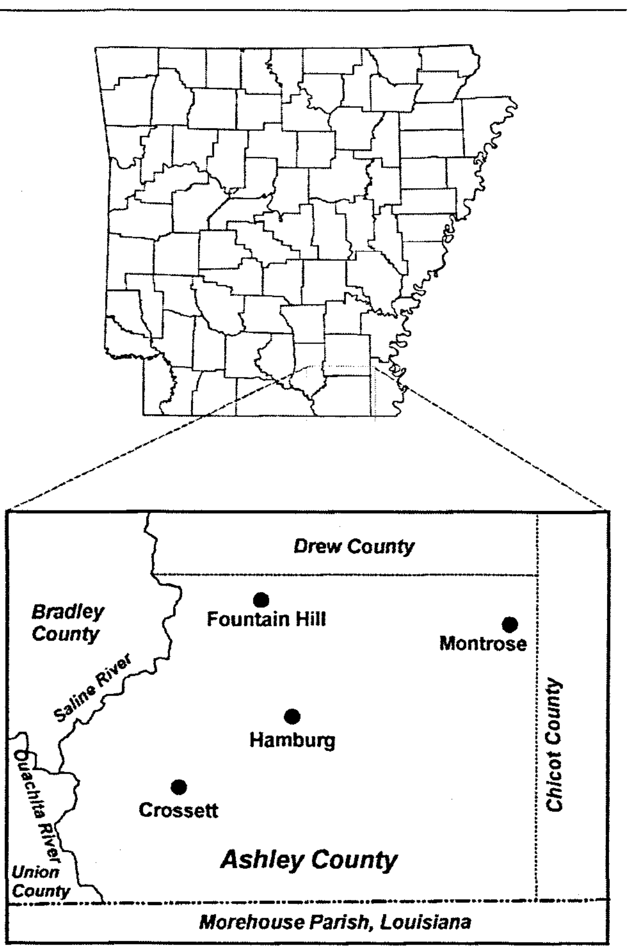


Fig. 1. Location of Ashley County and key cities and villages. Only the northwest corner of the county was not included in the 1939 collection of aerial photographs.

photographs to the USDA Forest Service's Southern Research Station for ecological analysis. During an initial evaluation of these images, we detected a series of circular anomalies in the Mississippi River Embayment of eastern Ashley County. Originally, we believed these were "prairie" mounds, and given their location on the alluvial plain, this alone would have been considered unusual. However, later consultations and evidence provided to us (e.g., Cox et al. 2004) showed them to be seismic features, not mounds of biological or aeolian origin, as first thought. This prompted us to further investigate other environmental features on these historical images.

Digital Image Acquisition and Analysis.—To further the analysis, we digitally scanned at 600 dpi all 305 images in the collection, covering over three-quarters of Ashley County. Once scanned, the pictures were edited in Adobe Photoshop Elements (v3.0)® to remove or minimize the visual impact of pen and stamp marks left on the photographs by previous users. The images were then rectified with Leica Imagine (v9.1)® and ArcGIS (v9.1)® software to produce a seamless digital mosaic with a spatial resolution of approximately 0.7 m. To determine the 1939 extent of the Smith Prairie and the Ouachita-Saline River old-growth bottomland hardwoods, we manually digitized these features as polygons in ArcGIS using the rectified mosaic. During this process, the images were magnified sufficiently to differentiate between prairie and forest or farmland and to distinguish between the smaller crowns of second-growth timber and the wider crowns of virgin bottomland forests. After these polygons were created using the reference mosaic, the ArcGIS software determined their coverage area in square meters, which were then converted to hectares.

Results and Discussion

Evidence of Large-Scale Seismic Activity.—As previously mentioned, one feature obvious in the historical aerial photographs of eastern portions of Ashley County is the widespread coverage of "sand blows." Sand blows are seismic features that occur when buried layers of saturated sand are liquefied by the intense shaking of strong earthquakes and forced upward ("blown") through localized weaknesses in overlying strata of denser, more impermeable materials (e.g., clay) (Obermeier et al. 2001). These sands emerge either along fissures or at given points, often with considerable force, and will usually form a low, linear ridge or circular mound. Extensive eruptions of sand in northeastern Arkansas and southeastern Missouri accompanied the New Madrid earthquakes of 1811 and 1812 (Shepard 1905, Jackson 1979, Johnston and Schweig 1996, Mueller et al. 2004). Following these tremors, Mitchill (1815, pp. 293-294) relayed this account of sand blow formation near modern-day Caruthersville, Missouri:

> Accounts from Little Prairie stated that ponds had been converted to upland, and dry land to lakes; that the banks of the river had sunk and fallen in to a great extent; that cracks had formed in the earth; that water had gushed out; and that there was a strange and chaotic mixture of the elements. In some places, sand, mud, water and stone-coal were reported to have been thrown up thirty yards high.

Liquefaction fields exemplified by sand blows, such as those formed in the New Madrid earthquakes, are considered diagnostic of intense seismic activity (Saucier 1994). However, though often spatially extensive, sand blows and other discrete evidence of liquefaction are prone to erasure by agricultural practices such as plowing and leveling and hence may be missed.

Figure 2 represents a mosaic of six of the 1939 aerial photographs from an area near Montrose, Arkansas. The numerous light-colored circular patches visible in the farm fields represent individual sand blows of appreciable size, many

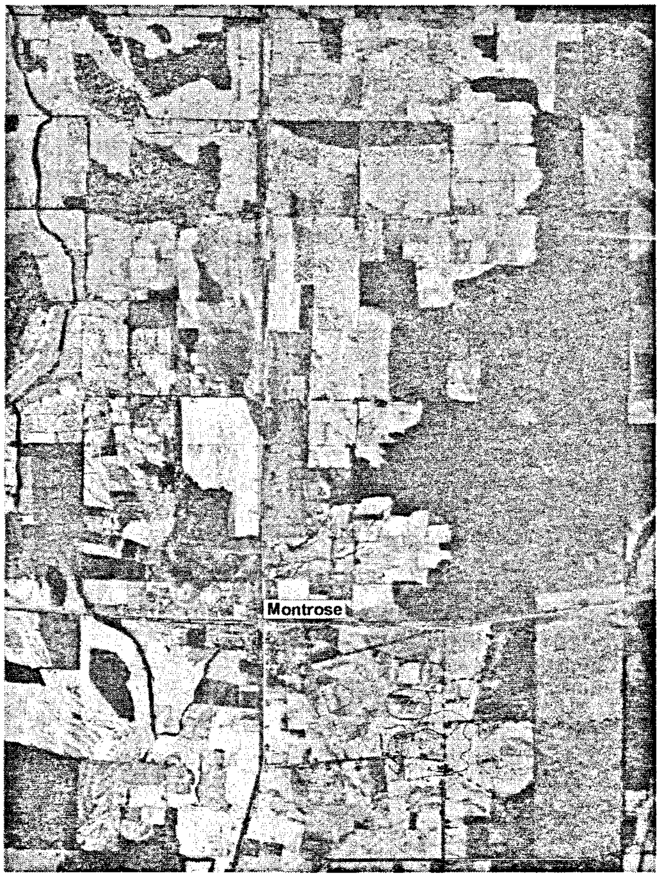


Fig. 2. Portions of the eastern part of Ashley County near Montrose assembled and rectified from 6 different 1939 aerial photographs. Sand blows are the small, light-colored dots scattered over virtually the entire farmed landscape. Pictures courtesy of Ed and Patsy White.

estimated to be from 10 to 30 m in diameter (Cox et al. 2004). These features were first reported for Ashley County by geologist Dr. Randel Cox along the Saline River Fault Zone (SRFZ), which runs from the Ouachita Mountains in central Arkansas toward the southeastern corner of the state (Cox et al. 2000). Cox et al. (2000) mention limited and "scattered" areas of sand blows in line with the SRFZ in Ashley County. After further investigation on contemporary aerial photographs and some fieldwork, Cox et al. (2004) expanded the recognized area of liquefaction in Ashley County and reported another liquefaction field in nearby Desha County. This investigation included the *in situ* analysis of several sand blows, which suggested multiple seismic events had produced the liquefaction field in Ashley County. Most recently, Cox et al. (2007), with older aerial photographs (some dating to the late 1930s) and field work, further expanded the liquefaction fields in southeastern Arkansas. Using known relationships between the strength of earthquakes and the extent of liquefaction fields, Cox et al. (2007) estimated that the Ashley County seismic events may have ranged between magnitudes 5.5 and 6.5.

Because of the relative recency (some were as late as 1980) of the photographs used by Cox et al. (2007), many areas affected by sand blows were missed. Cox et al. (2007) assumed the intensity of the seismic event(s) was related to the long-axis radius of the heavily affected (>1% coverage in features) liquefaction field, which they placed at 16.5 km. However, this underestimated the extent of the liquefaction visible in the 1939 photographs. Our work shows that the zone heavily affected by soil liquefaction in Ashley County was at least twice the original 500 km^2 estimate. There are sand blows evident along the entire eastern quarter of Ashley County from the Drew County line in the north to the Louisiana state line in the south—a distance of over 42 km. This helps to explain how some of Cox et al.'s (2007) field data indicated earthquakes of magnitude 7.0 or higher, even though their liquefaction correlations suggested smaller quakes.

Figure 3 presents a sequence of aerial photographs showing how little visual evidence of large-scale liquefaction fields in Ashley County remains. All of the images included in Fig. 3 are of the same parcel of land covering approximately 345 ha about 2 km north of Montrose, Arkansas. In the 1939 photographs, scores of sand blows are quite obvious in their distribution across the landscape, sometimes appearing in linear or dendritic patterns that can form as sand erupts along fissures in the soil (Saucier 1994, R. Cox, pers. comm.). By the time of the 1979 soil survey (source of the middle image) and following decades of increasingly intensified land use, most of the sand blows had been obscured by plowing, leveling, erosion, and other manipulations of the soil surface. Patches of circular sand blows can still be seen in some areas, but they are much diminished from the earlier image. Gill et al. (1979) do not report when the aerial photographs they used for mapping the soils of Ashley County were taken, but presumably they would have been flown either in the late 1960s or early 1970s—certainly, they are no more recent than the late 1970s. The bottom image was digitally acquired in 2006, and virtually all traces of the sand blows have been eliminated. This pattern is consistent across the visible portions of the entire Ashley County delta, and what was once a massive seismic feature has been effectively erased across the landscape.

Limited documentation of the seismic features in Ashley County can be found in other sources (e.g., Vanatta et al. 1916, Bragg 2003). In the first soil survey of this county, the eastern portion was dominated by two soil types: Portland clay and Portland very fine sandy loam (Vanatta et al. 1916). The Portland very fine sandy loam is of particular interest because given how it was mapped, it most directly corresponds to some of the most concentrated areas of sand blows. Furthermore, in the description of this soil type, Vanatta et al. (1916, p. 1203) reported, "[t]he material in the mounds in this soil is lighter in color and texture, consisting usually of brownish and yellowish very fine sandy loam to a depth of 3 feet." Later they remarked, "[h]ummocks and swells are of common occurrence, but the

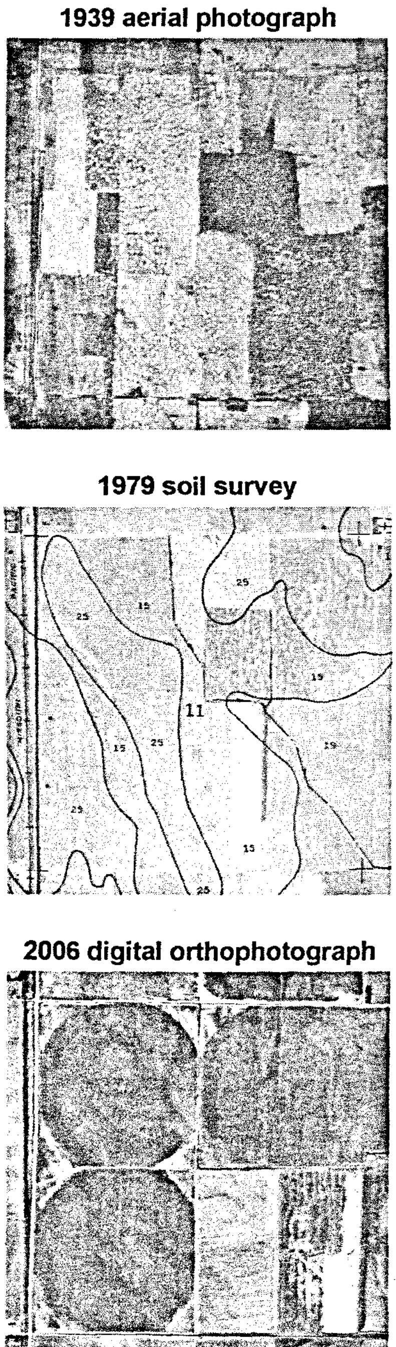


Fig. 3. Gradual disappearance of Ashley County sand blows, illustrated by evidence visualized from Section 11, Township 16 South, Range 4 West, just north of Montrose. Top image—1939 aerial photograph (courtesy of Ed and Patsy White); middle image—1979 soil survey (Gill et al. 1979); bottom image—2006 digital orthophotograph (courtesy of the Arkansas Geographic Information Office).

dome-shaped mounds so common in the uplands are absent except in occasional areas." (Vanatta et al. 1916, p. 1204). Obviously, they assumed the mounds they encountered in the alluvial areas of Ashley County were the same as those observed in the uplands, which is understandable given their general similarities in shape, size, distribution, and local abundance (see also Saucier (1994)).

There are several possible explanations for why Vanatta et al. (1916) observed only a few mounds compared to the broader distribution apparent in the 1939 aerial photographs. It is likely that they visited only limited portions of eastern Ashley County and may have missed large fields of sand blows. The area had also been tilled for decades by this point—some areas were being commercially farmed before 1840 (Bragg 2004a), so this agricultural activity could have erased most low mounds, especially if they were not pronounced. Most likely, the sand blows apparent in the photographs formed during multiple seismic events over centuries (Cox et al. 2004, Cox et al. 2007), so there have been plenty of opportunities for erosion and siltation to have removed or covered evidence of the sand blows. Farming may have exposed long-hidden sand blows, but without the ability to observe the fields from the air, Vanatta et al. (1916) lacked the necessary perspective to witness their light-colored, linear or circular signature in the soil, especially if they surveyed while crops were still on the fields.

Starting in 1815, the General Land Office (GLO) implemented public land surveys in eastern Arkansas. In November of 1828, deputy surveyor Nicholas Rightor surveyed parts of the public domain in southeastern Arkansas. While working approximately 5 km east of what would eventually become Portland near the Ashley/Desha County line, he described the following feature (Daniels 2000):

> Entered Earthquake Swamp which lies in an elipsis [sic] form its longest diamr [sic] N E & S W.
> Timber all dead and of highland kind except small Persimmon which appears to have grown since it sunk no brush or briers growing in it.

This is significant, as Rightor would have seen the aftermath of the New Madrid earthquakes, having contracted with the GLO in Missouri and Arkansas as early as 1815 (Glass 2002). None of the other surveyors in the area of eastern Ashley County reported any evidence of quakes, such as fresh sand blows. Given how strong the 1811-1812 New Madrid earthquakes were, it is possible that this "earthquake swamp" was an area of land subsidence related to these events, rather than activity in the Saline River Fault Zone that underlines this area. However, it has been suggested that the New Madrid quakes may have triggered seismic activity in distant fault zones, perhaps as far as 200 km from the main epicenters (Mueller et al. 2004).

The evidence of a large liquefaction field in eastern Ashley County is critical because the area has not been previously considered susceptible to large-scale seismic events. Even though some remnants of the sand blows are visible in the aerial photographs used in the most recent Ashley County soil survey (Gill et al. 1979), they were not recognized as the seismic feature they are—the authors make no mention of mounds, sand blows, or any circular features in their description of the soils of the area. Jackson's (1979, p. 12) map of seismic risk for the United States clearly identifies a zone of moderate and major damage encompassing the New Madrid area and adjacent regions, including parts of nearby Desha and Chicot counties, but not reaching into Ashley County. Using surface evidence, seismograph readings, and limited imagery of sand blow fields, Cox et al. (2000, 2004) identified at least 2 additional fault lines extending into southeastern Arkansas, and other evidence of prehistoric seismic events in southern Arkansas and northern Louisiana has been recently published (e.g., Washington 2002). However, the magnitude and extent of potential damage from these fault zones may not be fully realized, given the lack of clear and continuous seismic evidence. These historical aerial photographs present an opportunity to better understand the seismic potential of the region.

The Demise of a Historical Prairie.—Modern-day residents of southern Arkansas familiar with the extensive pine forests, bottomland hardwood stands, and farmlands may be surprised to learn that certain areas formerly supported extensive prairies. Tallgrass prairies once covered hundreds of thousands of contiguous hectares across large portions of the state, especially in eastern Arkansas in an area known as the "Grand Prairie" and in west-central Arkansas near Fort Smith (Lantz 1984). Smaller pockets of prairie occurred in many other areas, and Ashley County was no exception—its historical prairies once covered thousands of hectares (Anonymous 1890, Wackerman 1929, Bragg 2003).

A few of the smaller prairies in Ashley County are "saline" or "lick" grasslands that formed due to high soil salinity, producing extreme plant-growing conditions similar to what is now seen at Warren Prairie in Drew and Bradley counties and Pine City Natural Area in Monroe County. However, this was not the origin of the much larger prairies that once dominated portions of Ashley County. Wackerman (1929) attributed these prairies to the lack of good drainage and resulting extremes of soil saturation and growing-season drought, but it seems unlikely that this would fully explain the absence of trees. These large prairies were probably legacies of warmer and drier past climates that were perpetuated over the millennia by frequent fires, many of which were probably started by humans (Bragg 2003).

Though their origins are poorly understood, the prairies once found across the Pleistocene terraces of southern and eastern Arkansas are still apparent in the 1939 aerial photographs, as they had not yet been heavily exploited. Based on reports by "old settlers," Vanatta et al. (1916) stated that the prairies had shrunk considerably over the years. The reduction of Smith Prairie can be seen by comparing coverage estimated from plat maps made by early surveyors, prairie areas reported in Anonymous (1890), and the 1939 aerial photographs. Figure 4 is a compilation of the 1842-vintage GLO plat maps encompassing Smith Prairie (Daniels 2000). According to the approximations made from the relatively imprecise boundaries of the GLO plat maps, Smith Prairie covered roughly 1,650 hectares at this time. A half-century later, Anonymous (1890) provided an estimate of 1,635 hectares for this same prairie.

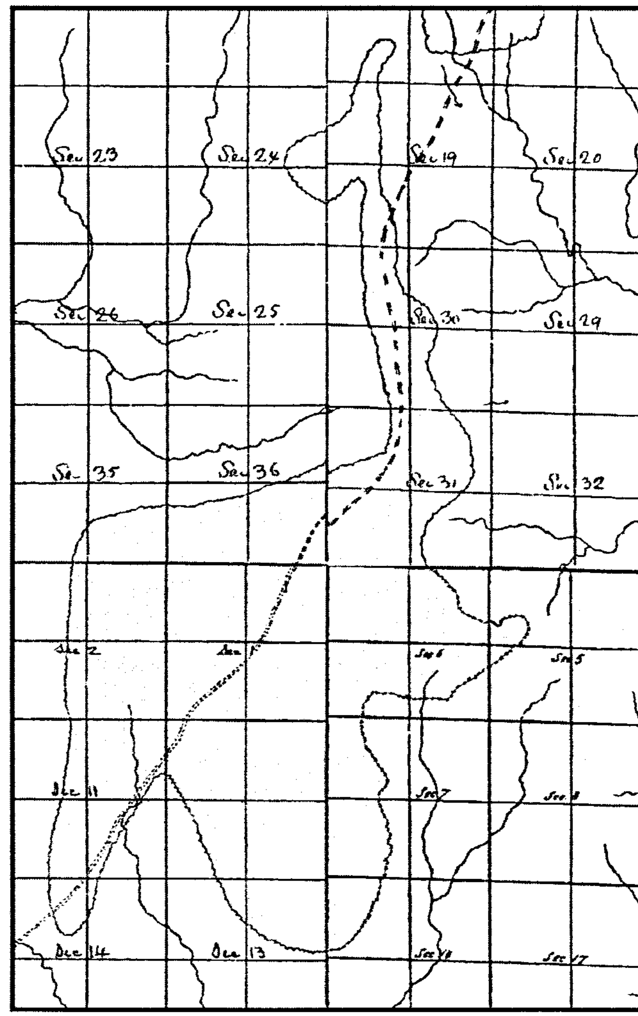


Fig. 4. A plat of the approximate configuration of Smith Prairie (shaded) in central Ashley County as drawn by the GLO land surveyors, circa 1842.

By the time the 1939 aerial photographs were taken, forests had further encroached on Smith Prairie. In addition, landowners had begun to farm parts of the prairie. These further reduced the identifiable area of Smith Prairie to about 1,150 hectares (Fig. 5). The light-colored line identifying the margins of Smith Prairie on the 1939 aerial photograph mosaic in Fig. 5 was manually digitized using the 1939 rectified mosaic of the prairie/forest ecotone. Some apparently open areas along this line were

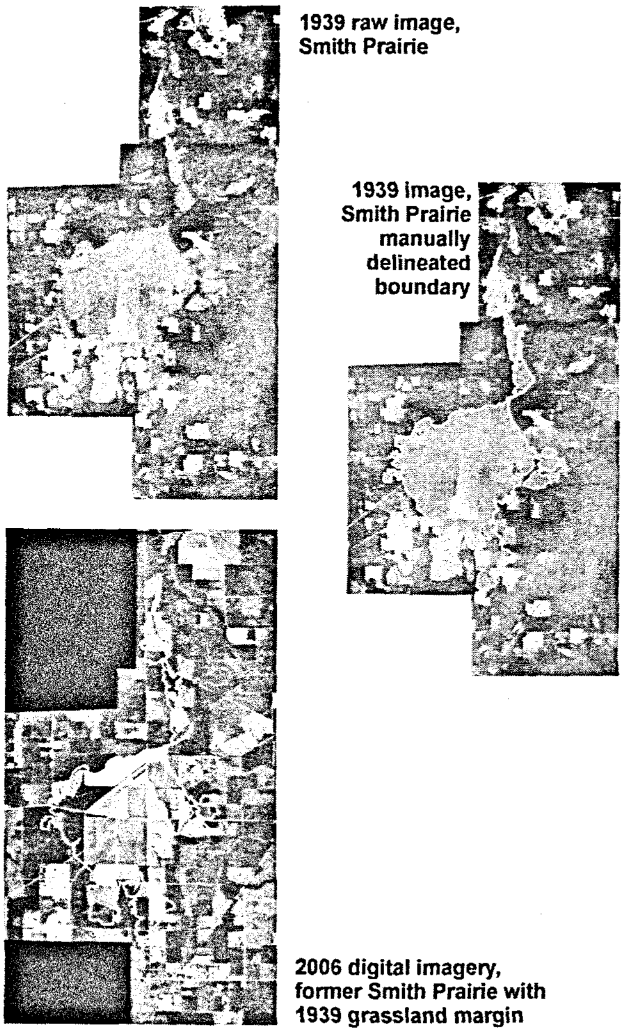


Fig. 5. Mosaics of the 1939 aerial photographs and 2006 satellite imagery of Smith Prairie in central Ashley County. The topmost picture shows the area without modification, while the adjacent pictures contain a light yellow boundary line manually digitized on the 1939 photographs as the interpreted grassland margin. The bottom picture is the modern imagery with the interpreted prairie margin overlaid, showing how Smith Prairie has been entirely converted to other land uses. Images courtesy of Ed and Patsy White and the Arkansas Geographic Information Office.

determined to be either cleared timberland, undifferentiated farmland, or other non-prairie features. In the 2006 imagery (bottom of Fig. 5), Smith Prairie has disappeared, replaced by farmland, pine plantations or other forest cover, and urban/residential development.

Prairie Mounds.—The GLO surveyors sometimes mentioned prairie mounds (also called "pimple," "gas," or "mimas" mounds). Deputy surveyor Nicholas Rightor, for instance, encountered numerous mounds in Pine Prairie in east-central Ashley County (Daniels 2000):

> Land a little rolling 2d rate prairie – Intersperced [sic] with natural mounds in general about 40 feet in base and 5 in height and will average about 4 mounds to the acre.

Later, Rightor described Smith Prairie in central Ashley County:

> Land rolling prairie...by the many natural mounds of 2d rate quality or at any rate tolerable good prairie land; no doubt produce very good crops, and make very prety [sic] farms with good oak timber in the woodland for fencing—

Millions of prairie mounds cover parts of the southern US west of the Mississippi River (Cain 1974, Saucier 1994). They are obvious in the 1939 USDOD photographs of Ashley County—Cain (1974) and Saucier (1994) also published old aerial photographs of extensive prairie mounds in Arkansas, Louisiana, and Missouri. In the minimally disturbed areas of Smith Prairie (Fig. 6), many mounds appear to be free of woody vegetation. However, in certain locations, mounds are identifiable largely because of the trees or shrubs that occupy their summits. Vanatta et al. (1916) and Cain (1974) also reported trees on some prairie mounds. Examination of modern-day examples of these features sometimes finds distinct plant communities on the mounds. However, this is not surprising, given their slight elevation and often better drainage (Vanatta et al. 1916, Bragg 2003).

Though most visible in prairies, abundant mounds can also be seen in the historical photographs in areas cleared of their timber (note the upper left corner of Fig. 6). Today, undisturbed natural mounds can still be found in many forested areas, including some of the last old-growth timber remaining in Ashley County—they are a conspicuous feature of the Levi Wilcoxon Demonstration Forest just south of Hamburg (Bragg 2004b). From this, it is obvious that any "exclusive" relationship between these mounds and open grasslands must have been a prehistoric one.

The origin of these mounds is still subject to considerable debate (Saucier 1994); geomorphologists generally ascribe them to be aeolian deposits similar to nabhka mounds found in arid lands and deserts (Saucier 1994, R. Cox, pers.comm.), whereas others attribute them to the activities of fossorial rodents (Cox 1984, Cox and Scheffer 1991) or insects (Veatch 1906, Saucier 1994). Cain (1974) postulated that these mounds could have arisen from widespread rill erosion around the bases of large trees, whose roots acted as anchors for the soil. Their pattern and shape are also suggestive of the sand blows seen on the Mississippi Valley alluvial plain, hinting of a seismic origin first implied by Hobbs (1907). However, none of these theories has yet proven to be definitively testable in all areas.

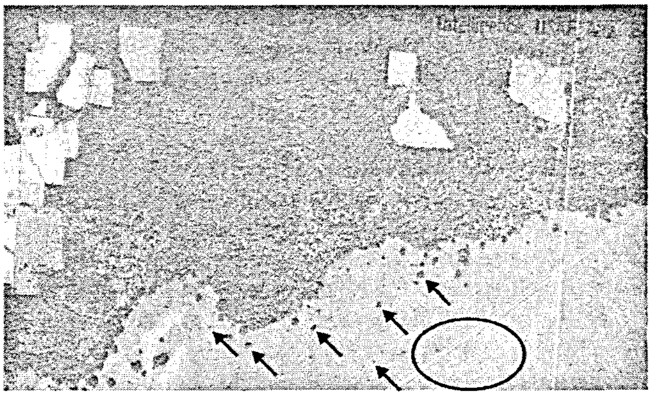


Fig. 6. Portion of Smith Prairie from the 1939 aerial photographs with some prairie mounds covered in woody vegetation (arrows) and some without (oval). Circular spots in the cleared and tilled land of the upper left quadrant of the image are also prairie mounds. Picture courtesy of Ed and Patsy White.

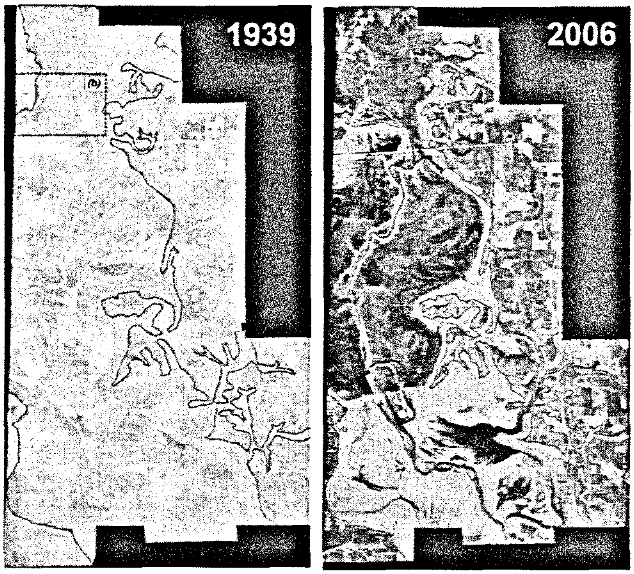
Fig. 7. 1937 photograph of the "typical" virgin bottomland hardwood forests of the Felsenthal Region of the Ouachita and lower Saline rivers in extreme western Ashley County. Picture by Russ Reynolds, photo number 350894 in US Forest Service archives at the Crossett Experimental Forest.

Extent of Virgin Bottomland Hardwood Forests in 1939.—Thousands of contiguous hectares of virgin bottomland hardwoods along the Saline and Ouachita rivers are still noticeable in the 1939 aerial photographs. These lands were frequently inundated for extended periods, slowing their exploitation by the commercial lumbering and subsidence agricultural interests that cleared most of the rest of the region. For instance, Vanatta et al. (1916, p. 1217) were unable to explore and describe the soils of this area due to widespread flooding in the springs of 1912 and 1913. GLO surveyors traversing these lands often delayed their work because of high water, and when they entered these bottomland forests, they often reported overflow marks 5 m or more up the boles of the trees (Daniels 2000).

The presence of virgin bottomland hardwood forests in this area is further corroborated by an image taken 1937 by Russ Reynolds. Reynolds, as a part of his official scientist duties for the Southern Forest Experiment Station of the US Forest Service, worked with the Crossett Lumber Company on the efficacy of logging their bottomland hardwood forests along the Ouachita and Saline rivers (Reynolds 1980). One of Reynolds' photographs (Fig. 7) taken near the village of White, Arkansas, was captioned as being "typical" of the old-growth overcup oak (*Quercus lyrata*)-bitter pecan (*Carya aquatica*) forest cover type of the "...Tensas Delta country" of Arkansas and Louisiana and was "overmature and quite defective". In an unpublished report to the Crossett Lumber Company, Reynolds described these forests as "...chiefly over-cup oak, with a small amount of red and water oak...this riverbottom [sic] type is characteristically short bodied and quite defective. Many of the logs are of good size but hidden defects such as shake, worm, stain, etc., cause a considerable degrade in the lumber produced..." (Reynolds 1936, p. 1). The low timber quality of this portion of the Ouachita River drainage helps explain why this area remained largely uncut until well into the 20th Century.

Based on our assessment of the extent of the contiguous virgin hardwoods, this stand of uncut timber covered at least 14,900 hectares in Ashley, Bradley, and Union counties (Fig. 8a). The longest axis of this timber extends over 23 kilometers, and the area averages 3- to 9-kilometers wide. The polygon digitized for Fig. 8a is an approximation of the intricacies of the upland/bottomland ecotone throughout the Felsenthal Region. Undoubtedly, there were spurs of old-growth bottomland hardwoods reaching from the Saline and Ouachita rivers into the adjoining uplands. Additional areas of virgin forest along the Ouachita River were also found south of Arkansas in Morehouse and Union parishes of Louisiana, but these were not included in our aerial photograph coverage, so their extent has not been documented.

Sheltered by poor log quality and frequent inundation, in the 1930s these uncut forests may have served as a refuge for the Ivory-Billed Woodpecker (*Campephilus principalis*). Figure 7 shows a relatively open bottomland hardwood forest, an important habitat element for the ivory-bill, which needed plenty of space between trees to negotiate its considerable wingspan (Jackson 2004). A tract of old-growth bottomland hardwoods the size of the Felsenthal Region compares favorably with other known refugia. Jackson (2004) described 2 locations with definite or likely Ivory-Billed Woodpecker populations in the lower Mississippi River Valley in 1939—the then 30,000 hectare Singer Tract in Madison Parish, Louisiana, and a 5,000 hectare parcel in Bolivar County, Mississippi. The overcup oak-sweetgum (*Liquidambar styraciflua*)-mixed oak-dominated virgin hardwood forests of the Felsenthal Region (Table 1) were compositionally similar to those reported for the Singer Tract, a.)



b.)

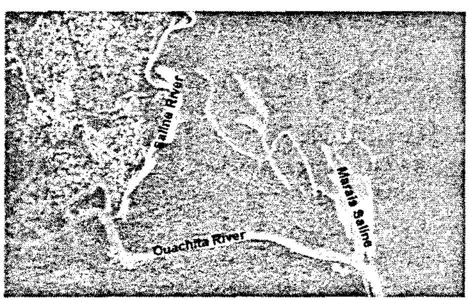


Fig. 8. An approximation *(a)* of the extent and distribution of virgin bottomland hardwood forests along the Felsenthal Region of the Ouachita and Saline rivers in 1939, compared to the 2006 image of the same region. A close-up of a portion of this timber *(b)* along the Saline River shows the encroaching logging on the west side (left) of the channel in 1939. Images courtesy of Ed and Patsy White and the Arkansas Geographic Information Office.

the last definitively known home of the ivory-bill (Tanner 1942, Tanner 1986). Note that there are no formally documented reports of the Ivory-Billed Woodpecker in Arkansas during the 1930s, and only spotty records prior to that. Tanner (1942) mapped the location of a historical report of an Ivory-Billed Woodpecker at the confluence of the Ouachita and Saline rivers, but this is an error—the original 1834 sighting by G.W. Featherstonhaugh was at the junction of the Ouachita and Caddo rivers (Featherstonhaugh 1835), many kilometers further upstream.

Although these bottomlands are considered virgin, they were not untouched. In addition to some scattered roads, railroads, farm clearings, and river navigation structures, there had been limited logging across the region over the years. For instance, GLO deputy surveyor Nicholas Rightor mentioned loggers were "rafting" baldcypress (*Taxodium distichum*) from a swamp near the confluence of the Ouachita and Saline rivers in 1827 (Daniels 2000, Bragg 2004a). Widespread lumbering eventually did come to this portion of the Ouachita and Saline bottoms. This forest clearing, probably done by the Bradley Lumber Company of Warren, Arkansas, is visible in the left side of Fig. 8b. Timber removals in the Felsenthal Region during the mid-1900s accelerated following growing shortages of more valuable timber, product line expansion by the Crossett Lumber Company, increased lumber demand during and after World War II, and improvements in harvest techniques and technologies (Darling and Bragg, unpub. data). During this same period, the other large remnant stands of old-growth bottomland hardwoods in Mississippi and Louisiana likewise fell to the axe and plow, and with its habitat gone, the Ivory-Billed Woodpecker was assumed to have vanished (Tanner 1942, Jackson 2004) until it was relocated in eastern Arkansas in 2004 (Fitzpatrick et al. 2005).

Conclusions

This work demonstrates the value of old aerial photographs in the description of historical features and provides a snapshot of prior environmental conditions that can help us understand present and future landscapes. For instance, evidence gathered from these aerial photographs suggests that either the New Madrid Fault had a greater impact much farther south than previously thought, or (more likely) that the more recently described Saline River Fault has the capacity to produce devastating earthquakes. This, in turn, has considerable implications for emergency planning in southeastern Arkansas, which generally considers itself outside of most seismic hazard zones. Without these old photographs, the extent of this liquefaction zone may have been lost.

Most aerial photography dates to only the World War II era or later, limiting its applicability in historical assessments. However, the scale at which these images are available, coupled with their geographic coverage, makes them a vital source of new information. Although most of the environmental attributes apparent in these photographs are not as significant as the extensive liquefaction zones, they have important ramifications for land-use planning, ecosystem management, and even the conservation of threatened and endangered species. If nothing else, they are manifestations of the landscape captured at a period much closer to the original Euroamerican settlement of Ashley County, and they form a baseline for understanding the impacts of humans on the ecosystems of the region.

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Table 1. General Land Office witness trees along the Ouachita and Saline rivers in western Ashley County, Arkansas, adapted from Bragg (2003).

Surveyor species name	Likely scientific name(s)	Count	Percent
Pine	*Pinus taeda*	471	16.457
Overcup oak	*Quercus lyrata*	406	14.186
Sweetgum	*Liquidambar styraciflua*	308	10.762
Pin oak	*Quercus phellos, Quercus nigra*	297	10.377
Black oak	*Q. falcata, Q. velutina, Q. pagoda, Q. shumardii, Q. nuttallii*	203	7.093
White oak	*Quercus alba*	192	6.709
Post oak	*Quercus stellata*	122	4.263
Pecan	*Carya illinoensis*	103	3.599
Cypress	*Taxodium distichum*	91	3.180
Hickory	*Carya* spp.	90	3.145
Willow oak	*Quercus phellos*	85	2.970
Persimmon	*Diospyros virginiana*	82	2.865
Red oak	*Q. falcata, Q. pagoda, Q. velutina, Q. shumardii, Q. nuttallii*	76	2.655
Black gum	*Nyssa sylvatica*	71	2.481
Holly	*Ilex opaca*	41	1.433
Privey	*Forestiera acuminata*	40	1.398
Elms	*Ulmus* spp.	38	1.328
Gums	*Nyssa* spp., *Liquidambar styraciflua*	12	0.419
Other oaks	*Quercus* spp.	6	0.210
Ash	*Fraxinus* spp.	5	0.175
Other hardwoods	20+ species	123	4.298
	Ouachita and Saline river bottomland totals:	2862	100.000