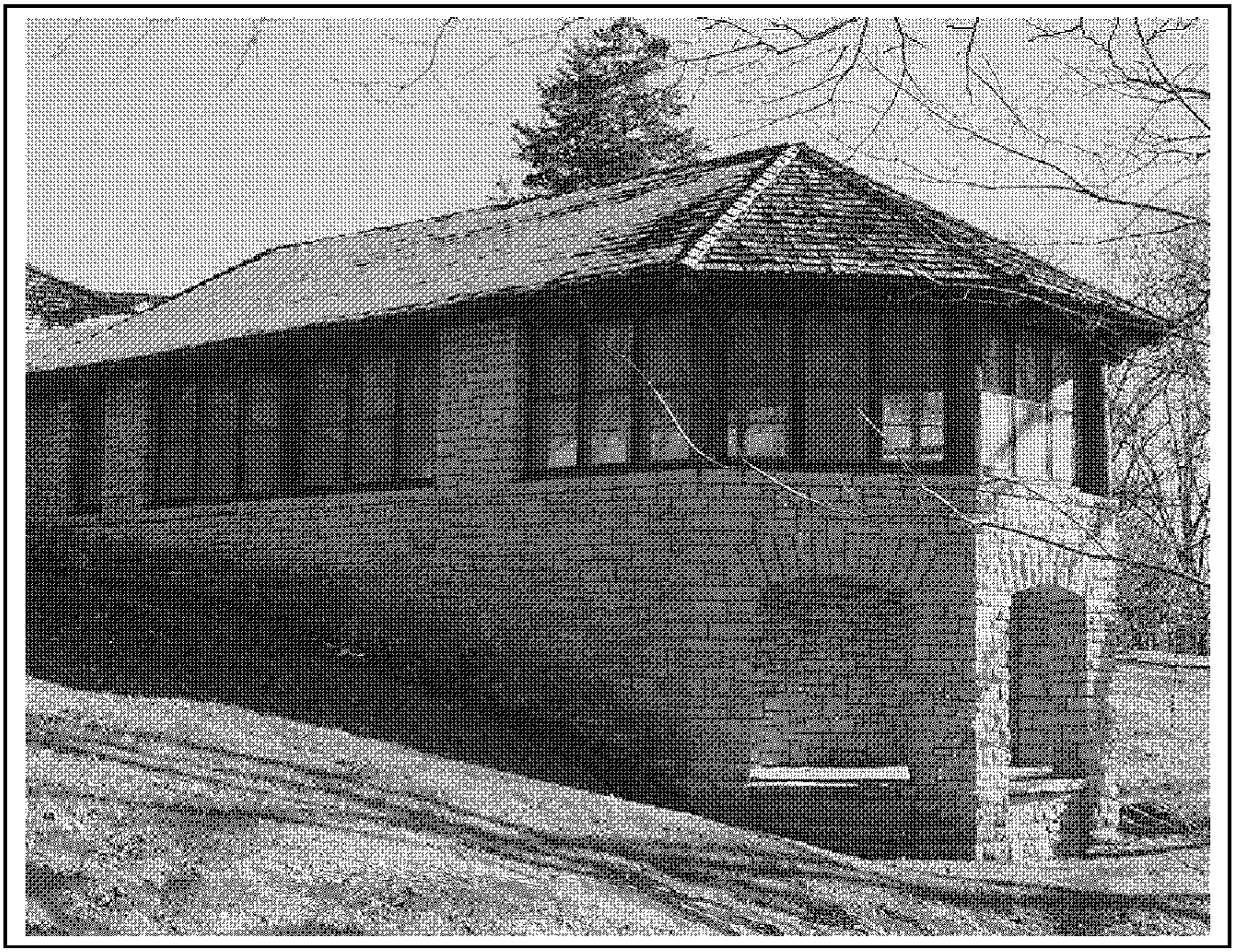
THE NATURAL HISTORY OF PALISADES-KEPLER STATE PARK, LINN COUNTY, IOWA

edited by Raymond R. Anderson and Bill J. Bunker



Geological Society of Iowa

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Cover photograph: Photograph of southwest end of the Lodge at Palisades-Kepler State Park. The Lodge was constructed by the CCC in the 1930s, and renovated this year. Photograph by Palisades-Kepler Park Ranger Jim Hansen.

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Edited by:

Raymond R. Anderson and Bill J. Bunker
Iowa Department Natural Resources
Geological Survey Bureau
Iowa City, Iowa 52242-1319

with contributions by:

Kim S. Bogenschutz
Iowa Department of Natural Resources
Wildlife Research Station
1436 255th Street
Boone, Iowa 50036

William Green
Office of the State Archaeologist
700 Clinton Street Building
Iowa City IA 52242-1030

Jim Hansen
Parks, Recreation & Preserves Division
Iowa Department of Natural Resources
Des Moines, IA 50319

John Pearson
Parks, Recreation & Preserves Division
Iowa Department of Natural Resources
Des Moines, IA 50319

Stephanie A. Tasier-Surine
Iowa Department Natural Resources
Geological Survey Bureau
Iowa City, Iowa 52242-1319

Brian J. Witzke
Iowa Department Natural Resources
Geological Survey Bureau
Iowa City, Iowa 52242-1319

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INTRODUCTION TO THE NATURAL HISTORY OF PALISADES-KEPLER STATE PARK

by Raymond R. Anderson
Iowa Department of Natural Resources
Geological Survey Bureau
109 Trowbridge Hall
Iowa City Iowa 52242-1319

Palisades-Kepler State Park lies along the beautiful Cedar River in southeastern Linn County. The 840-acre park has dramatic river bluffs, deep ravines, majestic hardwood trees, a large variety of wild flowers, and an abundance of wildlife. Palisades-Kepler State Park is also important for its prehistoric past. A molar from a mammoth was once found here, and exposed rocks along the Cedar River are rich in fossils that lived in the shallow seas that covered the area during the Silurian Epoch, about 425 million years ago. The presence of Indian mounds reminds us that this was a favorite haunt of Native American hundreds of years ago.

In the late 1890's James Sherman Minott acquired 160 acres of timberland on the Cedar River and built a spacious inn for the accommodation of visitors, rented boats, and sold lots for the building of summer cottages. Afternoon outings on the Cedar River, capped by a quiet dinner at the combined log cabin restaurant, general store, and hotel were common in the early 1900's. Noted American poet Carl Sandburg was a yearly visitor to the "Pal" (as local residents called the Palisades) during the 1920s and 30s.

In 1922, Palisades State Park was established. Much of Minot's original land had been acquired, and the State Board of Conservation had taken special notice of the unique bold cliffs and proclaimed that "these palisades lining the Cedar River are quite special." In September of 1928, the Board of Conservation accepted the gift of property from the estate of Louis H. Kepler, essentially doubling the size of the park. The Board added his name to the park name, Since that time, almost 700 acres have been added to Palisades-Kepler State Park.

In July 1934, a Civilian Conservation Corps (CCC) company was established at the park. The roads, hiking trails, entry portals, lodge, and other timber and stone structures constructed by the CCC remain to give the park much of its rustic character. Today Palisades-Kepler State Park and several associated natural areas, offer the citizens of Iowa a beautiful setting for picnicking, hiking, fishing boating, camping, or renting a lodge or cabin.

This field trip is the fourth in a series on the Natural History of Iowa State Parks produced by the Geological Society of Iowa. This trip will present participants with an opportunity to read about, see, and discuss the geology, archaeology, flora, fauna, and history of the park with the experts in each field. I hope that you will find this field trip enjoyable and educational, and that you will take every opportunity to enjoy the beauty and wonder of Palisades-Kepler and the many other fine State Parks in Iowa.

BEDROCK GEOLOGY OF PALISADES-KEPLER STATE PARK

Brian J. Witzke
Iowa Dept. Natural Resources – Geological Survey Bureau
Iowa City, Iowa 52242-1319

INTRODUCTION

During the Silurian Period about 425 million years ago, the area that would one day become eastern Iowa lay beneath warm shallow seas in the southern tropics. The rocks that are so beautifully exposed at Palisades-Kepler State Park were originally deposited as lime sediments in a vast seaway that covered much of the interior of North America during the middle part of the Silurian. These seas teamed with life, and the hard skeletons and shells of many of these once living marine organisms are now preserved as fossils in the Silurian rocks of eastern Iowa.

Downcutting of the Cedar River at Palisades-Kepler has exposed an instructive and picturesque array of Silurian rocks which reveal a cross-section through an ancient reef-like accumulation of mounded carbonate sediments that had grown upward from the seafloor. Such mounded features are widely distributed in Silurian strata of North America, and these reefal buildups are particularly well known in the Great Lakes area from Ohio to Wisconsin. Of all the many exposures of these features known in the Midwestern United States, however, those at Palisades-Kepler provide among the best and most complete portrayals of these mounded reef-like accumulations available for geologic study.

Figure 1. The Waubeek Mbr of the Gower Fm forms bluffs on the east side of the Cedar River near the Dam at Palisades-Kepler State Park.

Because the bedrock exposure at Palisades-Kepler is so instructive, the area has been the subject of a number of geologic studies. Norton (1895, p. 129) noted that the exposures "front the river in vertical cliffs, (Fig. 1) locally called the Palisades," which reach a maximum height of 89 feet. Philcox (1970, 1971, 1972) was the first to study the exposures at Palisades-Kepler in detail, which he described as a coalesced complex of mounds. He interepreted the mounds to have been largely constructed of carbonate (lime) mud with an abundance of crinoid (sea lilies) debris and locally common corals. Philcox recognized that these crinoidal mud mounds were succeeded in time by a second stage of mound growth typified by an abundance of brachiopod shells and an absence of crinoid material. Mikulic (1979) identifed local "pockets" within the crinoidal mounds which contain remarkable accumulations of trilobite and nautiloid fossils, probably within depressions or fissures developed within the lithified mound. Witzke (1981a,b, 1983, 1985, 1987a, 1992; Witzke and Johnson, 1999) studied the stratigraphy and paleontology of the mounded complex at Palisades-Kepler. He included the crinoidal mud mounds in the upper Scotch Grove Formation, and he defined a new member to include these strata, the Palisades-Kepler Member, whose name derives from the State Park (the type locality). Witzke included the succeeding generation of brachiopod-rich mound deposits within the Gower Formation, Brady Member.

THE ROCKS

The rock known as dolomite (or dolostone) comprises virtually all of the exposed bedrock at Palisades-Kepler State Park. This rock type was also termed "magnesian limestone" by geologists in the previous century, a name that reflects its chemical composition. This rock is an aggregate of small mineral crystals of calcium-magnesium carbonate ($CaMg[CO_3]_2$), and where the crystals are big enough to be seen with the naked eye, a sugary crystalline aspect is evident (especially in bright sunlight). Dolomite should be contrasted with true limestone, as limestone is of different composition (comprised of the mineral calcite, $CaCO_3$).

The dolomite strata at Palisades-Kepler were originally deposited as lime sediments (composed of $CaCO_3$), but later chemical processes resulted in mineral replacement of the original calcite by dolomite, a geologically common process known as dolomitization. This chemical replacement probably occurred in brackish groundwater systems that developed during withdrawal of the Silurian seas from the region. Dolomitization is a solution-reprecipitation process which results in mineral replacement of much of the original lime sediment (including lime mud and original calcite skeletons of shelled organisms like crinoids). However, because of a molar volume decrease during replacement, some of the original sediment was dissolved and not replaced, leaving open void spaces within the rock. Such voids are evident at Palisades-Kepler, especially hollow void spaces left where fossil shells once existed (many of the fossils are now seen as external and internal molds). Small pores and larger vugs (irregular Swiss-cheese holes in the rock) are further evidence of the porosity increase which accompanied dolomitization. Later-stage mineral fillings, primarily large crystals of calcite, are locally evident in some vugs and pores.

Although the rocks have been pervasively dolomitized, original depositional features are still clearly displayed. The abundance of fossil grains is highly variable, ranging from sparsely fossiliferous (skeletal mudstones) to densely packed skeletal grains (crinoidal and brachiopodal packstones). The mound rocks locally display evidence of fissure and crevice fills that accompanied mound growth, indicating that the mounds became lithified during their growth. The early lithification of the mounds is further indicated by the local presence of brecciated (broken into discrete pieces) and intraclastic (rounded pieces of transported rock) rock types. Of special note is the local presence of lumpy or botryoidal coatings around fossil grains or void spaces. In thin section these coatings display a fibrous microstructure indicating their origin as marine carbonate cements. The lithification of the mounds accompanied their deposition, and was apparently accomplished by the infusion of marine cements.

Nodules of chert (silicon dioxide) are scattered in strata exposed near river level just below the old dam (and continuing downstream). As for the pervasive dolomitization, these chert nodules are also replacement products of original calcium carbonate. The rocks at Palisades-Kepler have been subjected to modern weathering processes; rain water is slightly acidic and will slowly but surely dissolve the dolomite bedrock. This dissolution of dolomite has created a network of solutionally-enlarged fractures, rock shelters (overhanging rock ledges), and small caves and other solutional openings in the park.

THE FOSSILS

Fossils are abundantly displayed in the rocks at Palisades-Kepler (although, of course, fossil collecting is not allowed in state parks). There are several different associations of fossils noted in different settings and strata within the park, and these will be discussed separately.

Fossil associations within the mounded reef-like facies of the upper Scotch Grove Formation, Palisades-Kepler Member, are clearly and overwhelmingly dominated by crinoid debris, primarily stem pieces and disarticulated segments (the "Crinoidal Carbonate Mound Community" of Witzke and

Johnson, 1999). Crinoids are stalked echinoderms which display a long stem capped by a plated head (calyx) bearing long arms which were used in feeding (modern forms are called "sea lilies"). Upon death, individual crinoids rapidly and readily disarticulate into numerous isolated plates and stem segments. Each individual plate and segment contained within the crinoid skeleton is originally composed of single crystals of calcite, and upon dolomitization, many of these individual plates are now preserved as large individual crystals of dolomite. In other instances, the crinoid plates and stems have been dissolved, leaving the fossils as hollow molds. Although disarticulated stems and plates are the typical occurrence of crinoid fossils in the park, articulated heads (calyces or cups) are not uncommon in places, and a number of identifiable forms can been seen (the plate arrangement of the cups is needed for the taxonomic identifcation of most crinoids). The preservation of crinoid cups is most easily accomplished by relatively rapid burial (otherwise they disarticulate into separate plates after death). Where crinoid cups are preserved at Palisades-Kepler, the overwhelmingly most common form belongs to the ubiquitous Silurian crinoid, *Eucalyptocrinites*. *Siphonocrinus* is second in abundance, which was among the largest crinoids which inhabited the mound environments; large stem segments which reach diameters up to 2.5 cm were likely produced by *Siphonocrinus*. A number of additional crinoid taxa have been recognized at Palisades-Kepler, including *Crotalocrinites*, *Macrostylocrinus*, *Calliocrinus*, *Dimerocrinites*, *Periechocrinus*, and *Ichthyocrinus*. Another stalked echinoderm group, the rhombiferan cystoids, are locally represented by heads of *Caryocrinites*. Based on the shear abundance of crinoid material within the mounds, it can reasonably be concluded that crinoids were the dominant form of invertebrate life which inhabited these environments. Their skeletons contributed considerable quantities of lime sediment sediment to the growth of these mounds and their flanking deposits.

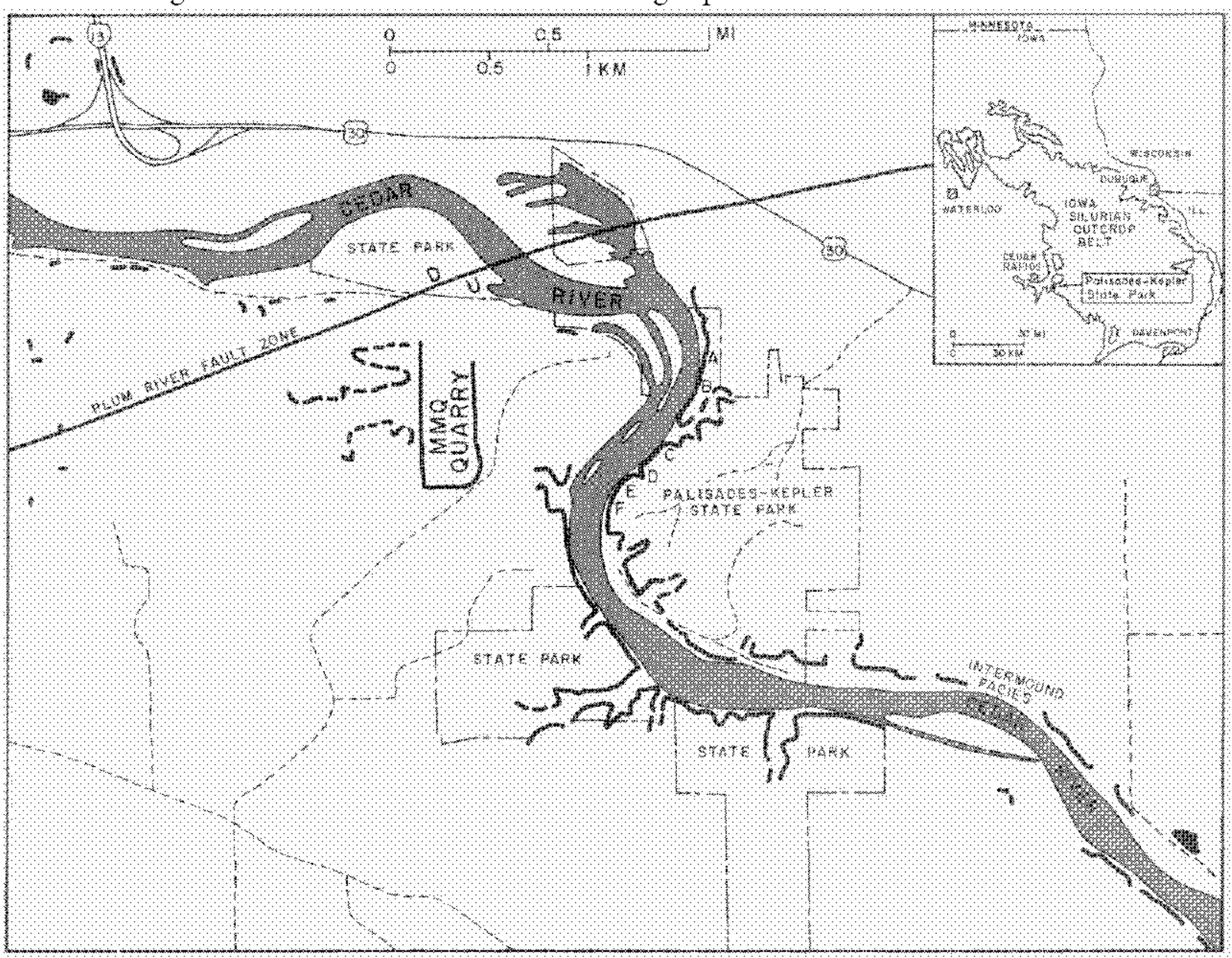

Figure 2. Location map, Palisades-Kepler State Park and surrounding area, Linn County, Iowa. Secondary roads are dashed; general bedrock outcrop shown in black. Localities A through F correspond to mound crest locations of Philcox (1970). MMQ is the active Martin Marietta Cedar Rapids Quarry.

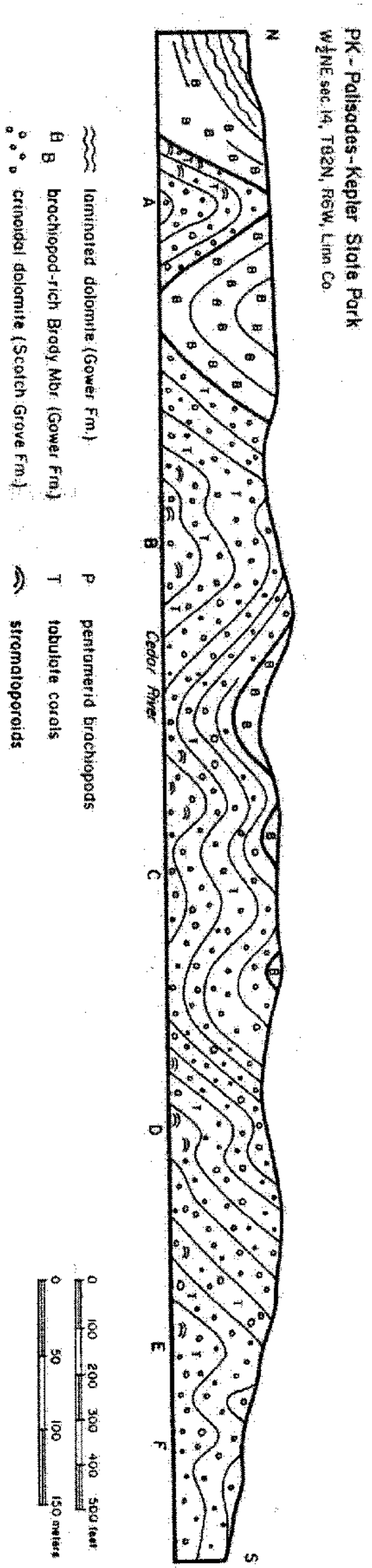

Figure 3. Schematic representation of the main mound complex exposed in the northern part of Palisades-Kepler State Park (Cedar Cliff Trail area). Letters A through F mark the locations of mound crests identified by Philcox (1970; see also Fig. 2). Figure is vertically exaggerated (approximately 3:1). Adapted from Witzke (1992).

A number of additional fossils are identified in the crinoid-rich mounds of the Palisades-Kepler Member, but these are all subordinate to the crinoids in abundance. Coral and stromatoporoid fossils are locally prominent, especially in the northern portion of the mounded complex. However, the corals do not form an intergrown organic framework, and the mounds are not coral reefs in the usual sense of the term. Colonial corals are typically small domal or tabular forms (usually <6 inches, rarely to 2 feet). The commonest colonial corals are the tabulate corals *Favosites* ("honeycomb coral") and *Halysites* ("chain coral"); rarer forms include *Alveolites*, *Heliolites*, and *Syringopora*. Solitary rugose corals (cup and horn corals) are locally present (<2 inches in diameter). Stromatoporoids are a group of sponges (or sponge-like animals) with a robust calcareous skeleton; stromatoporoid fossils commonly co-occur in the more coral-rich portions of the mounds.

Dense accumulations of rarer fossils are observed in a few places within "pockets" in the mounds, and these are typically segregated as trilobite-rich and nautiloid-rich occurrences. A trilobite-rich pocket at Palisades-Kepler described by Mikulic (1979) contains thousands of disarticulated molts of the smooth-shelled trilobite *Bumastus* (with lesser numbers of *Kosovopeltis*). Nautiloid-rich pockets are seen at several places in the park, containing hundreds to thousands of fossil molds of nautiloid cephalopods (ancient relatives of the modern Chambered Nautilus). Outside of these pockets, isolated straight-shelled, curve-shelled, and coiled nautiloids are locally seen within the mounds. Individual nautiloid fossils range from a few inches up to two feet in length, and a number of different forms are present (including *Amphicyrtoceras*, *Dawsonoceras*, *Elrodoceras*, *Euryizoceras*, *Kionoceras*, *Lechritrochoceras*, *Michelinoceraas*, *Phragmoceras*, others).

Although never particularly abundant, a great number of brachiopods can be recognized within the crinoidal mounds, but careful searching is usually required. The diversity of brachiopods is noteworthy, and the following forms have been identified: *Atrypa*, *Stegerhynchus*, *Rhynchotreta*, *Ferganella*, *Hedeina*, *Platystrophia*, *Dalejina*, *Protomegastrophia*, *Leptaena*, *Dinobolus*, and *Harpidium*. Bryozoans ("moss animals") are relatively small colonial animals, and, due to their small size (<1 inch), they are generally not easy to recognize. Nevertheless, well-preserved bryozoan fossils are locally common within debris flows in the northern part of the park, suggesting they were relatively abundant animals in the mound environments. Lacey fronds of fenestellid bryozoans are the most common, but small branching bryozoans are also present.

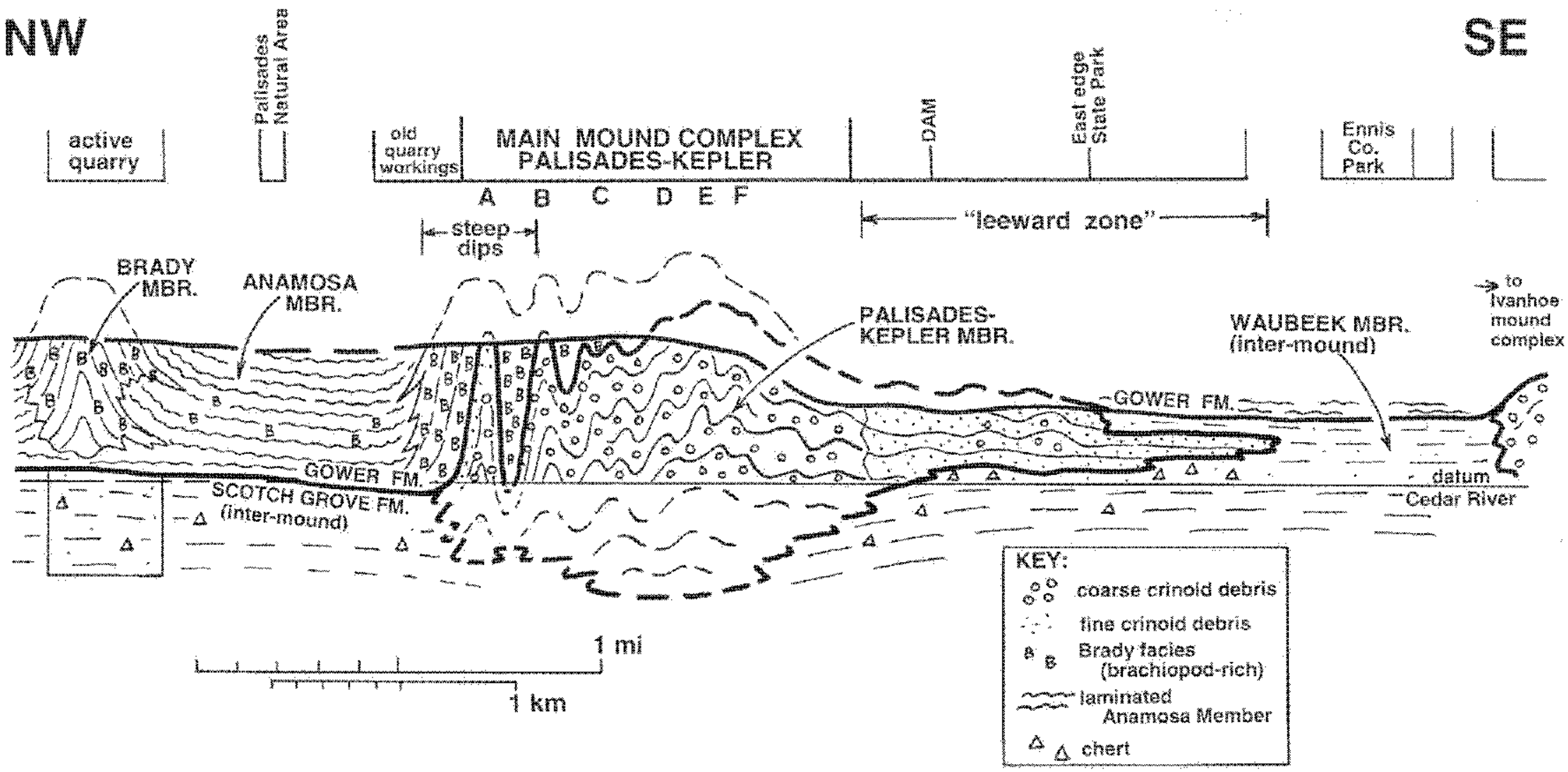

Figure 4. Schematic cross-section of upper Scotch Grove and Gower Formation strata along the Cedar River, Palisades-Kepler State Park and surrounding area. Extent of exposures are bracketed at top of figure (see Fig. 2 for general locations). Relationships of Brady and Palisades-Kepler mounds are dashed where inferred. Figure is vertically exaggerated.

Additional fossils observed within the crinoidal mounds in the park include scattered gastropods (snails), and several different genera have been recognized. Bivalves (clams) are rarely noted. Ischaditids fossils are occasionally identified, and these unique fossils are now interpreted by most paleontologists to represent an extinct group of calcareous green algae. The presence of calcareous algae in the mound environments is of note, as these are the only recognized plant fossils yet identified. Plants were likely much more abundant in the mound environments than the fossil record would seem to indicate. The dominant sediment deposited in the mound environments was not crinoid debris (which is secondary), but carbonate mud of unknown origin. Microscopic particles of carbonate sediment produced by the disintigration of calcareous green algae are known to be the primary source of carbonate mud in most modern shallow tropical seas. It seems reasonable to hypothesize that the vast quantity of carbonate mud produced in the Palisades-Kepler mounds was also produced by green algae.

Inter-mound and sub-mound horizontal strata are present immediately below the dam in the park, and similar strata continue in intermittent exposures downstream to Ennis County Park. The fossils occurring in these strata are generally small (1-10 mm), and are typically dominated by scattered small crinoid debris. The notably smaller size and different composition of these faunas contrasts with the abundant large crinoid debris of the nearby mounds. The fossil association contained within these inter-mound strata has been labeled the "*Hedeina*-Gypidulid Community" by Witzke and Johnson (1999). Fossils identified in the basal strata immediately below the dam include the following: brachiopods (*Hedeina*, gypidulid, *Atrypa, Plecatrypa, Ferganella, Rhynchotreta, Resserella, Dalejina, Protomegastrophia*, leptostrophid), small cup coral, bryozoans (fenestellids), trilobites (proetid, calymenid), ostracodes (beyrichids), and crinoids (*Dimerocrinites, Myelodactylus, Pisocrinus*).

The Gower Formation abruptly overlies the Scotch Grove Formation, and strata of the Brady Member are seen capping and flanking the older crinoidal mounds in the northern part of the park. These strata contain a significantly different fossil association than anything seen in the underlying Scotch Grove Formation, and significant environmental changes have been suggested to explain these differences (Witzke, 1983, 1987b). The complete loss of crinoid material is the most noteworthy difference, which reflects a fundamental and significant environmental change that contrasts Scotch Grove and Gower deposition across much of eastern Iowa. Crinoids are echinoderms, and echinoderms are characteristic in the modern world of normal marine salinities; the physiology of echinoderms enables them to flourish only in marine environments of stable salinties. Therefore, the loss of crinoids (as well as the loss of trilobites and bryozoans) in the Gower faunas has been interpreted to mark a shift in the seaway towards increasing salinity, elevated to hypersalinity through excess evaporation in the retreating arm of the seaway. Only those organisms capable of dealing with hypersaline conditions were able to survive. The Brady faunas seen at Palisades-Kepler show a considerable decrease in overall diversity compared to underlying Scotch Grove faunas, and the Brady strata are overwhelmingly dominated by a only a few species of brachiopods. Although less diverse, the shear numbers of brachiopods in these strata is staggering, and reasonable estimates indicate literally millions of fossil brachiopods occur within these in the park. Most brachiopods are relatively small (generally 5-12 mm).

The faunas of the Brady Member have been included within the "Rhynchonellid-Protathyrid Community" by Witzke and Johnson (1999), who designated the typical locality for this fauna in the old abandoned quarry workings in the northern part of Palisades-Kepler State Park. At most localities in the park, this fossil association is characterized by only a few types of fossils, typified by two brachiopods, a prominently-ribbed rhynchonellid brachiopod (an unnamed form) and a smooth-shelled protathyrid brachiopod (probably *Greenfieldia*). In places, the abundant protathyrid brachiopod preserves delicately dolomitized interal spiral support structures (called spiralia). A few additional fossils are locally associated with these brachiopod-rich occurrences, including small horn corals (*Pycnostylus*), small corallite clusters of a favositid coral, and small gastropods. In the lower portions of the Brady Member, likely deposited under less salinity stress than overlying strata, a slightly more diverse fossil association has been recognized in the northern part of the park which includes, in addition to the above noted fossils, the following forms: brachiopods (uncinulid, *Atrypa, Meristina, Spirinella, Leptaena, Coolinia*), branching favositid corals, bivalves (*Mytilarca, Cyrtodonta*), and nautiloids.

Finely laminated inter-mound Gower strata of the Anamosa Member can be seen in quarry workings adjacent to the Palisades Natural Area, at the northernmost end of the old quarry workings in the northern part of the park, and at other nearby localities. These laminated strata are virtually devoid of shelly fossils, except in areas adjacent to nearby brachiopod-rich Brady mounds, where distal debris flows containing Brady brachiopods were delivered to deeper-water environments that were otherwise devoid of most life. A salinity-stratified seaway has been hypothesized to explain the absence of shelly fossils from the inter-mound Anamosa environments, with bottom waters more hypersaline than the surface waters where the mound faunas flourished (Witzke, 1987). Some crinkly laminations and low domal laminated forms within the Anamosa Member strata may represent subtidal algal mats (stromatolites). Enigmatic rod-shaped fossils locally occur within the laminated strata, but whatever organism produced these objects remains unkown. Besides possible blue-green cyanobacterial mats, the rod-producing organism seems to have been the only macroscopic life form that was able to live in the inhospitable inter-mound bottom environments.

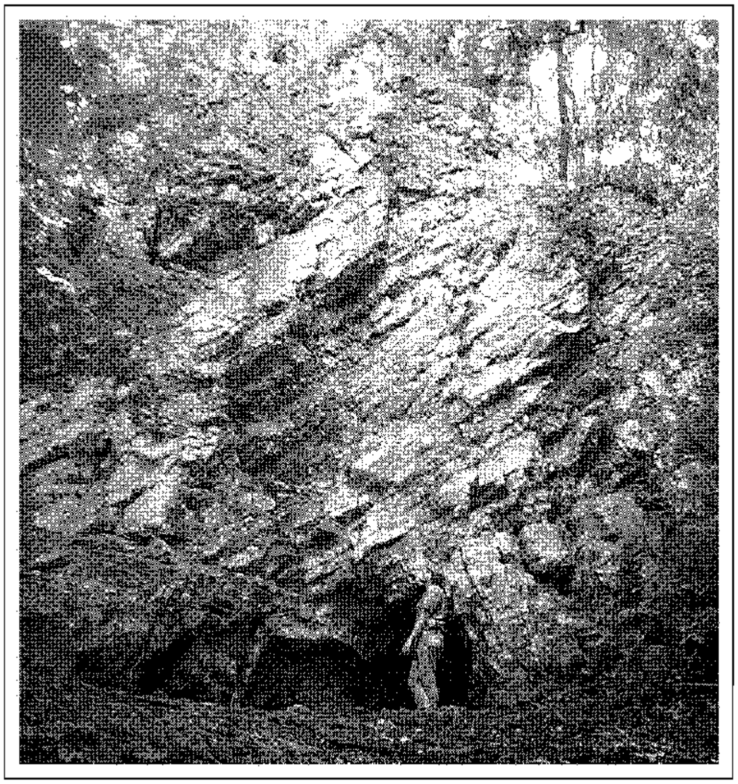

Figure 5a. Photograph of steeply-dipping beds within Palisades-Kepler Mbr mound complex as seen at Stop 7. Line drawing of exposure shown in Fig 5b.

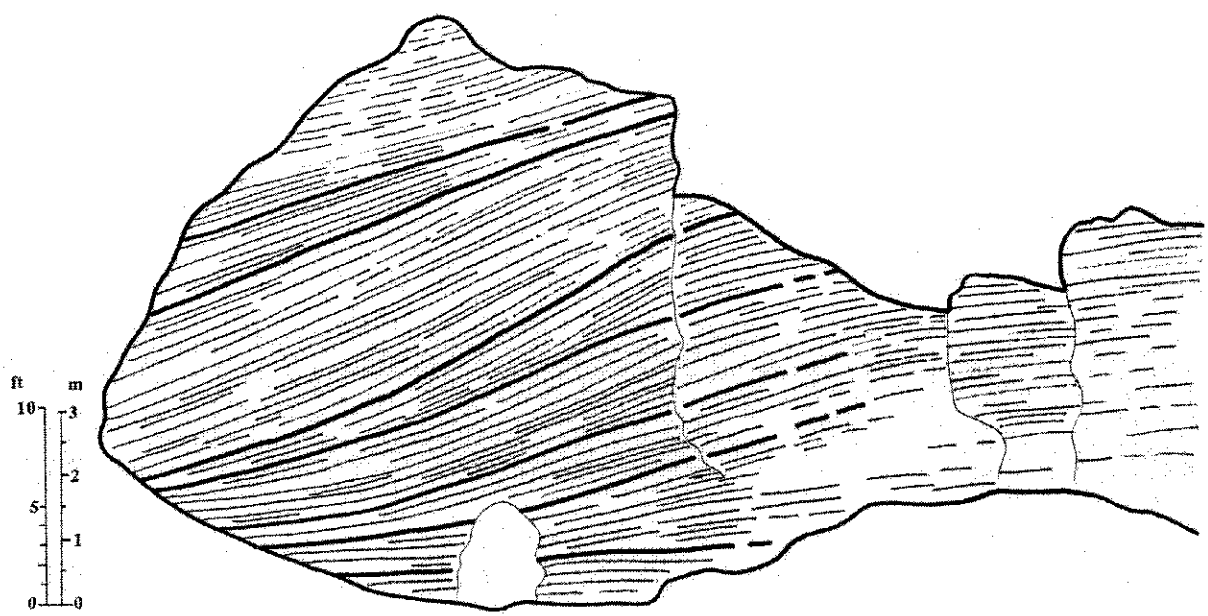

Figure 5b. Photo tracing of dipping flank beds, northern part of Mound B, Palisades-Kepler State Park (see photo 5a above). Strata are nearly horizontal to right (south), but dip steeply to the north. Strata are graded crinoid-rich debris flows, some with wedge-shaped geometries.

UPPER SCOTCH GROVE FORMATION

Main Mound Complex

The main mound complex in the northern area of Palisades-Kepler State Park is marked by a coalesced series of haystack-shaped mounded features, whose crests were given letter designations A through F by Philcox (1970)(see. Figs. 2, 3, 4). This complex is characterized internally by weakly stratified beds (commonly 20 cm to 2 m thick) which define the general geometry of the mounds. The beds contained within the bulk of the mound complex dip at varying attitudes, generally at angles less than 10º to 20º. Across much of the area (mounds C through F and the opposite side of the river trending downstream into the drainages of Palisades-Dows Preserve), the strata appear to be roughly subhorizontal (0-5º), although the beds can be seen to swale and roll across the exposure faces at low angles (5-10º, locally to 20º). In places, stratification is difficult to identify, where the bedding style is more massive. Irregular bedding breaks within the mound complex are generally marked along concentrations of fossil debris; the lower portions of individual beds are commonly more fossil rich than their upper parts, although exceptions are noted. Much of the complex resembles a large platform mound, steepest at the northern margin, but with a relatively flat rolling surface across much of the central region.

The beds along the northern end of the complex locally achieve notably steeper dips, especially along the northern flanks of mounds A and B (see Fig. 3). These steeply dipping flanking strata achieve dips of up to 30º to 40º, and the dips are observed to steepen upward within the exposure faces. The dipping flank beds represent debris flows off the tops of the mounds, and many show wedge-shaped geometries that thicken up-dip. In addition, individual beds show clear grading internally, with the coarsest material at the base (packed concentrations of coarse crinoid material, sometimes with stem segments oriented either perpendicular or parallel to dip). The upper parts of individual beds are typically less fossiliferous and contain more muddy matrix material. The upward steepening aspect of these successions of debris flows demonstrates that the mounds were actively growing upward, with episodic debris flows triggered by sediment movement off the mound tops. Much of Mound A (Figs. 3, 4) is disjunct from the main complex, where it exists surrounded and buried by younger strata of the Brady Member. Remnants of Brady Member strata are seen to locally cap swales near the tops of Mounds B and C (Figs. 3, 4), indicating that the full thickness of the upper Scotch Grove mound complex is locally preserved. However, across most of the complex, the mound crests are erosionally truncated beneath the cover of Quaternary sediments (primarily loess), and the actual vertical dimensions of the complex can only be inferred (Fig. 4).

Corals and stromatoporoids are most common in the central area of Mound D and the northern portions of Mounds A, B, and C, but they nowhere comprise more than a few percent of the sediment volume in those areas. Internal sediment fills, including trilobite and nautiloid-rich pockets as well as unfossiliferous mud fillings, have been identified in places within Mounds A, B, and C. Fracturing and brecciation is locally apparent in the central portions of Mounds C and D.

"Leeward Zone" of the Mound Complex

The mound complex at Palisades-Kepler is highly asymmetric, as first recognized by Philcox (1970). He labeled the southeastern exposures in the park the "leeward zone" of the complex, which occurs generally downstream from Mound F, and includes exposures beginning upstream from the dam and continuing eastward to the park boundary. This leeward zone of the complex contrasts significantly from the main mound complex in two important ways. First, the strata in this area are mostly horizontal to sub-horizontal, contrasting with the more notable dips in the northern part of the complex. However, several small-scale mounded features do occur within the leeward zone, primarily in the eastern series of exposures in the park. Second, the rocks in the leeward zone are more finely porous, and much of the crinoidal material is represented by small molds of individual stem columnals (most less than 2 mm in

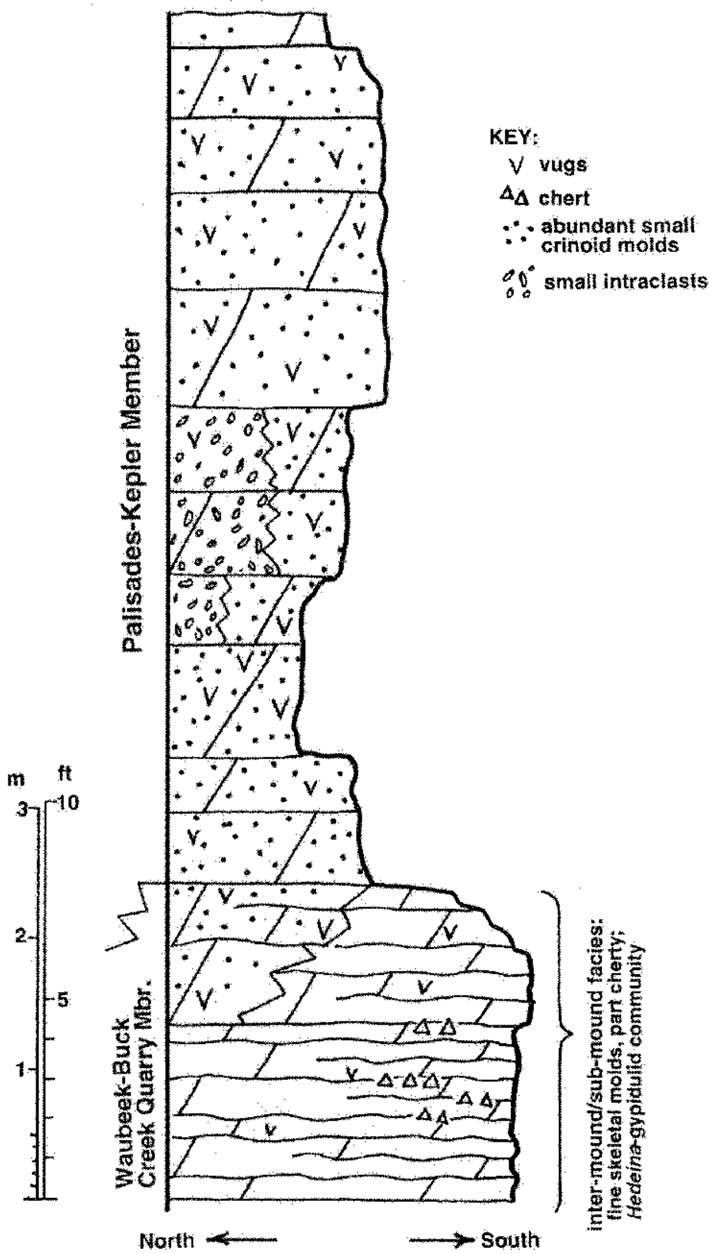

Figure 6. Graphic stratigraphic diagram of section exposed near north end of dam on Cedar River, Palisades-Kepler State Park; based on measured section. Basal strata are inter-mound facies of the undifferentiated Waubeek-Buck Creek Quarry Member; these are locally cherty. Overlying porous dolomites (intraclastic in part) belong to the "leeward zone" of the Palisades-Kepler Member.

diameter). This contrasts notably with the much larger crinoid stems seen in the main part of the mound complex. Some coarser crinoid material is locally associated with the smaller mounds in the eastern part of the leeward zone.

The northwestern portion of the leeward zone near its interface with the main mound complex, which can be seen in a series of exposures upstream from the dam, contains some unique lithologies not seen elsewhere in the park. Rounded and reworked carbonate clasts (most 1 to 5 mm) merge into the finely porous crinoidal lithologies, and even larger clasts (1-2 cm) are seen near the base of some of these intraclastic intervals. The origin of these intraclastic rocks is unclear, but their occurrence near the margins of the main mound complex suggests derivation from down-dip movement of lithified material from the higher portions of the complex.

The porous and finely crinoidal leeward zone is seen to thin eastward (especially eastward from the park boundary), interfingering with denser and more sparsely fossiliferous inter-mound rocks in that direction (Fig. 4). Immediately downstream from the dam in the park, the lower porous crinoidal leeward-zone rocks merge with cherty inter-mound strata along their lower boundary (Fig. 6). In a general sense, the leeward zone of Philcox (1970) represents a transitional belt that separates the main mounded complex from their flat-lying inter-mound equivalents to the southeast. The gradual transition of more-or-less horizontally-bedded strata in this belt contrasts markedly with the northwestern portion of the complex, where steeply dipping flanking strata abruptly mark the margin of the complex.

Inter-Mound Strata

Denser and more sparsely fossiliferous horizontally-bedded dolomite strata characterize the inter-mound equivalents of the Palisades-Kepler mounds. These strata were deposited in settings adjacent to and between the mound complexes, and were thereby deposited in slightly deeper-water environments than those which characterized the mounds themselves. These inter-mound strata, which comprise the bulk of the upper Scotch Grove Formation in eastern Iowa, are variably included within two named members within the formation (Witzke, 1992). Where chert is a prominent constituent of the dolomite lithologies, the strata are assigned to the upper part of the Buck Creek Quarry Member. Where chert is sparse or absent, the strata are included in the Waubeek Member. Inter-mound strata in the area of Palisades-Kepler are slightly cherty (as seen below the dam, at exposures immediately downstream from the park, and at the nearby Martin Marietta Quarry), and, therefore, assignment to the Buck Creek Quarry Member seems reasonable. However, chert is only sparsely represented in these strata and is nowhere prominent; inter-mound exposures a short distance downstream at Ennis County Preserve lack chert. The general paucity of chert in the area probably makes assignment to the Waubeek Member a better choice. In general, these inter-mound strata display scattered chert nodules, and inclusion in an undifferentiated Waubeek-Buck Creek Quarry Member seems appropriate.

The inter-mound strata in the vicinity of Palisades-Kepler are dense well-bedded dolomites with scattered to common molds of small fossils (especially fine crinoid debris). Vugs are locally present. A different association of fossils (*Hedeina*-Gypidulid Community) contrasts with the coarse crinoid and coral fossils seen in the contemporaneous mounds. The inter-mound strata of the upper Scotch Grove are generally overlain by flat-lying laminated dolomites of the Anamosa Member, Gower Formation. By contrast, the upper Scotch Grove mound complexes are overlain and flanked by dipping brachiopod-rich strata of the Brady Member, Gower Formation.

GOWER FORMATION

The Gower Formation, the youngest Silurian formation recognized in Iowa, is subdivided into two distinct phases in Linn, Johnson, Cedar, and Jones counties. The regionally dominant inter-mound phase is characterized by finely laminated horizontally-bedded strata assigned in the Anamosa Member. The brachiopod-rich mounded phase is known as the Brady Member. A third phase, the LeClaire Member, is recognized in the Quad Cities area of Scott and Muscatine counties (Witzke, 1992).

As seen in the Palisades-Kepler area, the Gower Formation is generally conformable above the Scotch Grove Formation. The formational contact is abruptly marked by a shift to laminated dolomite strata in the inter-mound areas. Above the mounded Palisades-Kepler Member, Brady strata also are apparently conformable in most areas of the mound complex, and the contact can be generally marked at the base of the first brachiopod-rich debris flow. However, the top 1 to 3 meters of the underlying Palisades-Kepler Member illustrates a degree gradation into the overlying Gower beds, commonly showing a general upward decrease in the abundance and size of crinoidal material. Strata of the Gower Formation entirely lack crinoid debris. Philcox (1972) suggested that some of the crinoidal mound crests were locally and temporarily exposed to subaerial erosion prior to their burial by Gower sediments (a possible erosional surface separates Scotch Grove and Gower strata at the old quarry workings at the south end of the dam at Palisades-Kepler).

Brady Member

Dolomite strata of the Brady Member are well displayed in the northern part of Palisades-Kepler State Park, where mounded and dipping Brady strata are observed to flank and bury the older crinoidal mounds of the Palisades-Kepler Member (Figs. 3, 4). Brady rocks are best portrayed in the area between Mounds A and B, along the northern flanks of Mound A, and locally above and around Mound C (including important exposures up the stream drainage northeast of Mound C). An isolated Brady mound is clearly displayed in the nearby Martin Marietta Quarry northwest of the park (Fig. 4), but this Brady mound occurs above inter-mound upper Scotch Grove strata and not above the crinoidal mounds as seen in the park.

The Brady Member is characterized by dense dolomite lithologies in the central mounds, commonly only sparsely fossiliferous. This suggests that the bulk of the Brady mounds were originally composed of carbonate mud, although brachiopods, corals, and other fossils are present (*Harpidium-Trimerella*

Community of Witzke and Johnson, 1999, described from central mound at Martin Marietta Quarry; Loc. "MMQ" Fig. 2, "active quarry" Fig. 4). Fossils are scattered in these mounds, but the dipping flanking strata commonly concentrate many of the fossils in graded debris flows, and literally millions of brachiopod molds characterize these deposits. The brachiopod-rich flanking strata form the bulk of the Brady Member exposure at Palisades-Kepler, with fossils typically preserved as ovoid molds creating Swiss-cheese porosity.

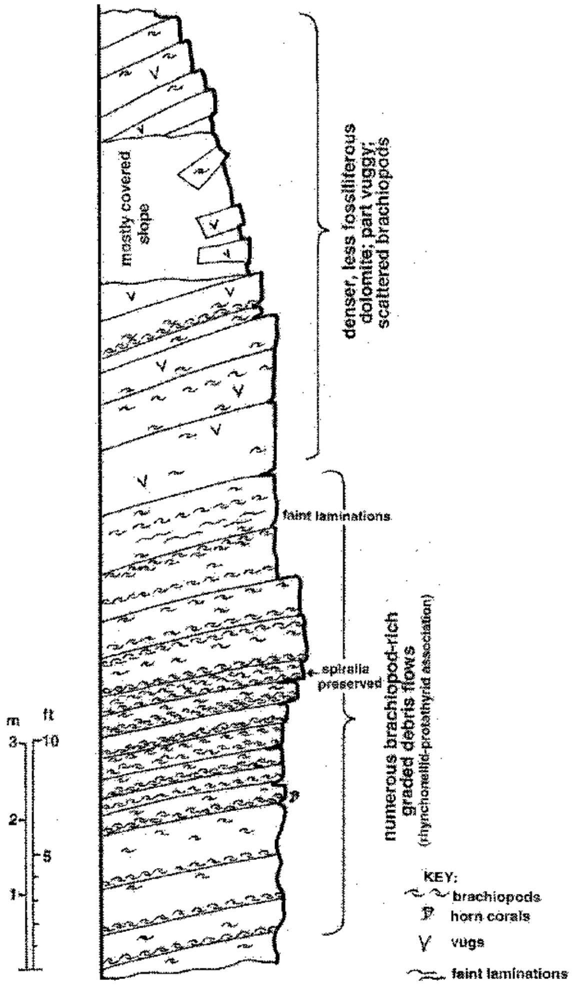

Figure 7. Graphic section of exposure of Brady Member, stream drainage northeast of Mound C, Palisades-Kepler State Park; based on measured section. Brachiopod-rich debris flows characterize the lower half of the exposure. Strata dip northward, steepening up-section.

The brachiopod-rich flanking strata dip at varying angles away from the mounds, generally paralleling the underlying mound geometries of the crinoidal Palisades-Kepler Member. These beds achieve their steepest dips north of Mound A (30 to 40º), but dips of 10 to 30º are more typical over much of the remaining Brady outcrop. An instructive exposure along the stream drainage north of Mound C (Fig. 2) reveals characteristic features of these strata (Fig. 7). Brachiopods are concentrated along the base of graded beds, but variations in thickness and shell concentration are noted. This and other localities in the park show an upward steepening of the dipping strata (Fig. 7), a feature also seen in older crinoidal mounds. This upward-steepening most likely reflects the progressive upward growth of the adjacent mounds.

The flanking Brady debris flows are seen to flatten out down-dip, merging into flat-lying laminated Anamosa strata at the northern end of the old quarry workings and at the nearby active Martin Marietta Quarry (Fig. 4). Tongues of brachiopod-rich Brady lithologies locally extend considerable distances into inter-mound areas of laminated Anamosa strata. Brachiopod-bearing Brady interbeds and stringers within the Anamosa Member at the old quarry adjacent to the Palisades-Natural area (Figs. 4, 8) occur over 2000 feet (600 m) from the nearest recognized Brady Member mounds (Mound A and MMQ).

Anamosa Member

The Anamosa Member is the dominant facies of the Gower Formation in eastern Iowa. The type locality for the member derives from the quarries at Stone City west of Anamosa in Jones County, where the member is the primary source of building stone in the region (Witzke, 1992). Throughout its extent, the Anamosa Member is characterized by horizontally-bedded laminated dolomites. The laminations vary in thickness at different exposures, ranging from less than a millimeter to several centimeters in thickness. Some beds are prominently laminated, but other beds may display only faintly developed laminations. Non-laminated dense dolomite beds also occur within the member. The laminations are commonly planar (horizontal), but some intervals display crinkly (crenulate) laminations, and low domal forms (generally less than 10 cm amplitude) are locally recognized (possibly cyanobacterial stromatolites).

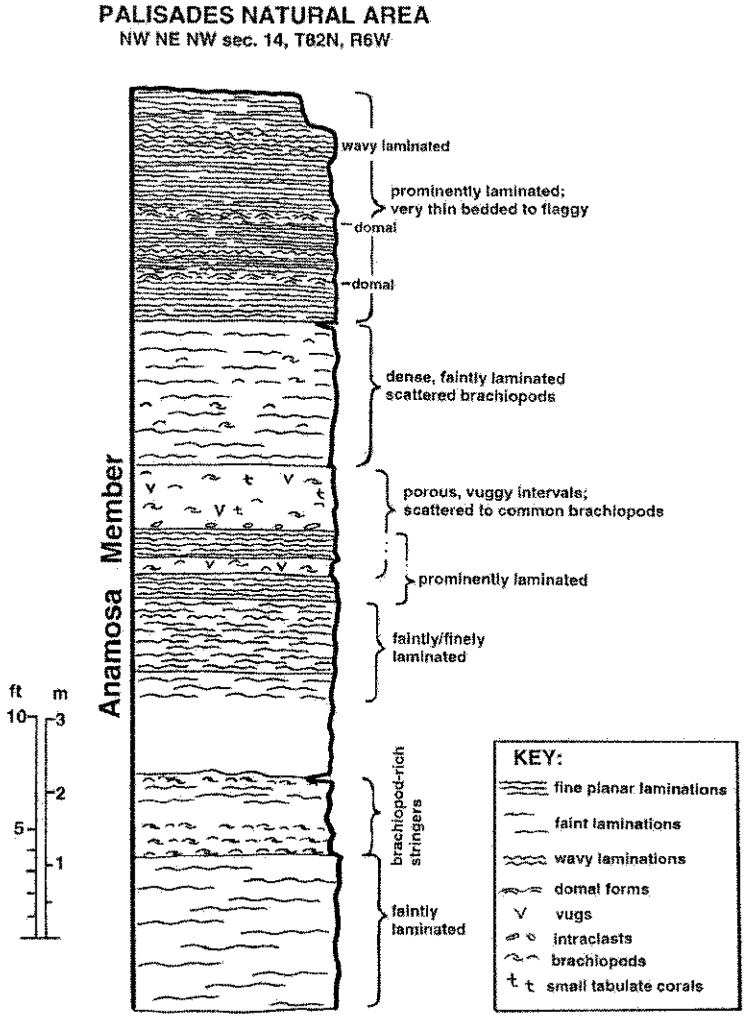

Figure 8. Graphic section of laminated dolomite exposure, Anamosa Member, old quarry face adjoining Palisades Natural Area; based on measured section. Interbeds of brachiopod-bearing non-laminated strata represent distal debris flows from nearby Brady Member mound facies

Compared to the extensive Scotch Grove and Brady exposures, laminated Anamosa strata are relatively limited in the Palisades-Kepler area, but a number of interesting sections are available. The old quarry north of Mound A, near the northern margin of the park, shows the merging of dipping Brady beds into horizontally-bedded laminated Anamosa strata. On the other side of the river in the Palisades Natural area, a quarry face displays an interesting succession of laminated Anamosa strata (Fig. 8). Further to the west at the Martin Marietta Quarry, a considerable thickness of laminated Anamosa strata is seen (up to 60 ft) adjacent to a Brady mound and above inter-mound upper Scotch Grove strata. Laminated Anamosa rocks locally cap the "leeward zone" of the complex (interfingering with Brady beds), as seen on the south side of the river below the dam (Philcox, 1970). Anamosa strata also appear above the inter-mound Waubeek Member downstream near the Ivanhoe bridge.

DEPOSITIONAL INTERPRETATIONS

The succession of Silurian strata in eastern Iowa was deposited in shallow tropical seas, and the vertical changes seen in this succession were a response to changes in water depth and salinity during its deposition (Witzke, 1992). Strata of the upper Scotch Grove Formation have been dated by its contained fossils to the Wenlock Stage in the middle part of the Silurian Period; it is contemporaneous in part with the Wenlock Limestone of England and Wales. Deposition of the overlying Gower succession began in the middle part of the Wenlock Stage, but its age in the upper part is not known with certainty (it may range into the Ludlow Stage of the Upper Silurian). The Gower correlates with the lower part of the Salina Group in the Michigan Basin, where similar laminated carbonate rocks occur with thick intervals of evaporite salts.

The presence of abundant fossils of stenohaline marine organisms, especially crinoids, is good supporting evidence that upper Scotch Grove deposition occurred in a well-circulated seaway with normal marine salinities. The processes that initiated mound growth in the upper Scotch Grove succession is not known with certainty, but Philcox (1971) suggested that the early growth began with localized accumulations of skeletal debris. Of note, the initial growth phases began coincident with a global rise in sea level (Witzke, 1992). The crinoidal mounds of the Palisades-Kepler Member represent in-place accumulations of skeletal debris and carbonate mud. It is possible that the mounds represent some sort of self-perpetuating process of biologic origin whereby the initial accumulations of biologically-generated carbonate sediments created topographic features which were favored sites of attachment for successive generations of organisms, especially crinoids and mud-producers (algae).

The mounds became rigid features rising above the sea floor, and this early lithification was apparently a result inorganic precipitation of carbonate cements within the sediments (and secondarily by the binding effects of the organisms that lived on the mound surface). The central mounds were sites of abundant mud production, and it is unlikely that the accumulation of this mud could have occurred in wave-washed shoaling conditions. The abundance of mud suggests the position of fairweather wavebase likely limited the vertical growth of these mounds. However, episodic current activity across the mound crests is indicated by several lines of evidence: 1) graded flank beds (debris flows), 2) local preservation of crinoid cups and other readily disarticulated fossils, 3) burial of overturned corals, and 4) coral growth morphologies (Philcox, 1971). Graded flank beds clearly indicate episodic deposition of debris, likely triggered by storm events in up-slope or mound crest positions. Storm events seem the most reasonable explanation to explain the episodic deposition of graded deposits on and around the mounds. Eastern Iowa lay in the southern tropics during the Silurian (about 20-25ºS latitude), an area that would be expected to have numerous tropical storms (hurricanes). Silurian paleogeography would predict that storm tracks would most commonly trend from the northeast to southwest (modern-day north to south). The marked north-to-south asymmetry of the crinoidal mounds at Palisades-Kepler is probably a response to storm currents generated by large tropical storms. Such currents disrupted mound growth, episodically transporting sediment across the mound surface and triggering debris flows off the steep margins. The southward "leeward zone" of Philcox (1970) likely defines the down-gradient movement of sediment off the mounds by storm currents, ultimately dissipating in the deeper inter-mound environments.

The diverse benthic faunas that inhabited the upper Scotch Grove inter-mound areas indicate that bottom salinities and oxygenation were sufficiently maintained by general circulation within the epicontinental sea. However, water depths were certainly greater in these areas, and evidence for sediment transport and redeposition is largely absent in these strata. It seems likely that the inter-mound environments (which characterized deposition of the Waubeek Member) were primarily below general storm wavebase. The actual water depths of these inter-mound environments remains conjectural, but the presence of abundant carbonate mud and the fact that certain organisms possessed eyes (e.g., trilobites) supports the idea that these environments were within the photic zone (light penetration) of these clearwater tropical seas.

The deposition of crinoid-rich sediments in the mounds of the Palisades-Kepler Member ceased as Scotch Grove deposition came to a close. The loss of the diverse stenohaline marine faunas at that time was certainly a response to significant environmental changes in the seaway, and an increase in overall salinity is the simplest explanation. An increase in salinity could occur in these tropical latitudes when open circulation patterns became disrupted within the seaway. It has been hypothesized that the withdrawal of the seaway from the interior of North America left eastern Iowa as a restricted embayment of the sea, where excess evaporation led to increasing salinity (Witzke, 1987).

Gower deposition in the area occurred within this restricted embayment. The mound crests of the earlier crinoidal mounds of the Palisades-Kepler Member served as loci for the continuation of mound growth in the shallower settings (Brady Member). Although crinoids were now absent from these mound environments, the deposition of abundant carbonate mud continued unabated, and a different group of shelly organisms now dominated the mounds (especially a few species of brachiopods). The similarity of graded flanking debris flows on and around the Brady mounds with those seen in the earlier Palisades-Kepler mounds suggests that the area continued to experience episodic tropical storms. The cessation of

Brady mound growth, however, likely accompanied the continuing withdrawal of the seaway from the area, and a general increase of salinities within the embayment as it continued to shallow.

The inter-mound Gower environments (Anamosa Member) were notably different than those present during upper Scotch Grove deposition, and were characterized by a general absence of shelled organisms. The continuous laminations in these sediments indicate that burrowing organisms were also absent from these environments. Why would bottom-dwelling animals be completely absent from the inter-mound areas, whereas shelled animals (especially brachiopods) flourished on the mounds? The fact that the mound crests were deposited in shallower water than the intervening inter-mound areas supports the idea that the surface waters were better circulated (less saline, more oxygenated) than the bottom waters. Witzke (1987) suggested that salinity stratification was developed in the Gower embayment, with poorly oxygenated and hypersaline bottom waters incapable of supporting bottom-dwelling animals. The laminated aspect of Anamosa sedimentation may relate to seasonal or episodic changes in the surface waters, creating a varve-like succession of carbonate sediments. Although not seen at Palisades-Kepler, the highest Anamosa strata recognized in the Stone City area display evidence of nearshore and mudflat deposition. These upper Gower strata mark the final phases of Silurian deposition in eastern Iowa, just before the complete withdrawal of the seaway from the area. A long period of erosion ensued across the region (some 30 million years in length) before the seaways once again returned to eastern Iowa during the Middle Devonian.

FIELD TRIP EXAMINATION

The primary examination of the picturesque and instructive succession of Silurian strata at Palisades-Kepler will take place in the northern part of the park. We will begin by hiking up the Cedar Cliff Trial to examine exposures of the central mound complex (Mounds F, E, D – see Fig. 2) along the way. These strata display gently dipping and rolling geometries. Participants should observe the abundance of crioid material displayed at many of the exposurs, and trip leaders will point out salient features, including the local preservation of crinoid cups and corals.

Much of Mound C is not easily accessible along the river, but we will descend the trail along the north margin of this mound to a point where a stone bridge crosses a small creek. At this point we will depart the trail a short distance up this creek to a relatively small but well displayed northward-dipping exposure of the Brady Member (Fig. 7). This is an easy place to observe the brachiopod-rich strata that characterize much of the member. The succession here displays an upward steepening aspect to the strata, with lowest dips at the base (~10º) and steepest at the top (northern edge ~30º). We will tentatively follow this creek drainage to its mouth along the Cedar River, where crinoidal strata of Mound C are seen. A short distance south of the stream mouth, near the base of the exposure, a large nautiloid-rich "pocket" is easily accessible. This "pocket" is about 3 m wide and at least 60 cm high, and contains an abundance of straight-shelled nautiloid fossils 2 to 6 cm in diameter. We will proceed back to the trail and continue northward across the top of Mound B.

Near the northern margin of Mound B, the flanking strata of the Palisades-Kepler Member significantly steepen. We will leave the trail at this point to examine a wonderfully displayed expsosure of steeply-dipping crinoid-rich debris flows (Fig. 5). These beds are, in part, wedge shaped, and each individual bed shows clear evidence of grading, with the coarsest crinoid debris at the base of each bed. Travel after this point will be primarily off-trail and is potentially difficult for those participants uncomfortable with hiking on steep partially vegetated slopes. For those wishing to proceed, we will continue off-trail along the base of the cliff section to examine the northern segment of Mound B proceeding northward across and through Mound A into the old quarry workings at the northern boundary of the park.

As we continue northward from the steeply-dipping flank strata, we will follow the dipping units of Mound B to its contact with overlying brachiopod-rich Brady strata. The contact between the Scotch Grove and Gower formations can be seen at a few places between Mounds B and A, and we will see the general reduction of crinoid grain size and abundance upward to the contact. Dips will reverse (south dip) as we transect into Mound A, then the dips will change northward as we approach the northern margin of Mound A. Some interesting internal sediment fills can be locally seen within Mound A. The margin of Mound A is seen within an extensive old quarry area that occupies the northern part of the park. Steeply dipping Brady strata occupy this area, and large blocks of brachiopod-rich rock occur as talus at the base of the quarry faces. We will proceed the length of this quarry area to its northern margin; along the way the dipping Brady strata are observed to decrease their dip to the north. At the northern margin, the strata are largely horizontally-bedded, where brachiopod-rich Brady beds are observed to interfinger with laminated strata of the Anamosa Member. At this point, a trail spur can be followed up the slope to rejoin the main trail. We will return to the parking area via the main trail.

A brief examination of the "leeward zone" and inter-mound strata is tentatively planned near the dam site along the Cedar River (Fig. 6). The lowest strata here are notably different than anything seen in the northern part of the park. These are the inter-mound lithologies that are characterized by relatively sparse small fossil molds, and chert nodules are locally seen in these strata. The overlying porous to vuggy dolomites, with an abundance of small molds of crinoid debris, characterize the "leeward zone" of Philcox (1970). At the point where the staircase descends through a rock crevice, intraclastic dolomite can be identified within the re-entrant of a rock shelter. These strata are almost horizontally bedded, but minor dips are observed. Gently dipping "leeward zone" units overlie and interfinger with inter-mound strata proceeding downstream to the eastern boundary of the park. At Ennis County Preserve the entire succession is represented by inter-mound lithologies of the Waubeek Member (Fig. 4).

Depending on time and weather, an optional hike at the end of trip will be offered for those participants wishing to see the spectacular and pristine stream drainage that cuts through a separate mound complex on the opposite side of the river. We will park in the large parking lot for the Palisades-Dows Preserve and Observatory adjacent to the telescope facility. Much of the hike will be off-trail. There is a undeveloped trail that heads off into the woods north of the observatory, and we will follow this across the top of a ridge and descend into the stream drainage to the northwest. Following the stream drainage, we will encounter increasingly dramatic exposures of crinoidal mound-rock, most of which displays relatively gentle dips (sub-horizontal strata and gently-dipping beds, most northward dipping 0 to 10º, locally 15-20º in the northern part). The valley exposes some stunning cliff sections, towering above the creek.

For a dedicated few, a final optional stop can be arranged at the Palisades Natural Area, where an old quarry face exposes an instructive succession of laminated dolomite of the Anamosa Member (Fig. 8).

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QUATERNARY GEOLOGY OF PALISADES-KEPLER STATE PARK

Stephanie A. Tassier-Surine
Iowa Department of Natural Resources
Geological Survey Bureau
Iowa City, IA 52242-1319

INTRODUCTION

Palisades-Kepler State Park is situated along the Cedar River near the boundary between the Iowan Surface to the north and the Southern Iowa Drift Plain to the south (Fig. 1). The park area displays more landform characteristics of the Southern Iowa Drift Plain as this area did not undergo as severe of erosional processes as the Iowan Surface. However, due to the close proximity of the Iowan Surface, both landform regions will be discussed. The surrounding landscape speaks to the geologic evolution of Palisades-Kepler State Park, but limited exposures of Quaternary deposits are located within the park.

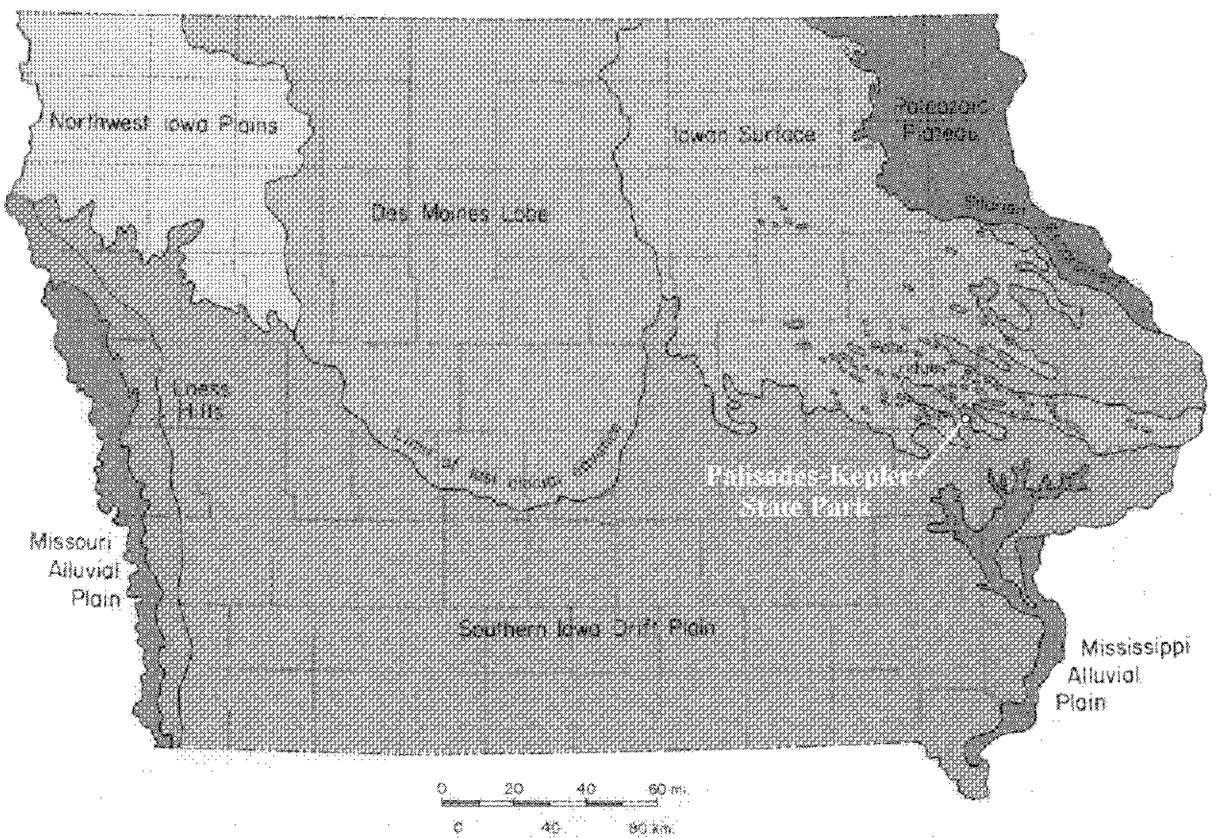

Figure 1. Landform regions in Iowa. From Prior, 1991.

SOUTHERN IOWA DRIFT PLAIN

The Southern Iowa Drift Plain is characterized by a steeply rolling landscape. The Iowan Surface and the Southern Iowa Drift Plain are underlain by the same materials; however, the relief of the Southern Iowa Drift Plain landscape is more notable. Both surfaces are cut deeply into the Pre-Illinoian glacial drift and are mantled by various thicknesses of Wisconsinan loess. In contrast with the Iowan Surface, the Southern Iowa Drift Plain did not experience the same extreme erosive processes that were imposed upon the Iowan Surface during the Wisconsinan glacial episode.

The Southern Iowa Drift Plain was last glaciated during the Pre-Illinoian, and through time, erosion has eliminated the features typically associated with a glaciated landscape (moraines, kames, kettle ponds, lakes, etc.). Episodic periods of rapid erosion and downcutting alternated with intervals of relative landscape stability to allow soil profiles to develop into the exposed glacial deposits. These processes shaped the landscape leaving behind stepped erosional surfaces of varying age. Hilltops mark the level of the original land surface and valleys mark the extent of the erosion into the glacial plain, giving an indication of the massive amount of material that has been removed and the extent of time required to form the landscape. A windblown mantle of loess and eolian sand was deposited at the surface as the landscape was developing. The depth of this material ranges from 5 to 30 feet and is thickest near sources of windblown material and on broad, uneroded uplands where the most continuous deposition occurred. The Peoria Loess comprises most of this mantle in the eastern portion of the Southern Iowa Drift Plain (the Peoria overlies the Pisgah and Loveland loess in the west). Today, tens to hundreds of feet of glacial drift deposited hundreds of thousands of years earlier are all that remain as evidence of the past ice sheets.

The Southern Iowa Drift Plain has also been more extensively downcut by rivers and streams than the Iowan Surface, further enhancing the relief of the hills and valleys. In this region, streams have had sufficient time to carve into the land surface eroding the previous glacial landscape and establishing well-connected drainage systems.

IOWAN SURFACE

The depositional history of the Iowan Surface was under great debate for an extended period of time before the determination that erosional processes had controlled the development of the present day landscape. Early researchers believed the surface represented the results of an Iowan glacial event occurring sometime between the Illinoian and the Wisconsinan. The idea was later modified to place the Iowan Surface within the earliest substage of the Wisconsinan. During the 1960's more intensive studies pointed to an erosional surface that had been cut into the Pre-Illinoian deposits.

Prior to the Wisconsinan glacial events, the area was part of the Southern Iowa Drift Plain. Glaciers last passed over this area during Pre-Illinoian time and subsequent episodes of erosion, weathering and soil development, and loess deposition have shaped the landscape. During the Wisconsinan, a severe cold-climate weathering period (21,000 to 16,500 years b.p.) erased all but a few remnants of the earlier landscape leaving behind the characteristic low relief, gently rolling topography of the Iowan Surface. During this time of intense weathering, periglacial processes such as strong winds, solifluction and freeze-thaw activity were active and aided in the creation of an erosional surface on top of the Pre-Illinoian deposits. Later episodes of soil development and the deposition of wind-derived sediment created the landscape we see today. The Iowan Surface is underlain by the same material as the Southern Iowa Drift Plain, however, it is more deeply eroded and has poorly defined drainage divides. Downcutting processes by rivers and streams have also been less severe than those on the Southern Iowa Drift Plain. The Iowan Surface is characterized by low relief, slightly inclined topography and gently rolling slopes.

Four features are typically considered characteristic of the Iowan Surface: paha, stone lines, erratics and ice wedge casts. Paha, the Dakota Sioux word for hill or ridge, are found predominantly in the southern portion of the Iowan Surface. Paha are isolated, elongate hills of loess and eolian sand deposited on the land surface as the surrounding landscape was being eroded and lowered. These hills are aligned with a northwest to southeast orientation parallel to and in close proximity to river valleys, suggesting that paha may be dunelike features associated with strong northwest winds. Stone lines are lag deposits developed during times of erosion when finer particles were removed by wind and water. Stone lines are often covered by a thin layer of loess and are frequently observed in cross-sectional views. Glacial erratics (boulders transported by glacial advances) are also found scattered across the landscape of the Iowan Surface. Most of these erratics are igneous or metamorphic rocks originating from the north, likely Minnesota and Canada. Subsequent erosional events removed the finer-grained deposits surrounding the erratics leaving them exposed at the surface. Also noted throughout the landscape are ice-wedge casts or polygons. Ice-wedge casts form as frozen ground cracks and fills with material through time. These features are commonly connected in a polygonal pattern, similar to the more familiar mud cracks, creating an integrated drainage network. Although most of the features of the Iowan Surface are not commonly observed within Palisades-Kepler State Park, they can be found in areas immediately to the north.

QUATERNARY DEPOSITS

Surficial materials at Palisades-Kepler State Park are comprised predominantly of loess and eolian sands. These materials may be a few meters in thickness and extend throughout and beyond the area of the park. The Cedar River provided the source area for these windblown deposits. This mantle of windblown material is probably underlain by Pre-Illinoian deposits (likely the Wolf Creek or Alburnett Formations) although limited exposures of Quaternary materials are available within the park. These windblown deposits are typically yellow-brown to gray, may show stratification and can be well-sorted locally.

In addition to the glacial drift, alluvial materials are also identified within Palisades-Kepler State Park near the Cedar River. A sand and gravel bar located along the Cedar River (Fig. 2) comprises one of the more obvious sedimentary deposits within the park. This elongate bar is located above and below the dam along the northeastern side of the river. The bar is composed predominantly of fine to medium sand and gravel. Sand and gravel bars form in rivers and streams as a result of a change in river discharge or velocity. During higher flow, the water is capable of carrying larger particles and will deposit the sand and gravel as a result of reduced water velocity. Therefore, the bar has a variety of possible origins. Any location in a river such as a broader area in the river or where rock is shallower can cause the water to slow and deposit material. Flood or high water events may also transport large amounts of

Figure 2. Sand bar in the Cedar River at Palisades-Kepler State Park.

coarse-grained sediment to be deposited as the water velocity lowers. It can also be noticed that the majority of the sand and gravel is on the inside of the stream bend indicating that downcutting may have occurred on the opposite bank while deposition was taking place on the inner side where stream flow is slower. The possible influence of the dam construction and human activities affecting the sand and gravel deposition is unknown.

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VEGETATION OF PALISADES-KEPLER STATE PARK AND PALISADES-DOWS STATE PRESERVE

by
John Pearson, Botanist/Plant Ecologist
Parks, Recreation & Preserves Division
Iowa Department of Natural Resources
Des Moines, Iowa 50319-0034

GENERAL SETTING

Palisades-Kepler State Park and Palisades-Dows State Preserve are part of a complex of public land along the Cedar River in southeastern Linn County, Iowa. The area is on the extreme northern edge of the Southern Iowa Drift Plain, nearly on the southern edge of the Iowan Surface (Prior 1991). Historic (or "pre-settlement") vegetation in Linn County, as revealed by compilation of General Land Office (GLO) township plat maps drawn in 1841 (Anderson 1996), was dominated by "prairie" on the flat to rolling uplands away from the Cedar River and other major streams, with "timber" on the dissected slopes flanking the rivers. Palisades Park and Preserve are located within the timbered portion of the historic vegetation (Figure 1).

The terrain flanking the Cedar River in the vicinity of Palisades Park and Preserve consists of small, but abrupt limestone bluffs and dissected, loess-covered, forested uplands. Several ravines empty into the Cedar River, including large, deep ones on its western and southern sides named "Blowout Hollow", "Spring Hollow", and "Dark Hollow". This general setting contains several plant communities varying with substrate, topography, and past land use. These include mature and successional upland forests and several communities on limestone bluffs. Scattered old trees are an interesting feature of the upland forests and of the sheer limestone bluffs bordering the Cedar River.

UPLAND FORESTS

Mature forest generally prevails on the sloping, dissected, loess-covered uplands on public lands in the Palisades area today (Figure 2), but some variation in forest age occurs, reflecting the dates of previous logging and later suspension of logging on public tracts acquired from private landowners. The township containing the Palisades area was surveyed in 1841 and officially opened for settlement at that time; widespread logging of forests in the Palisades area probably occurred in the following decades. In a 1919 report, geologist James Lee alluded to the condition of forests in the Palisades area, noting that "little or none of it is primitive forest", indicating a prevalence of past logging even then.

Tracts not logged since the first wave of logging in the mid-1800's would be about 150 years old today. The earliest acquisitions to the park and preserve occurred in the mid-1920's, so tracts logged just prior to that time would be about 75 years old today. Later acquisitions occurred in the 1930's, 1940's, 1960's, 1970's, and 1990's (Figure 3). Today, the most mature forests are found in the northern part of the Palisades-Dows Preserve while some of the youngest are found in the southern part of the preserve. In a few locations, scattered old trees may be found in the midst of young forest stands.

Mature forest communities

White oak (*Quercus alba*), red oak (*Q. rubra*), and basswood (*Tilia americana*) are the major trees in upland forests, but variation occurs with topographic aspect. In 1969, Terry Cairns (then a biology student at Coe College in Cedar Rapids) studied a mature forest community in the northern unit of the Palisades-Dows Preserve. He determined that white oak comprised an average of 72% of the stand basal area (an integrated measure of tree size and density) on south-facing slopes, but was only half this

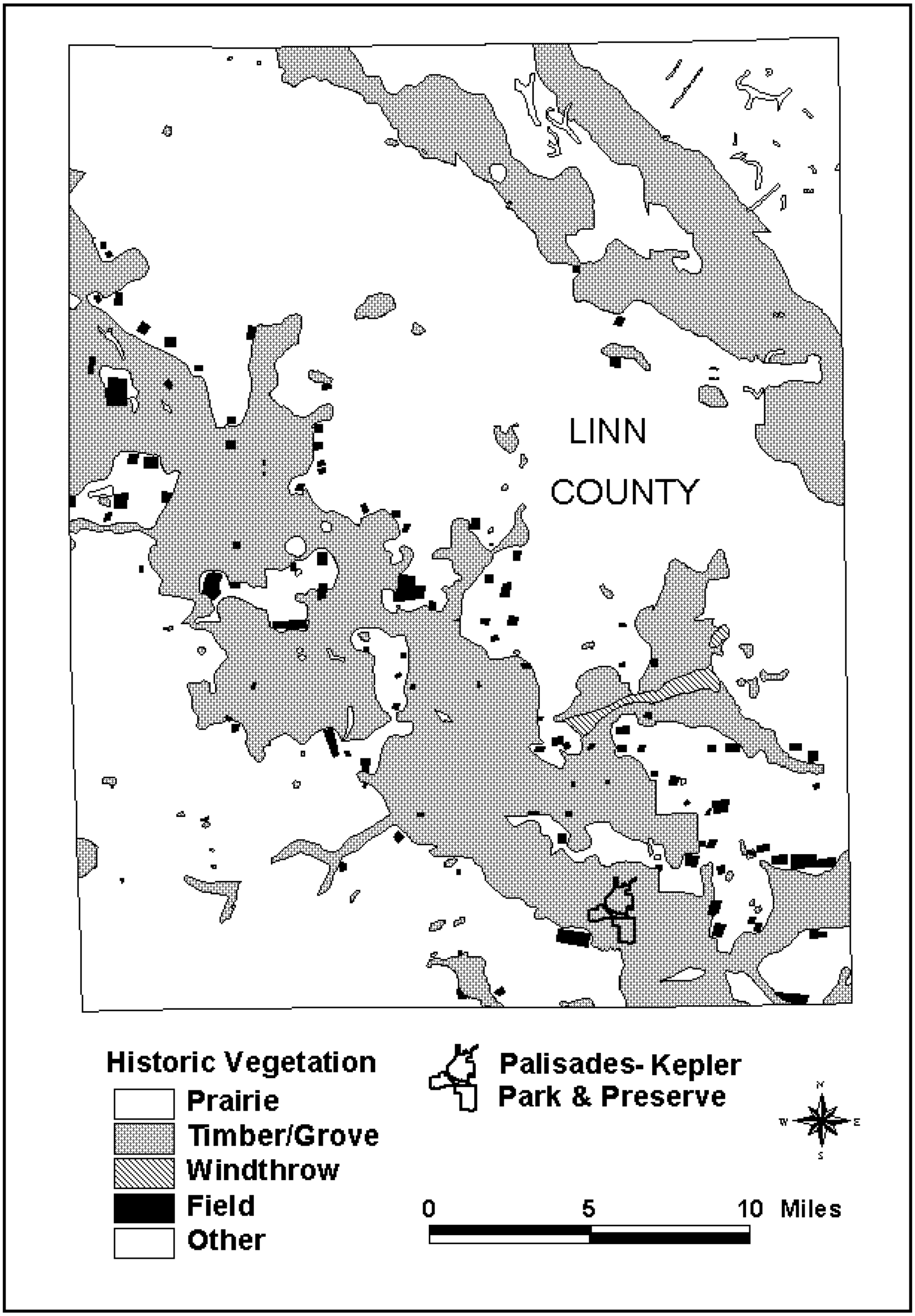


Figure 1. Historic vegetation of Linn County (including the Palisades-Kepler area) in 1846.

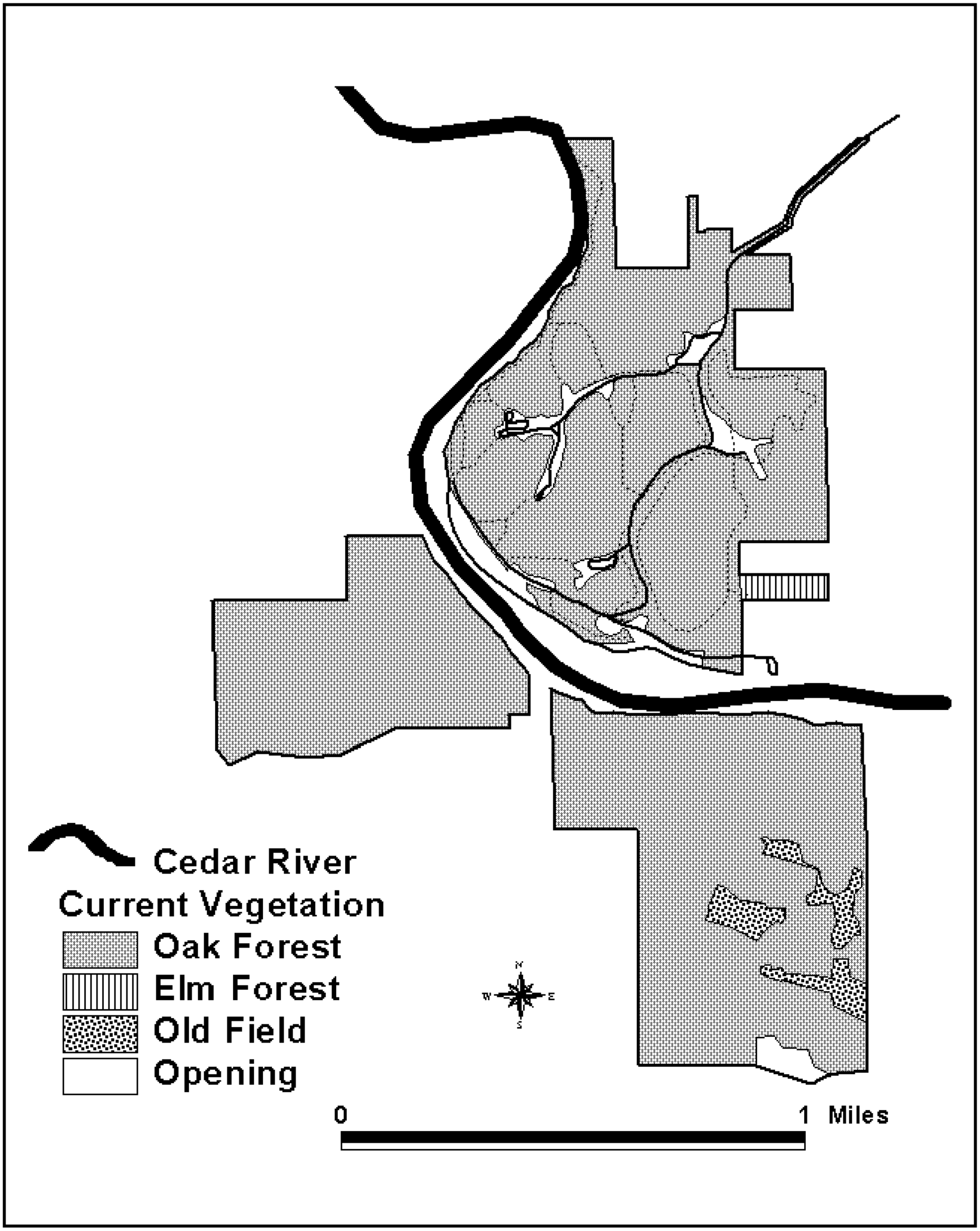


Figure 2. Current vegetation in Palisades-Kepler State Park and Preserve

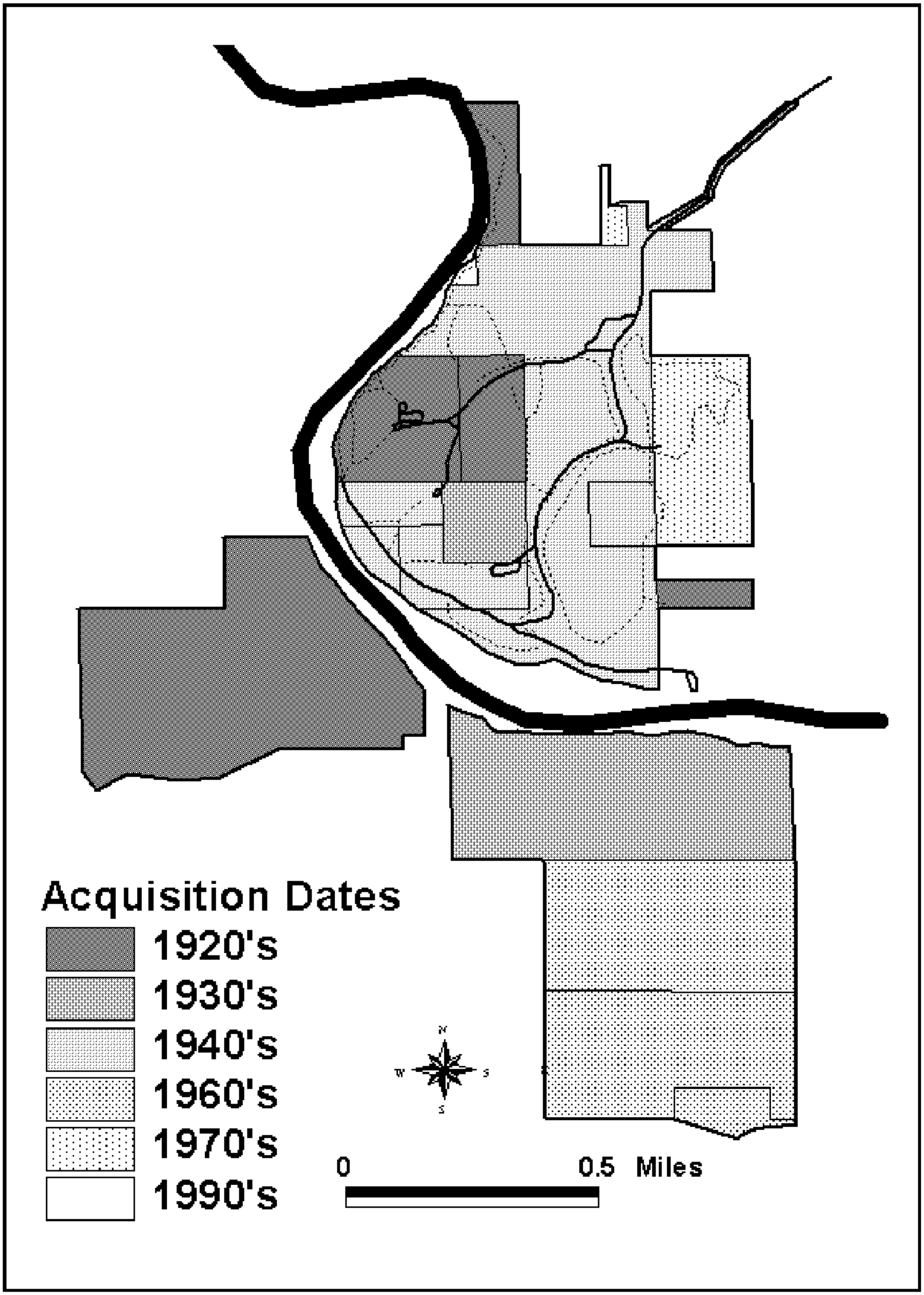
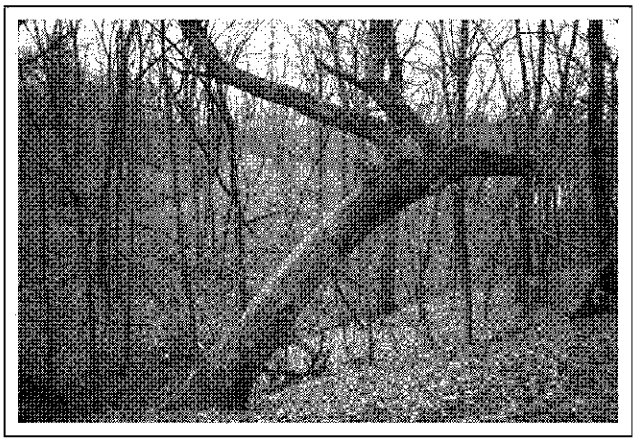


Figure 3 Past land acquisition in Palisades-Kepler Park and Preserve.

abundant (36%) on north-facing slopes; however, in his study area, it was the dominant tree regardless of aspect compared to all other species. Red oak and basswood were present on all aspects, but were observed to be more abundant on north-facing slopes, reaching maximum relative basal areas of 15% and 32%, respectively. Elm (*Ulmus americana*) formed an average of 10% of the forest. In Cairn's (1969) study area, sugar maple (*Acer saccharum*) was generally sparse and comprised less than 5% of the forest, even on north-facing slopes.

A vegetation map prepared by the Linn County Conservation Board (1985) depicted nearly the entire forest in the Palisades-Dows Preserve as a "red oak type, over 15 inches DBH [diameter at breast height]". In a moist ravine near the lodge in Palisades-Kepler State Park, district forester Steve Swinconos and I measured a forest plot in 1995, finding that red oak comprised 80% of the stand,



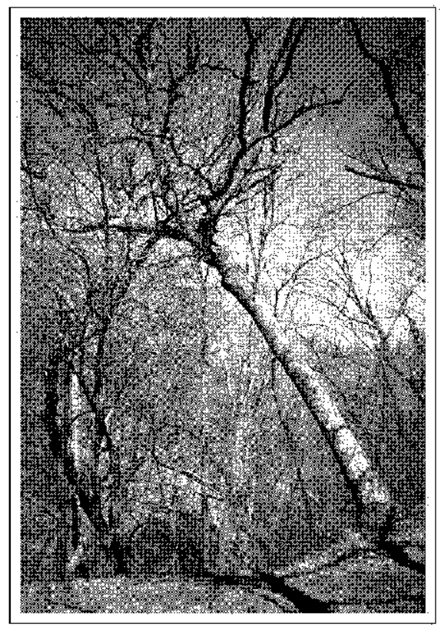
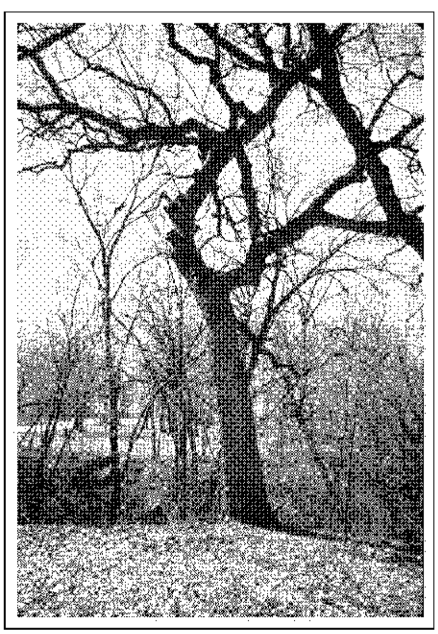
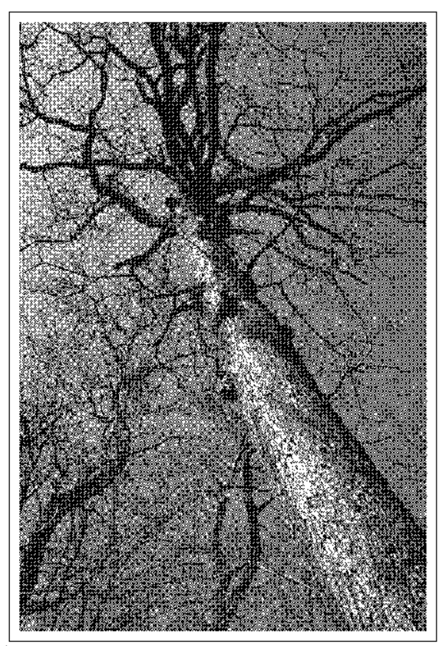


Figure 4. Photographs of old oaks from Ledges and Lake Ahquabi state parks, showing typical features such as massive trunks, knobby or gnarled branches, bent or leaning orientation, occurrence on steep slopes or hillcrests, and surroundings of younger trees.





followed by sugar maple (12%), white oak (4%), ironwood (*Ostrya virginiana*, 4%), and basswood (<1%). The largest trees in this plot were red oaks up to 25 inches in diameter.

Today's prevalence of white oak admixed with other species echoes the historic, "presettlement" forest. A summary of historic data along a section line in the Palisades-Dows Preserve (Linn County Conservation Board 1985) noted that "the surveyors marked several white oaks as witness trees and line trees, indicating that this species was abundant on the line. Other species noted by the surveyors were lynn [basswood], elm, sugar [maple], and [red?] oak together with briars and vines."

We will walk through mature upland forest as we follow the Cedar Cliff Trail north of the gazebo (Stop 2).

Old trees

Trees over 125-150 years old are scarce in Iowa because of widespread logging by settlers beginning about 1850, and especially after 1875 (Thomson and Hertel 1981). Although pre-settlement trees typically form a very minor part of the present-day forests in which they occur, they are scientifically and aesthetically interesting (Pearson 1989). During the late 1970's, dendrochronologist Daniel Duvick visited many parks and preserves in Iowa to obtain increment borings from nearly 500 trees as part of a larger study of the climatic history of the eastern United States (Duvick and Blasing 1981, 1983). Palisades-Kepler State Park was one of the sites that he investigated. He selectively cored 18 old-looking white oak trees in the park, two of which dated to the 1700's (1750 and 1785 to be exact); thus, his oldest tree would be nearly 250 years old today.

When data from old trees across the eastern United States were analyzed (Blasing and Duvick 1984, Cleaveland and Duvick 1992), their growth rates indicated a series of 20-year cycles in precipitation between 1680 and 1980. They also documented an average of two major droughts per century.

Aesthetically, many of the old oaks are "character trees" with a distinctive appearance promoted by their large girth, sometimes bent or leaning trunks, gnarled and knobby branches, patchy bark pattern, and occurrence on scenic hillcrests or steep slopes (Fig. 4). Their great age is a source of wonder for scientists and lay people alike. We will see several old white old oaks along the Cedar Cliff Trail, including Stop 6 and along the trail on route to Stop 8.

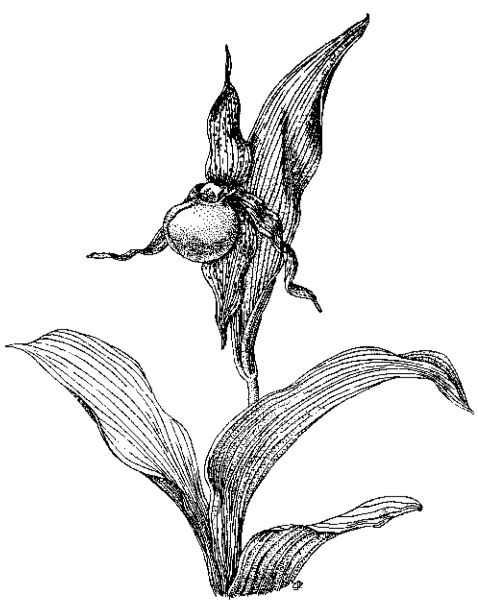


Figure 5. Yellow lady's-slipper orchid (*Cypripedium calceolus*). Drawing by Carol Jacobs.

Understory plants

According to Cairns (1969), the most frequent plant species in the understory of the upland forests were Virginia creeper (*Parthenocissus virginiana*, detected in 75% of a series of small plots), sweet cicely (*Osmorhiza claytoni*, 56%), enchanter's nightshade (*Circaea lutetiana*, 50%), shining bedstraw (*Galium concinnum*, 46%), and false Solomon's-seal (*Smilicina racemosa*, 44%). Sugar maple was the most frequently encountered tree seedling (43%) and gooseberry (*Ribes missouriense*) was the most frequent shrub (21%). In the mesic forest plot measured by Swinconos and Pearson, interrupted fern (*Osmunda claytoniana*) and pagoda dogwood (*Cornus alternifolia*) were the most abundant herb and shrub, respectively, in the forest understory.

Rare and uncommon plant species of Iowa which have been observed in the upland forests of the Palisades area include yellow lady's-slipper (*Cypripedium calceolus*, Figure 5), ginseng (*Panax quinquefolius*), coralroot orchid (*Corallorhiza odontorhiza*), rattlesnake plantain (*Goodyera pubescens*), nodding pogonia (*Triphora trianthophora*), and puttyroot orchid (*Aplectrum hyemale*).

Successional forest communities

Another variation in species composition of the forest canopy was induced by past land use. Although much of the forest in Palisades-Kepler State Park and the northern unit of the Palisades-Dows State Preserve consists of mature, highly natural vegetation, some old fields in the southern unit of the preserve were created by clearing, logging, and grazing prior to public ownership (Figure 2). These old fields have been undergoing natural succession since the cessation of disturbances around 1962. A forest cover map prepared by the Linn County Conservation Board (1985) classified these sites as "mixed upland hardwoods, 5-9 inches DBH". In 1980, nearly 20 years following abandonment of the fields, Dr. Paul Christiansen of nearby Cornell College detailed three variations of natural succession on disturbed sites that reflected differing initial conditions:

1) former cropfields had been invaded by elm (*Ulmus* spp.) and boxelder (*Acer negundo*),

2) former pastures had been invaded by honeylocust (*Gleditsia triacanthos*), eastern red cedar (*Juniperus virginiana*), and walnut (*Juglans nigra*), and

3) formerly logged areas had been invaded by bigtooth aspen (*Populus grandidentata*).

All three types of disturbed areas were being invaded by additional tree species, including white oak, red oak, basswood, shagbark hickory (*Carya ovata*), bitternut hickory (*C. cordiformis*), ironwood (*Ostrya virginiana*), black cherry (*Prunus serotina*), and hackberry (*Celtis occidentalis*). However, of the three field types, the logged areas were recovering toward natural conditions the most quickly, as the aspen was even then (1980) becoming decadent and being overtaken by other species (Christiansen 1980). Today, even the former cropfields are filled with dense stands of young trees, although elm and boxelder still predominate and distinguish them from young forests of more natural composition.

LIMESTONE BLUFFS

Deciduous forest prevails on the loess-covered, dissected, sloping uplands, but other distinctive plant communities are associated with limestone bluffs (Fig. 6). These include extensive, sparsely wooded cliffs bordering the Cedar River, vegetated bluffs in ravines, and small prairie-like "glades" on blufftops.

Figure 6. Trip leader John Pearson examines ancient cedar near Gazebo at Stop 2.

Cedar community

The Cedar River was historically known as the "Red Cedar River" in the 1800's and early 1900's because of the prevalence of eastern red cedar (*Juniperus virginiana*) on its blufflands. In his 1919 report, geologist James Lee wrote:

> *"One of the most striking features of the Palisades is the large number of evergreen trees which dot their surface. These are found not merely as a fringe covering the summit of the walls, as is commonly the case in northern Iowa, but upon nearly the whole face may be seen the low spreading ground spruce of the gnarled, twisted, knotty trunk of the hardy cedars."*

Many of the cedar trees clinging to the sheer bluffs along the river are very old (Fig 6). As part of a larger study of the natural vegetation of Niagaran escarpments throughout the Midwest (Larson et al. 1999a, 1999b), Dr. Doug Larson and his students with the Cliff Ecology

Research Group (University of Guelph, Ontario) used ropes in 1998 to venture over the bluffs at the Palisades park and preserve to obtain increment cores of 15 cedar trees and determine their ages. The oldest tree in his Palisades sample was 386 years. In fact, half of his sampled trees were over 300 years, two were 200-300 years, five were 100-200, and only one was less than 100 years old. A previous study reported a cedar tree over 400 years old on the Palisades (Landers and Graf 1975, Fig. 7). These reports indicate the presence of an ecologically "ancient" plant community on the inaccessible (and thus undisturbed) blufflands. Smooth cliff-brake (*Pellaea glabella*), a small fern adapted for growth on dry, sunny rock outcrops, also occurs on the limestone bluffs along with the cedars.

We will see the bluff community with its old cedars from our stop at the gazebo on the Cedar Cliff Trail (Stop 2).

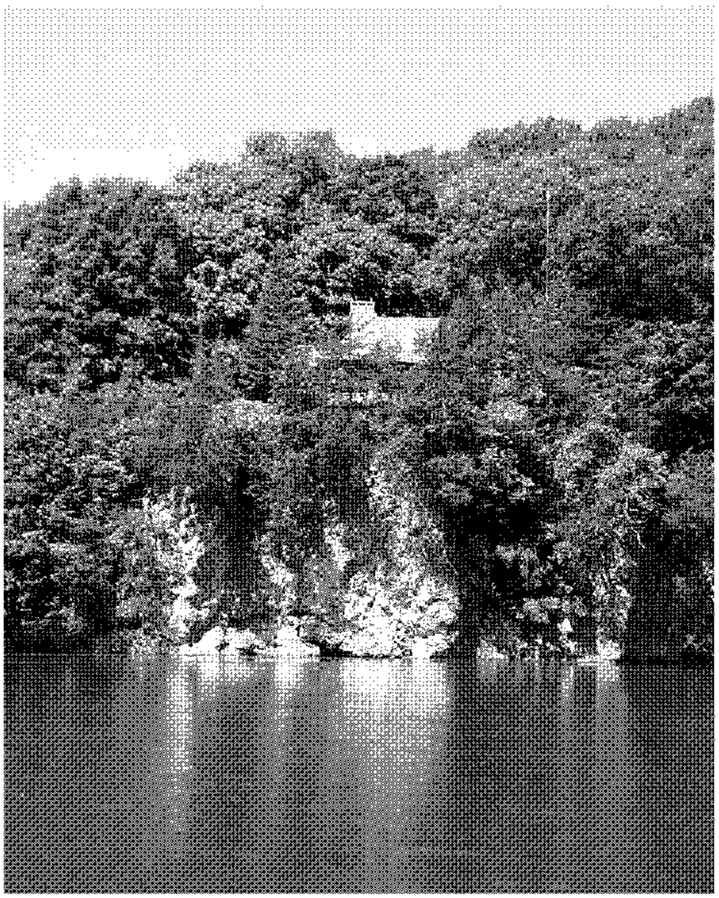


Figure 7. Cedar River bluffs, looking west across the river from Palisades-Kepler State Park. Note the cedar-covered limestone cliffs in the foreground and oak forest on sloping upland in the background. The house on top of the cliff is a private cottage immediately north of the Palisades-Kepler State Preserve.

Ravine bluffs

Smaller, shaded bluffs in tributary ravines, although less dramatic and exposed than the sheer cliffs bordering the Cedar River, are also botanically interesting. Canada yew (*Taxus canadensis*), maidenhair fern (*Adiantum pedatum*), walking fern (*Asplenium rhizophyllum*), and several bryophytes (mosses and liverworts) grow thickly on these moist, shaded outcrops and associated boulders. Uncommon plants also inhabiting these sites include shining clubmoss (*Lycopodium lucidulum*) and sullivantia (*Sullivantia sullivantia*). Dark Hollow, a large ravine in the southern part of the Palisades-Dows Preserve, is a good place to view this community.

We will see a revine bluff community at Stop 4)

Blufftop glades

Several tiny, prairie-like openings are scattered on rocky blufftops along the Cedar River at the edges of upland forests. Sometimes called "glades", these dry, semi-shaded habitats enhance local floristic diversity by harboring several prairie species which are absent from the rest of the park and preserve. Little bluestem (*Schizachyrium scoparius*), leadplant (*Amorpha canescens*), butterfly milkweed (*Asclepias tuberosa*), white prairie clover (*Dalea candida*), yellow coneflower (*Ratibida pinnata*), round-headed bush-clover (*Laspedeza capitata*), and wood betony (*Pedicularis canadensis*) are some of the species normally found in prairies that unexpectedly appear in these small openings. Although not positively known to exist in the park or preserve today, geographically vague reports of the small white lady's-slipper orchid (*Cypripedium candidum*) from "Palisades Park" might be traced to past collections from these glades.

We will view several small glades, including one at Stop 6 along the Cedar Cliff Trail north of the gazebo.

ACKNOWLEDGMENTS

I thank Terry Cairns, Paul Christiansen, Dan Duvick, and Doug Larson for making their data available for this report. Records of rare and uncommon plants were based on collections, annotations, and notes from R. Brown, R. Buchanan, D. Crawford, R. Drexler, Larry Eilers, Ada Hayden, J. Hartsaw, I. Melhus, Jeff Nekola, Fred Perkins, Richard Pohl, Bill Pusateri, and Bohumil Shimek. Thanks also to Greg Houseal for his species list of glade and ravine bluff communities.

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WILDLIFE OF THE PALISADES-KEPLER STATE PARK AND PALISADES-DOWS STATE PRESERVE AREA

Kim S. Bogenschutz
Iowa Department of Natural Resources
Wildlife Research Station
1436 255th Street
Boone, Iowa 50036

Palisades-Kepler State Park and Palisades-Dows State Preserve lie along the Cedar River in Linn County, Iowa. The rocky bluffs, steep ravines, and woodlands are home to a variety of wildlife. Diversity of forest wildlife results not only from the size of the forests within the park area but also their stand diversity. Large blocks of mature timber support bird species such as cerulean warbler, veery, and scarlet tanager. Yellow-billed cuckoos prefer brushy cover and younger woodlands found in small openings of the forest, and wood thrush are found in bottomland forests along the Cedar River. The age of forest stands, the composition and diversity of trees and shrubs, the condition of the understory, and the amount of disturbance from park visitors are all factors affecting the presence and distribution of wildlife in the park.

WILDLIFE SPECIES

Large populations of white-tailed deer reside within Palisades-Kepler State Park, Palisades-Dows State Preserve, and the surrounding areas. Other mammal species located within the area include many species of shrews, mice, voles, and ground squirrels, fox and gray squirrels, cottontail rabbits, opossums, raccoons, badgers, beavers, and bats. The park is an excellent place to view bats during the summer, especially around the campground and along the Cedar River. Common species observed are the big brown bat and little brown myotis. A 1919 Report of the Board of Conservation reported wolves being present in the park; however, it is presumed that the wolves were actually coyotes (see Fig. 1), which still range within the park area. The state-endangered bobcat has also been reported in the area and may be present within the park.

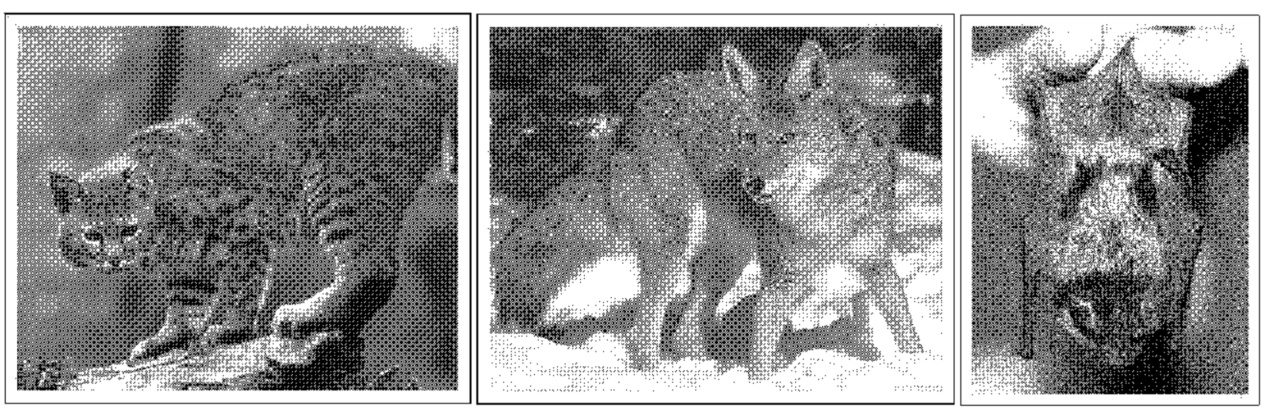

Figure 1. Bobcat, coyote, and the big brown bat are known from Palisades-Kepler State Park or the surrounding region.

Palisades-Kepler State Park and the surrounding area have high bird species diversity. Ninety-nine species of birds were documented in the park from 1985-1990 during the Breeding Bird Atlas project.

The forested landscape of the park and its location along the Cedar River make it a haven for many breeding birds. Confirmed nesting birds include wood ducks, blue-gray gnatcatchers, and yellow-throated vireos. A variety of other neotropical migrants are considered probable in the park (e.g., Acadian flycatcher, wood thrush, veery, cerulean warbler, ovenbird, Louisiana waterthrush, Kentucky warbler, American redstart, scarlet tanager). Large populations of wild turkey also reside within the park and in the surrounding forest areas. Bald eagles frequent the river during migration and in winter. An active great blue heron rookery is located along the south side of the Cedar River in Palisades-Dows State Preserve. A long-eared owl (state-threatened) was reported in the area in 1961; however, its current status is unknown.

Large numbers of softshell turtles may be seen sunning in summer on sandbars below the lowhead dam across the Cedar River at the south end of the park. The state-threatened central newt has been recorded on private property near the entrance road to the park.

WILDLIFE MANAGEMENT

The goals of wildlife management activities at Palisades-Kepler State Park, Palisades-Dows State Preserve, and nearby wildlife management areas are to develop self-sustaining and diverse wildlife populations and provide public viewing of a variety of species. Forest management will largely determine wildlife composition, distribution, and population levels. Natural succession will be allowed to continue on most of the woodlands of the park and preserve. This will create old growth stands of red and white oak, maple, basswood, and hickory. Oak regeneration on several other tracts will promote the continuance of an oak-dominated forest community. The habitat and mast provided by oak woodlands should continue to support populations of wild turkeys, white-tailed deer, neotropical migrants such as cerulean warbler, veery, and scarlet tanager, and a variety of small mammals. White-tailed deer can have negative impacts on vegetation within the park and preserve if their population becomes too large. Hunting is prohibited in Palisades-Kepler State Park and Palisades-Dows State Preserve; however, surrounding areas, including DNR wildlife areas and Palisades Access, allow deer hunting. In the absence of natural predators, hunting remains the most effective tool for controlling deer numbers.

Populations of many neotropical migratory bird species have declined in the past 25 years. One theory for the decline in neotropical migrant numbers is increased habitat fragmentation. Large forests have been broken-up, resulting in smaller forest tracts that attract edge predators such as skunks, raccoons, fox, crows, and blue jays. Brown-headed cowbirds are also attracted to habitat fragments. These nest parasites lay eggs in the nests of neotropical migrants that in turn incubate the cowbird eggs and raise the cowbird young at the expense of their own young. The large forest tracts at Palisades-Kepler State Park offer some protection from habitat fragmentation and are safe nesting areas for many breeding neotropical migrants. Woodland management will be accomplished in such a manner as to minimize impacts to birds.

Management activities will also be accomplished with regard for the various species of bats that inhabit the park area. All of Iowa's nine species of bats live in forest areas during the summer. Several species of bats use live and dead trees with loose bark for nursery roosts, whereas others use cavities and foliage for roost sites. In general, woodland management should include protection and retention of trees with loose bark and trees with cavities.

Planting shrubs and trees near public use areas will also provide food and cover for a variety of wildlife species and enhance viewing opportunities. Appropriate tree and shrub species include oak, ash, gray dogwood, chokecherry, wild plum, serviceberry, nanny berry, elderberry, hawthorn, and other native or non-invasive woody species. No non-native species will be introduced at Palisades-Dows State Preserve. The DNR has several guidebooks to assist viewers in identifying species: The Snakes of Iowa, The Salamanders and Frogs of Iowa, The Lizards and Turtles of Iowa, and A Guide to the Bats of Iowa.

The Palisades-Kepler State Park and Palisades-Dows State Preserve area supports a variety of wildlife species thus making it a valuable resource that requires careful management. Recreation, wildlife management, and forestry goals for the park and preserve will be coordinated to ensure that all Iowans can enjoy the park while crucial wildlife habitat is maintained.

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ARCHAEOLOGY OF PALISADES-KEPLER STATE PARK AND ENVIRONS

by
William Green
Office of the State Archaeologist
700 Clinton Street Building
Iowa City IA 52242-1030

INTRODUCTION

The Cedar River valley has attracted human settlement ever since the initial peopling of the Midwest. The central part of the Cedar valley in the Linn County area continues to be an attractive region for settlement and development today. The resulting urban and industrial growth has damaged or destroyed a large number of archaeological sites, and such development poses a continual challenge to resource conservation efforts. Fortunately, several large tracts of public land such as Palisades-Kepler State Park and the Palisades-Dows State Preserve afford opportunities for preservation, study, and interpretation of Cedar River valley archaeological resources in minimally disturbed settings.

Palisades State Park was purchased in 1922 (Crane and Olcott 1933; McKay 1989; State Conservation Commission 1937). Originally the park included tracts on both sides of the Cedar River (Kenyon 1930; Wood 1938). That portion on the right bank (west and south) of the Cedar River was designated a wildlife preserve and was open to only pedestrian access by 1937 (State Conservation Commission 1937). Palisades-Dows State Preserve was officially dedicated as a geological and biological preserve in 1980 (Fleckenstein 1992:134).

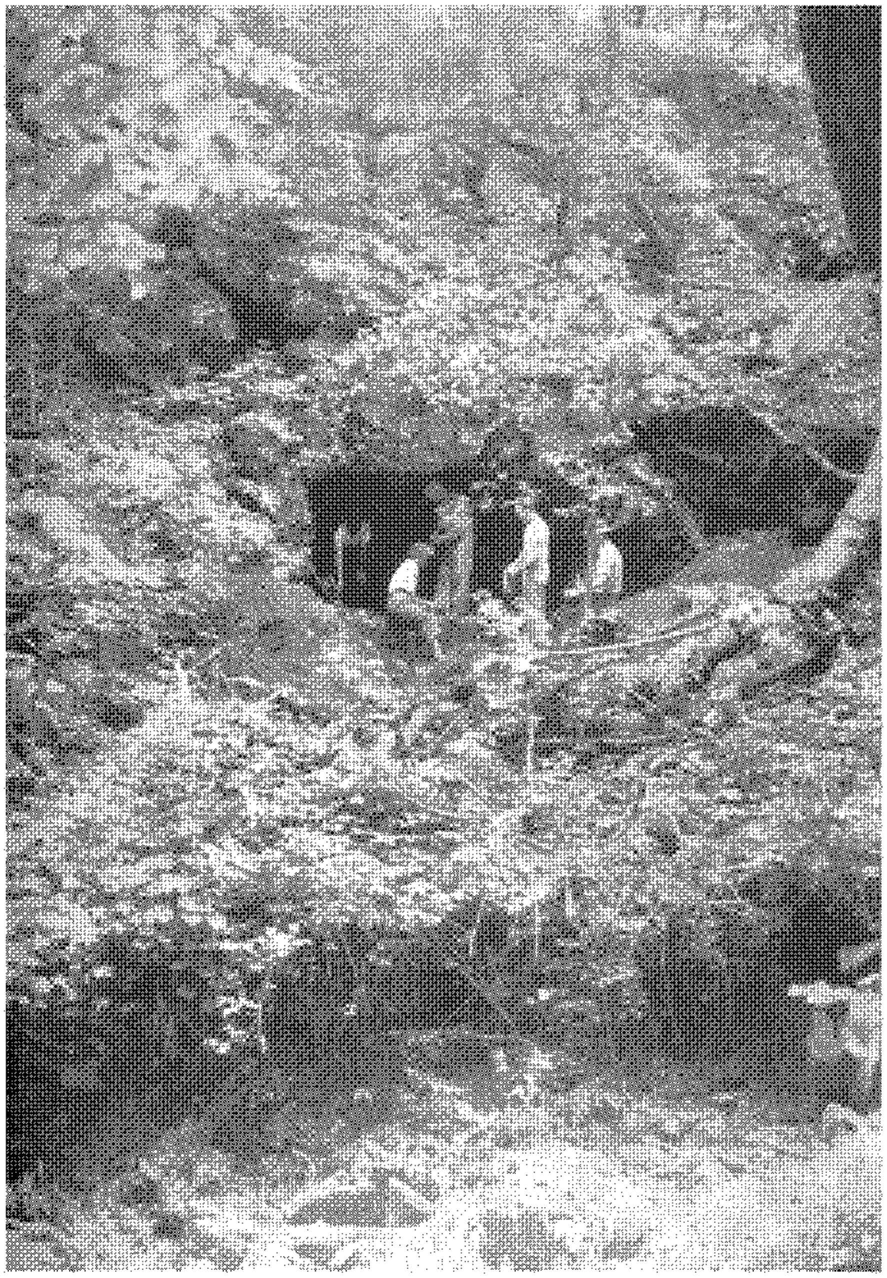
ARCHAEOLOGY AT PALISADES-KEPLER

Three main types of archaeological studies have been conducted in the Palisades locality: (1) mound surveys and rockshelter excavations on both sides of the Cedar River, (2) an intensive survey of Palisades-Dows State Preserve, and (3) a historical-archaeological survey of Linn County resources. The mound surveys and rockshelter studies were conducted by Charles R. Keyes, "father" of Iowa archaeology. Keyes was a German professor at Cornell College and directed statewide archaeological investigations in his spare time, in summers, and after his retirement from Cornell. The State Historical Society of Iowa and the University of Iowa supported Keyes' archaeological studies (Green 1992; Tiffany 1981). Keyes directed field schools in the Palisades locality, training students in archaeological methods and recovering important information on Woodland-period occupations. Excavation results were reported in several articles (Keyes 1931, 1943), and materials have been used for further analyses by other workers (e.g., Logan 1958, 1976).

The archaeological survey of Palisades-Dows Preserve was conducted in 1992 by the Office of the State Archaeologist, with the support of the State Preserves Advisory Board and the Iowa Department of Natural Resources. The goal was to locate all types of prehistoric and historic archaeological sites that may be present in the preserve but not to conduct substantial testing or excavation. A total of 20 newly recorded archaeological sites were located, and nine previously reported sites were revisited. Sites include open campsites and rockshelters utilized in prehistoric times as well as a road network and related sites associated with early 20th-century logging and CCC activities (see McKay 1989). A complete report on this survey is contained in Finney and Logan (1993).

Historical-archaeological surveys of Linn County have been conducted throughout the 1990s by the Linn County Historic Preservation Commission and Leah D. Rogers (e.g., Rogers and Page 1994). The goal is to locate and evaluate sites from the 19th century and to develop historical contexts to aid in the understanding of regional developments. Methods include both field investigations and archival, documentary, and oral-history research. One example of a historic-era site recorded through this effort is the Upper Palisades Quarry (13LN467), a late-19th-century gravel operation.

The studies noted above have located several archaeological resources that are easily viewable in Palisades-Kepler State Park and Palisades-Dows State Preserve: prehistoric mounds, rockshelters and campsites that supported human habitation, and 19th-century industrial structures and features. The summary below focuses on the prehistoric sites.

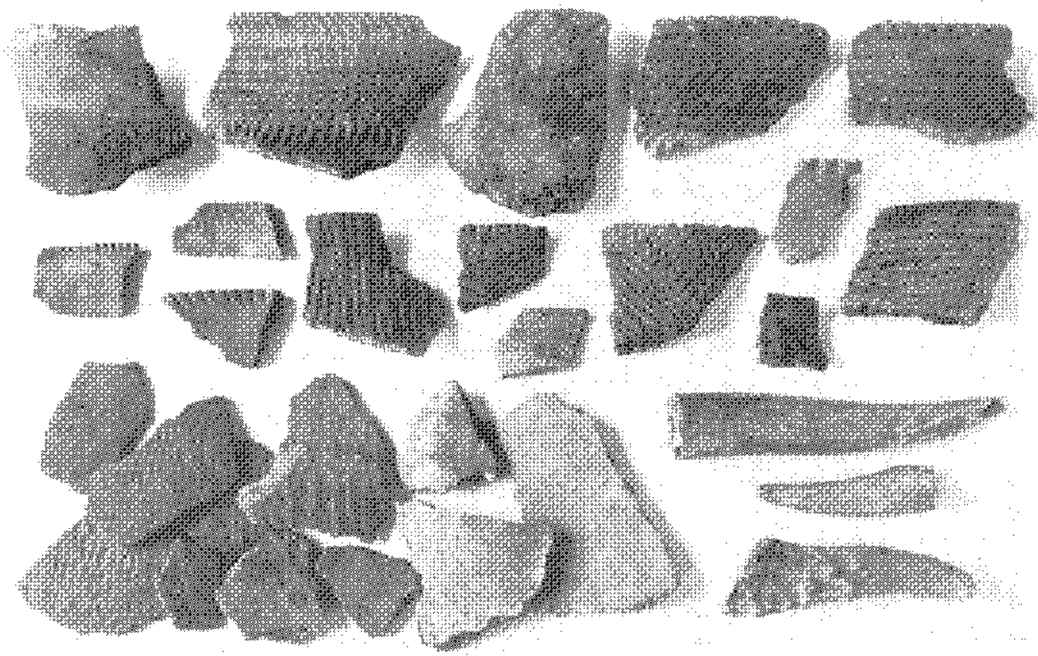


Photograph by J. Harold Ennis

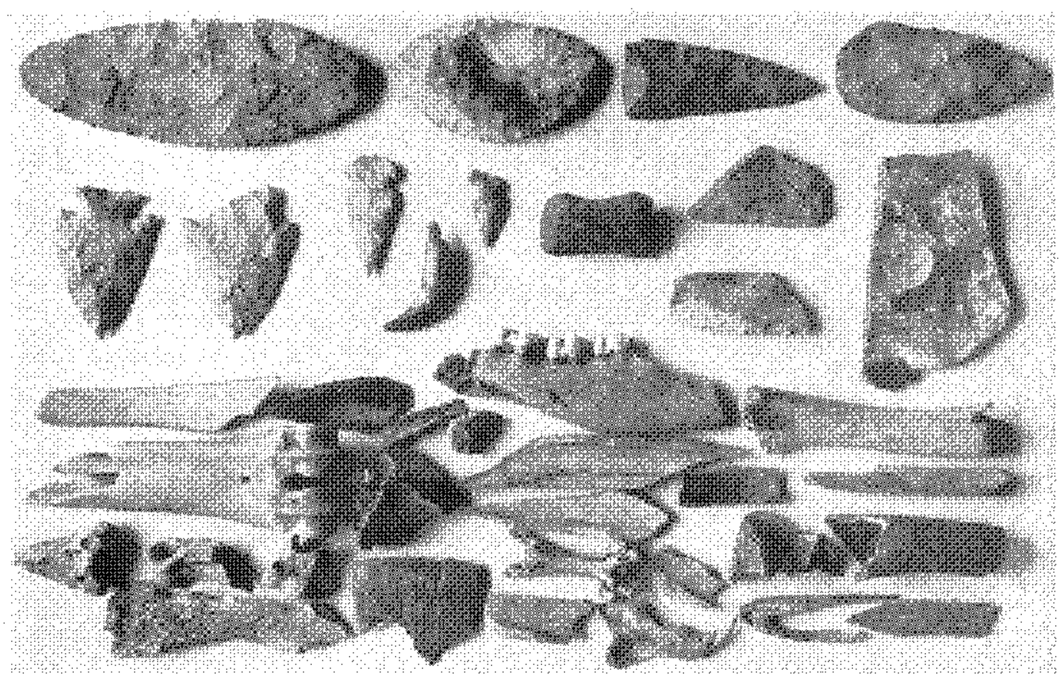
Figure 1. 1930 Excavation of Minott's Rock Shelter. From Keys, 1943.

On the ridge summit along the park road ca. 250 meters west of the main park shelter is a group of seven conical mounds (13LN209) originally described by Charles R. Keyes. There is no indication that these mounds have ever been systematically tested or excavated. They probably represent burial mounds of the Middle or Late Woodland period (ca. 100 B.C. – A.D. 1000). An archaeological survey in 1997 found no evidence of habitation in the picnic area and campground along the shoulder slopes 100–300 meters southwest of the mounds (Peterson 1997).

Rockshelters with evidence of prehistoric occupation within Palisades-Kepler State Park include the two sites known as the Gingerstairs rockshelters (13LN215), excavated by Keyes in 1930 (Fig. 1) and 1945 [Keyes 1931], and 13LN220, tested by Keyes in 1944 [Logan 1958, 1976]), as well as an untested rockshelter (13LN219). Within Palisades-Dows State Preserve, Keyes directed field-school excavations in the 1940s at the Minott's (13LN210) and Spring Hollow I, II, and III (13LN211, 212, 213) rockshelters. Excavations were designed to recover Woodland-era ceramics and other materials from secure habitation contexts (Keyes 1943). Recovery



PHOTOGRAPH BY CHARLES R. KEYES
RIMSHERDS AND BODYSHERDS FROM POTTERY VESSELS USED IN MINOTT'S ROCK SHELTER; THREE ANTLER TIPS



PHOTOGRAPH BY CHARLES R. KEYES
FLINT KNIVES, PROJECTILE POINTS, A CANINE-TOOTH PENDANT, SANDSTONE ABRADER, SCRAPER-KNIVES, AND BONE REFUSE FROM MINOTT'S ROCK SHELTER

Figure 2. Various artifacts recovered during the archaeologic excavation of Minott's Rock Shelter. Photos from Keys, 1943.

methods were good for the time and resulted in the accumulation of large collections of ceramics, lithic artifacts, and faunal remains (Fig. 2). Logan (1958, 1976) studied some of this material as part of his work on Woodland cultures of eastern Iowa, and he utilized the Minott's and Spring Hollow rockshelter materials as ceramic type specimens. The collections still retain a great deal of untapped research potential on Woodland technology, subsistence, and chronology. Collected materials and depictions of the rockshelters are displayed in exhibitions at Iowa Hall (Museum of Natural History, University of Iowa) and The History Center in Cedar Rapids.

Enjoy your visit to archaeological resources in Palisades-Kepler State Park and Palisades-Dows State Preserve. Remember that removal of any materials without permission of the Department of Natural Resources or State Preserves Advisory Board is prohibited.

ACCOMPANYING PAPER

PALEOENVIRONMENTS AND HUMAN PREHISTORY IN LINN COUNTY

by William Green

Introduction

This paper summarizes the interaction of environments and human populations in eastern Iowa, with specific reference to two portions of the Cedar River valley in Linn County: the Palisades locality, located between Cedar Rapids and Mt. Vernon, and the Wickiup Hill locality, located north of Cedar Rapids near Palo. Both locales have been subjected to archaeological investigations since the 1930s and continue to be foci of archaeological interest as well as public interpretation.

The author adopts the viewpoint that climate, vegetation, and fauna form critical parameters for studying past ecosystems and human cultures (King and Graham 1981). But understanding past environments and resources is only part of the challenge in interpreting human prehistory (Stoltman and Baerreis 1983). People have organized themselves in a variety of ways in order to exploit resources for subsistence. Similar resource bases may have supported vastly different economic strategies, depending in part on group size, technology, and organization. Therefore, even if the resource base remained relatively stable through time, patterns of human utilization were likely to change throughout both the prehistoric and historic eras. Of course, environments and resource availability *did* change through time, often subtly but occasionally on a large scale.

Paleoenvironmental studies reveal changes in vegetation, which in turn reflect both climate change and plant-community and species succession. Available animal resources also can be inferred from reconstructions of climate and vegetation. Plant and animal resources available to the inhabitants of the Cedar River valley were varied and abundant throughout most of the span of human occupation. Below is a brief summary of the climatic, floral, and faunal contexts for human utilization of Wickiup Hill and Palisades-Dows.

Early Eastern Iowa Climate

At the time of the first documented human presence in eastern Iowa, ca. 11,000–11,500 years ago, the region was hardly recognizable by today's standards. Glacial ice had recently retreated from north-central Iowa, and the climate was cooler than present. Vegetation was dominated by spruce and larch, and although some deciduous trees were present, hardwood forests and prairie as we know them were absent (Baker et al. 1980, 1990). Mammoths and mastodons shared this late Pleistocene landscape with a variety of smaller animals. The newly arrived, highly mobile bands of Paleo-Indian hunter-gatherers focused much of their attention on the now-extinct megafauna while probably also collecting other resources. A few spear points diagnostic of this period have been found in uplands bordering the Cedar valley (Anderson and Tiffany 1972; Morrow and Morrow 1994), but occupation appears to have been relatively sparse. This impression may result from the fact that little of the Paleo-Indian landscape is preserved today, especially in valleys.

The recession of the Des Moines Lobe from northern Iowa and Minnesota caused enormous amounts of glacial meltwater to pour through major river valleys around 12,000–14,000 years ago, carrying sand and gravel which subsequently was moved downstream as river channel systems developed (Baker et al. 1993). The Cedar valley was not a principal meltwater channel for the Des Moines Lobe, but the Shell Rock River may have funneled some meltwater into the Cedar River. Main channels might not have been especially productive of fish in the late Pleistocene, but a rich mosaic of habitats conducive to supporting a variety of usable resources probably existed in the Cedar valley. The diversity of resources may have attracted human populations to the valley, as well.

Regional climate continued to warm and by around 10,000 years ago a mixed conifer-hardwood forest was present. Fir, ash, birch, elm, basswood, and oak increased in abundance (Baker et al. 1990, 1993). Diversity in vegetation was accompanied by a likely increase in animal diversity and abundance.

Megafauna such as mammoth and mastodon was no longer present. As human societies shifted their economic emphasis from megafauna to other game such as elk and deer, they also began reducing the range of their annual movements. Hunting became more productive, so each group utilized regions of perhaps several hundred square miles rather than several thousand square miles as in the earlier part of the Paleo-Indian period. This reduction of hunting and collecting territories began at the transition from the Paleo-Indian to the Archaic period and continued through much of the prehistoric era.

Early Archaic (ca. 6,000-8,000 BP)

During the Early Archaic period (ca. 6,000–8,000 BP), much of the Wickiup Hill tract and most of east-central Iowa probably supported mesic deciduous forest composed of oak, hickory, elm, basswood, and other familiar tree types still common in parts of the region. Prairie vegetation was spreading eastward through Iowa but was still largely limited to the western and central parts of the state (Baker et al. 1990, 1992). The heavily forested eastern Iowa environment probably provided excellent habitat for deer and other game, and it supplied an increased number of potential plant foods (e.g., nuts, wetland tubers) for humans as well.

Late Paleo-Indian and Early Archaic peoples probably engaged in extensive seasonal rounds as they moved between upland and lowland resource zones. The types of sites that might represent these periods in Linn County can only be surmised, but probably would include small, temporarily occupied resource procurement camps. Previous studies have documented scattered Early Archaic occupation in the Cedar River valley near Wickiup Hill (Benn with Hovde 1976:140, 143). Artifacts from this period are found on uplands and on older terraces that have not been subjected to removal or burial by subsequent landform development. It is likely that Corrington Member and Gunder Member deposits contain intact surfaces from this era, but at depths not yet reached by archaeological survey. In eastern, central, and western Iowa, alluvial fans and terraces in large valleys contain substantial, well-preserved Late Paleo-Indian and Early Archaic archaeological sites at depths of several meters (Anderson and Semken 1980; Benn and Bettis 1985; Bettis et al. 1992).

Middle Archaic (ca. 4,500-6,000 BP)

A substantial change from previous conditions characterizes the period of ca. 4,500–6,000 years ago. This span comprises most of the Middle Archaic period (4,000–6,000 BP). Paleobotanical data from Indian Creek Nature Center, 9 km northwest of Palisades-Dows State Preserve (Baker et al. 1990), suggest that the climate became warmer and drier, and prairie vegetation moved into many areas that were formerly wooded. Vegetation thinning or denudation on hillslopes and in valleys may have led to landscape instability, with increased hillslope erosion and aeolian sand movement. This period may have seen extensive dune reactivation in the Cedar River valley, with sand becoming more readily subject to blowing because of reduced vegetation cover. At Indian Creek, "prairie or possibly oak savanna was probably the dominant vegetation at the site during this time, and the local water table was low enough that only mineral sediments were deposited and a few wet-ground taxa were present" (Baker et al. 1990:175).

Late Archaic (ca. 2,500-4,500 BP)

Few traces of settlement from this time are found in the area. This paucity of evidence may be due to the facts that: (1) archaeologists are not certain what types of diagnostic artifacts date to this period, and (2) most well-preserved Middle Archaic sites are probably deeply buried. Many of the side-notched projectile points found in the Pleasant Creek area near Wickiup Hill (Benn with Hovde 1976) may date to the Middle Archaic. If they do, this information could indicate continued utilization of uplands for resource collection despite drier conditions and prairie expansion. The formation of forest-prairie edge habitats and the expansion of other ecotones resulting from landscape instability actually may have *increased* the amount of desirable game habitat, leading to growth in deer and elk populations and concomitant human utilization. This scenario is completely conjectural, however, and requires testing.

By around 4,000–4,500 years ago, local climate ameliorated, and vegetation and hydrology began approaching historical Linn County "norms." At Indian Creek, climate "became more humid, oak arrived, deposition of organic sediments began, and the lowland swale was converted to a pond, probably with a marginal fen." During the Late Archaic period, by ca. 3,500 years ago, "mesic forest became established," with oak, elm, hickory, walnut, ironwood or hornbeam, sugar maple, and basswood. Widespread redevelopment of these forests probably was "caused by a continuation of the trend toward more humid climate" (Baker et al. 1990:175). Landform stability probably increased as vegetation cover improved, and Wickiup Hill took on its current physical and natural character.

General Land Office surveyors' notes describe Linn County landscapes of the 1840s and allow a glimpse into conditions that may have prevailed over the last 3,500 years. The Wickiup Hill vicinity was surveyed in June, 1841 (General Land Office 1841). The surveyor noted a few cultivated fields west of the Cedar River, but the vast majority of the area was still characterized by native vegetation. Prairie dominated the relatively level terraces west of the Cedar. Deciduous forest covered the Wickiup Hill tract itself. In the lowlands near the Cedar, the surveyor noted cottonwood, willow, and maple, and "undergrowth thick brush of vines, Dogwood, P. [prickly] ash & willow." Bluff slopes and uplands supported a diverse forest of white, black, and bur oak, hickory, white and black ash, elm, sugar maple, basswood, and ironwood. This array of arboreal flora is consistent with the local pollen record (Baker et al. 1990). The 1841 vegetation of the Palisades also matches the local late Holocene paleobotanical data. The GLO survey, conducted in April, recorded basswood, sugar maple, walnut, and cottonwood in the valley and heavy timber including white and black oak, ash, aspen, and hickory in the uplands (General Land Office 1841).

Woodland (ca. 1,000-2,500 BP)

The Late Archaic, Woodland, and Late Prehistoric occupants of Wickiup Hill would have had easy access to a diverse array of rivers, backwaters, small streams, wetlands, prairie, and lowland and upland forests. Wetland and aquatic plants such as wild rice, bulrush, arrowhead, American lotus, and cattail had important subsistence and technological uses. Trees and shrubs provided vital fruits, nuts, firewood, building material, and other resources. Characteristic animal life of this rich and diverse environment would have included dozens of species of fish, migratory and resident birds, amphibians, reptiles, and mammals (see Bowles 1975; Dinsmore 1994). Bison probably inhabited the area on occasion, but deer and elk were permanent residents and likely constituted the principal large-game resources. Residents of the Palisades locality had access to a similar range of resources, although large-valley backwater environments were less abundant because of the constricted floodplain.

Late Archaic through Woodland occupation (ca. 3,500–1,000 years ago) has been well documented in the Pleasant Creek and Lewis Bottoms locality. There, about 5 km northwest of Wickiup Hill on the west side of the Cedar River, several extensive archaeological survey and testing projects have revealed a wealth of information on local settlement patterns. Benn (Benn with Hovde 1976; Benn with Thompson 1977) documented 32 prehistoric sites in the Pleasant Creek Reservoir, many of which contain Late Archaic and Woodland components. Perry (1983, 1985, 1991) also recovered extensive data on Woodland occupations near both Wickiup Hill and the Palisades. Most of the diagnostic pottery found by Benn and Perry is assignable to the Middle and Late Woodland periods, ca. A.D. 100–1000. In a rare published report of a prehistoric habitation site on the Cedar River between the Wickiup Hill and Palisades localities, Starr (1887) described a possible Woodland-age shell midden at Cedar Rapids. At the mouth of Indian Creek, Grissel (1946) reported shell middens of possible Woodland affiliation, as well as habitation areas producing extensive Woodland and some Archaic materials. Intensive Late Woodland occupation has been well documented at the Minott's, Spring Hollow I–III, and Gingerstairs I and II rockshelters in the Palisades locality (Finney and Logan 1993; Keyes 1943; Logan 1976).

Woodland Mounds

An abundance of conical earthen mounds also suggests extensive Woodland-era occupation of the Cedar valley. Reports on blufftop mound groups around Cedar Rapids were published over 100 years ago. One summary indicated 84 mounds existed in ten different groups within the city (Bettesworth 1878). Later investigations refined the locational data on many of these sites and found additional mounds but also confirmed that many have been destroyed through agricultural and urban development (Abbott 1980; Finney 1992; Forman 1993; Schermer 1995:17). Few of the Cedar Rapids-area mounds have been subjected to intensive, systematic excavation, and Iowa's burial preservation law ensures this is unlikely to happen.

From what is known of mounds in eastern Iowa, it is logical to assume that most if not all of the Cedar valley mounds were built by Middle and Late Woodland peoples, ca. A.D. 100–1000. Most mounds probably served as burial and ceremonial sites for people who lived in nearby base camps or villages. Mounds may have served not only as cemeteries but also as ritual meeting places, territorial markers, and symbols of ancestral and ongoing connections with the land (Benn et al. 1993; Mallam 1982).

Woodland groups and probably their Late Archaic predecessors maintained extensive contacts with other peoples throughout eastern Iowa and the Mississippi valley. Stone artifacts of exotic cherts are found. Woodland pottery styles reflect local participation in widespread midwestern networks of inter-group contact, as well as development of distinctive regional styles (Benn with Thompson 1977; Perry 1991).

Woodland Agriculture

Middle and Late Woodland peoples throughout the Midwest cultivated a wide variety of native crops (Asch and Green 1992; Green 1994). Cedar valley sites have not yet produced specific evidence of native plant cultivation, but data from other parts of Iowa suggest that Indian agriculture focused on native North American crops for over a thousand years before corn was introduced into the region. The extent and diversity of ancient agriculture is not widely appreciated, partly because the domesticated varieties of some of the crop plants (e.g., marshelder [*Iva annua*] and lambs quarter [*Chenopodium berlandieri*]) are now extinct in North America. Former cultigens such as erect knotweed (*Polygonum erectum*), little barley (*Hordeum pusillum*), and maygrass (*Phalaris caroliniana*) are of little economic value today. But for Woodland peoples, the starchy or oily seeds of these plants constituted important elements of their diversified subsistence economy. Native crop agriculture as practiced throughout the Midwest certainly would have been feasible in the central Cedar River valley.

Modern Indian Tribes in the Area

Late Woodland occupation of the Wickiup Hill and Palisades localities probably lasted until around A.D. 1000 or 1100. From that time until the 1700s, much of the region seems to have been abandoned or at least minimally utilized. Archaeological sites dating to the Late Prehistoric period are plentiful in parts of the Mississippi, Illinois, and Des Moines River valleys, but large portions of eastern Iowa including the Iowa–Cedar drainage contain only a few traces of occupation. Populations seem to have clustered in a few large villages on the major rivers and utilized the interior valleys only for occasional hunting. This pattern may be related to changes in subsistence economy: during the Late Prehistoric, corn became the staple crop, eventually replacing most of the native cultigens. Occasional surpluses and the need to tend corn more carefully than the native crops perhaps encouraged a greater degree of sedentism than in Woodland times.

The paucity of documented Late Prehistoric occupation in the Cedar valley makes it extremely difficult to define possible prehistoric ancestors for many Indian tribes in the area. The Ioway and perhaps Oto, who lived in the northernmost parts of Iowa in the late 1600s and early 1700s, are connected with the Oneota culture. Does the absence of Oneota sites from most of the Cedar valley indicate the Ioway and Oto did not live there? Perhaps Ioway and Oto people utilized the region occasionally while residing in villages to the north. Meskwaki people began moving into the region in the 1700s, after the Ioway had relocated to the west and south (Rogers and Green 1995). The absence of substantial occupation between ca. 1100 and 1700, coupled with the difficulty of assigning tribal identifications to archaeological complexes, makes this period of Cedar valley archaeology especially enigmatic and challenging.

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HISTORY OF PALISADES-KEPLER STATE PARK

by Jim K. Hansen
from *Palisades-Kepler State Park; The Fires Seventy-Five* Years, by Jerry Reisinger
Parks, Recreation & Preserves Division
Iowa Department of Natural Resources
Palisades-Kepler State Park
700 Kepler Drive
Mt. Vernon Ia 52314

THE EARLY YEARS

Here, in and around the Palisades during the eighteen thirties and forties, gathered many of the rugged pioneer settlers. They came from Kentucky, Tennessee, Ohio and the Eastern states to obtain cheap lands. Land was had for the asking and most of it was sold at $1.25 to $5.00 an acre. Timber was plentiful, water was easy to obtain, the rainfall was plentiful, and the soil, when not rocky, was of a quality that produced fairly good crops.

Near the Palisades can still be found the remnants of the Cedar Springs Hotel (Fig. 1). The hotel was built to accommodate the mining town and quarry that was operated by the Ivanhoe Lime, Stone, & Construction Company. They provided rock for railroad beds in this part of the state. When the company pulled out of town the hotel gained popularity with Linn County residents. Guests could enjoy the top portion of the hotel that overlooked the limestone bluffs and river while the restaurant served 25-cent chicken dinners and sold boat rides in a sleek mahogany launch on the river.

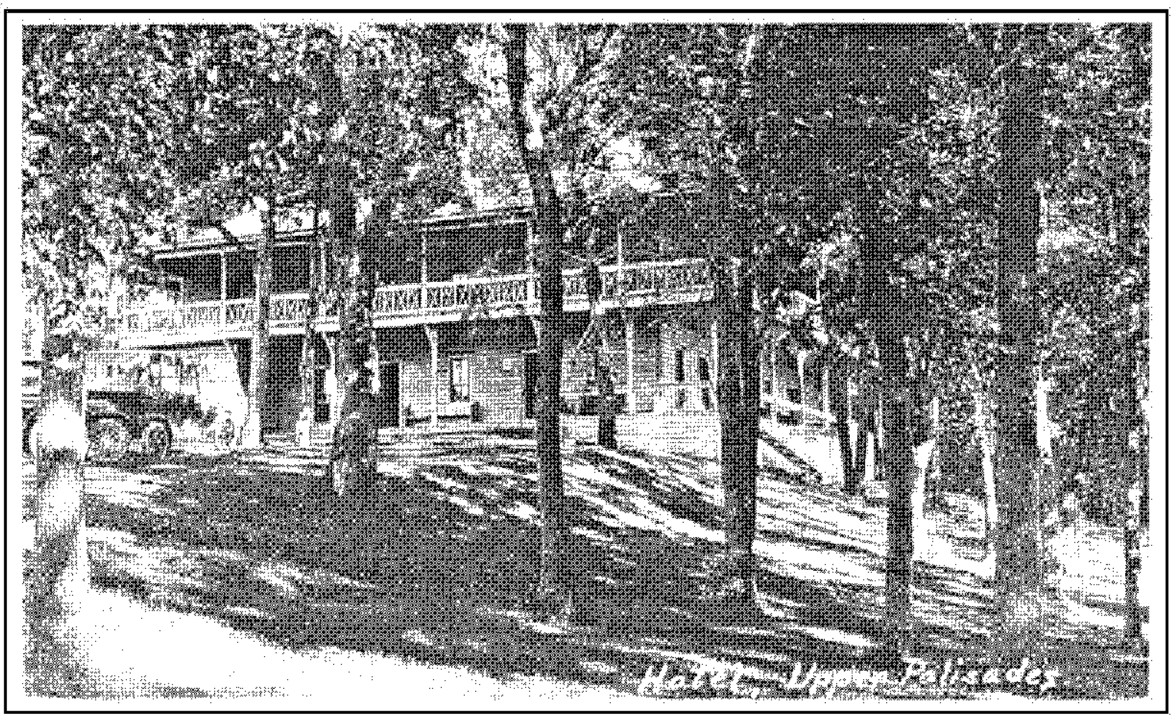


Figure 1. Print of the Cedar Springs Hotel, Upper Palisades, ca. 1920s.

Along the banks of the river and around the Palisades, the first settlers in this area saw the wigwams scattered about on both sides of the river. At times different tribes would be occupying opposite sides of the river. The Indian tribes of the Souk (Sac) and Fox called the river Moskwahwakwah, which refers to the red cedars. This same river has been referred to on many maps as the Red Cedar River, now more commonly known to local persons as just the Cedar River.

At the time of the Indians the Cedar River was the main highway for canoe travel. The numerous caves in the Palisades were used as "temporary homes" for travelling on the river. They were places for eating and resting. In the caves all sorts of Indian artifacts have been found, some of which are still held by collectors. Indian mounds, still very much in existence, were found to contain ancient pottery, fish hooks of stone, and arrowheads. It is believed that the mounds were of religious significance.

James Sherman Minott arrived in Mount Vernon, Iowa, in the spring of 1869. Captain Minott spent his first winter or two after coming to the Mount Vernon region hunting, fishing, and running his trap lines at the Palisades.

On the west side of the river, directly opposite the place where Minott's Lower Palisades tavern was eventually built (Fig. 2), is Spring Hollow, a large, cool ravine. At another furlong interval upriver, comes Blow Out Hollow. The name Blow Out comes from the wide, shallow cavern in the main cliff wall facing the river, the appearance of which suggests formation by an explosive force. These ravines, like the river itself, are bordered more or less by vertical limestone cliffs, very beautiful with their growths of lichens, liverworts, ferns, cedars, and northern yews. The ravines are perpetually shaded by the heavy forest and the broad bluff tops that tower above.

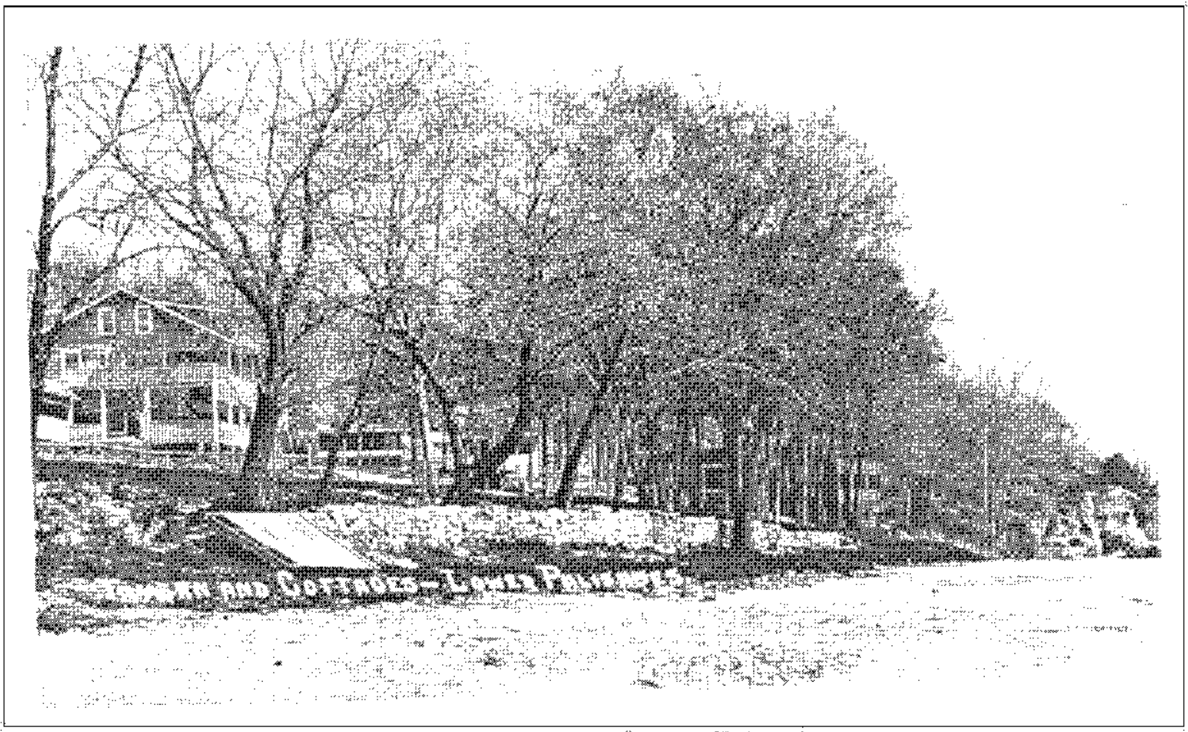


Figure 2. James Minott's Rock View Tavern and cottages at Lower Palisades.

In the south wall of Blow Out Hollow, scarcely a hundred yards from the river, is an inviting little cavern in the cliff wall, irregularly circular in form, eight by eight feet in size, with a level floor, above which the ceiling is removed far enough not to be troublesome to a man of stocky figure like Captain Minott. There he built a lean-to of slender tree trunks and thatch, installed a small cast-iron stove, built a bunk, and so created a refuge secure from the winter storms and cold of the late 1860s. To the Captain's successors, the little cavern was always known simply as Minott's Cave.

More important to a host of people in an area much larger than the Mount Vernon vicinity was the acquisition of some 160 acres in the late 1890s by Captain Minott. The rough, heavily timbered land in the Lower Palisades region of the Cedar River is some four miles from Mount Vernon. There he built a spacious inn for the accommodation of visitors to the natural paradise-- an inn that was destined one day to become the center of one of Iowa's best-known state parks. Minott established a boat livery and sold lots for the building of numerous summer cottages, with the lot prices ranging from $20 to $71. Many people took advantage of those prices, and soon the population of the area grew to 200. Afternoon outings on the Cedar River, capped off by a quiet dinner at the combined log-cabin restaurant, general store, and hotel were a common occurrence in the early 1900s.

In 1912, in his seventy-ninth year, Captian Minott died in his low one-story house set into the southeast slope of the Mount Vernon hill.

On September 16, 1919, the Cedar Rapids Gazette ran a news article stating that "preliminary steps toward making the Palisades area a state park would be taken at a picnic to be held at the Palisades".

In the Lower Palisades, Joseph Tomlinson Jr.'s family operated a hotel, dancing hall, and campground on Big Spring Island. In 1922 the state purchased the 140-acre Tomlinson estate to start the state park. The land had been in possession of the Kepler family for many years. In September of 1928 the State Conservation Board accepted the gift, noting its value for scientific, recreational, and historic purposes.

"*The natural beauties of the palisades have always been very dear to my heart,*" wrote Mr. Kepler in his will. "*The possibilities of a beautiful state park there have always appealed to me. I hope that people may find happiness in going there.*"

There was a strong association between noted poet Carl Sandburg and Cornell College (see Fig. 3), for Sandburg visited Cornell regularly from 1920 until 1939, and sporadically until 1957. During this time Sandburg toured the country lecturing, reading his poems, singing, collecting folk songs, and playing his guitar. His trips to Cornell were highlighted by picnics at the "Pal" and late-evening fireside gatherings with students in Clyde Tull's home. Between 1920 and 1939, Sandburg's visits to the area were annual events. If he came in the spring, he was fond of rambles with Cornell professors and students at the park.

Figure 3. Carl Sandburg (second from right standing) and friends at Palisades-Kepler State Park. Sandburg was a regular visitor at the park and near-by Cornell College between 1920 and 1939. Photo from Wiley, 1997.

THE CCC ERA

In April of 1933, sixteen Civilian Conservation Corps camps were authorized for Iowa, one of which was camp Company 781 (see Fig. 4), assigned to Palisades-Kepler State Park (later followed by Company 2722). Prior to the CCC camp's arrival, very little had been done toward developing any new, or improving any old, park facilities. But the park was about to undergo a dramatic change. With two weeks work to their credit, the CCC stationed at Palisades Kepler State Park had already finished half of the construction work on the barracks that would house them that winter. It would be one of the eighteen reforestation camps in Iowa, approved for winter work.

While the CCC people were busy constructing a camp for themselves and getting started on the basics of building the park's infrastructure, the Conservation Commission's Board was negotiating with Mr. Howard Hall of Cedar Rapids for a five-year lease and gentleman's agreement whereby the state would lease to Mr. Hall a cottage that the state had acquired along the river. In exchange for the lease, Mr. Hall was to pay the costs, estimated to be $500 to $600, for a memorial gateway at the entrance of the park. Additionally, he was to repair the cottage leased to him and keep it in good condition. By August of 1933, the plans for the entrance had been approved by both parties and work was to begin as soon as possible.

By November of 1934 word had been received by the National Park Service that the project of constructing the dam on the Cedar River had been approved and that construction by the CCC could start at once. Most people strongly believed that the dam would help create one of the finest recreation centers and resorts in this part of the state. It would increase the depth of the Cedar, which would make for

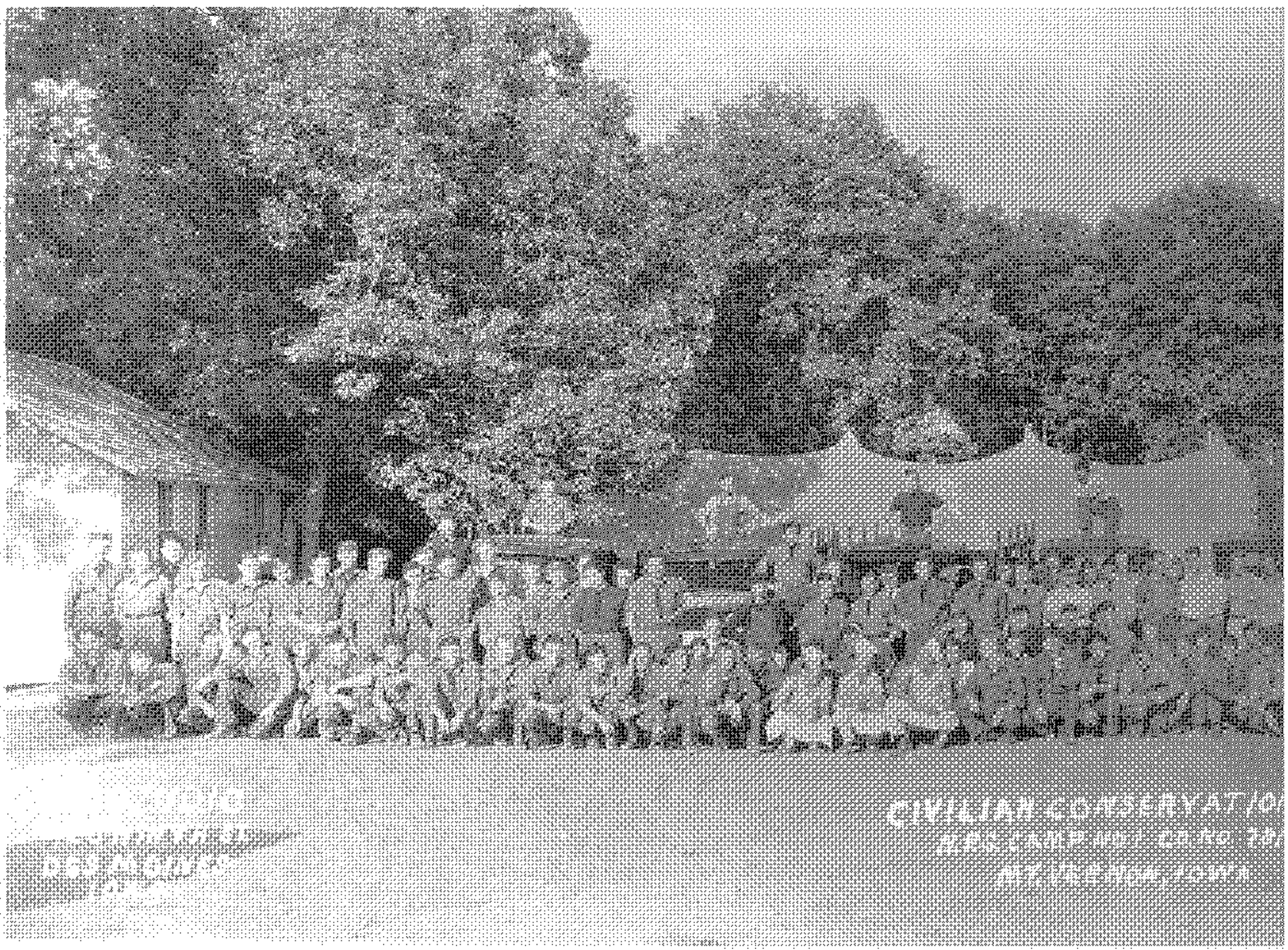


Figure 4. The Civilan Conservation Corp Camp No.1, Company Number 781 at Palisades-Kepler State Park

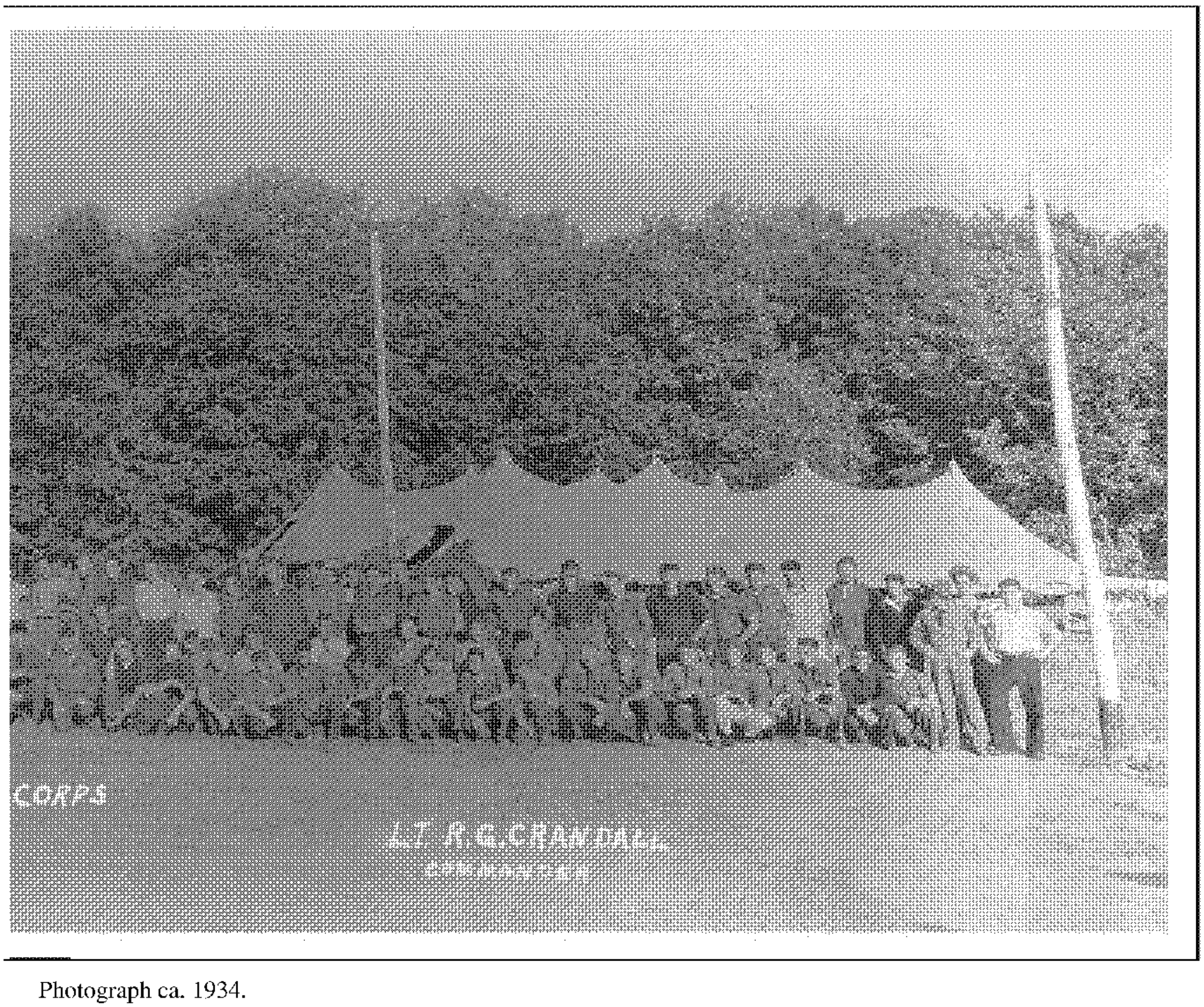
enjoyable boating, fishing, and swimming, and do much to increase up-river property values.

Original plans called for a dam across the main channel of the river 300 feet wide to an island, and another 200 feet the other side of the island. It would be constructed of earth, reinforced with steel piling, and have a concrete cap. It was decided to work day and night on the project, so electric lights were erected at the site and the camp scheduled the workers to accommodate three shifts.

The 210 men of the CCC camp would be used on the project, as were the Works Progress Administration (WPA) workers from the area. The WPA was another of the federal government's New Deal programs that was designed to get the country's citizens back to work and stimulate the economy during the Great Depression.

The year 1935 started as a fairly normal, busy year for the park. In March the commissioners again had Palisades-Kepler State Park on their agenda as they approved a rule that allowed for camping to take place at the park. Two major concerns arose that year for those involved in the project of building the park. It had become more evident as time went by that the dam was a long, tedious project that was plagued with one setback after another.

Across the river but in plain view from the park's picnic areas Howard Hall, a wealthy industrialist from Cedar Rapids, was having a nice cottage built by contractor Erroll Miller. Stone from the local quarry was used for the walls, and native timber for the roof joists. A magnificent view of the river and park was a nice feature of the cottage.



Photograph ca. 1934.

While improvements were being started on the camp, other projects in the park continued at a nice pace. Footings for a bridge across Fat Man's Agony, a steep ravine on the trail from the park to the Upper Palisades, were completed and masonry work on the bridge was half done. The bridge would have a 30-foot stone arch and be a beautiful structure when complete. Rock was being quarried for the stone portals at the entrance of the park and foundations were started.

Construction of the dam proceeded slowly, with water having to be pumped out of the completed cribs, and rock dumped into them. The concrete cap was now in place part way across the dam and railings were anticipated, as the dam would serve as a footbridge as well.

On October 25, 1935, a farewell dinner for Company 2722 of the Civilian Conservation Corps was held at the park lodge.

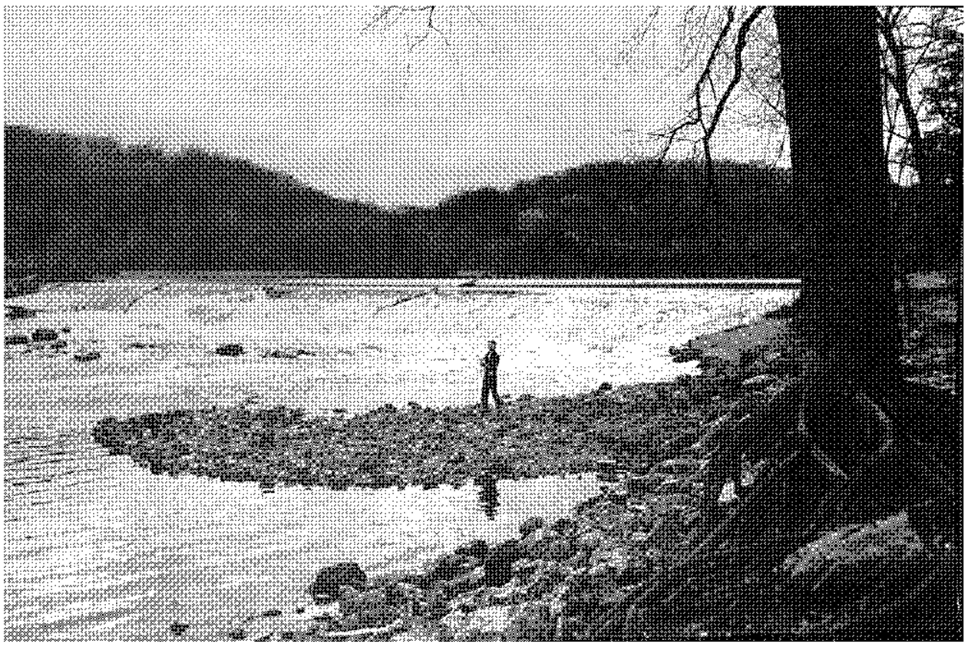


Figure 5. Photograph of the completed Palisades-Kepler dam.

By Christmas of 1935 the paved walk across the top of the dam had been completed by 15 men who had been pouring concrete. Another 10 men worked on other park projects, and for all practical purposes the entrance portals and electric lines were complete. The proposed $68,572 WPA project for the park was scheduled to provide a bathhouse for the beach, some small overnight cabins to be built in addition to the large stone cabins the CCC had built, a new parking area near the bathhouse, a driveway up to the stone cabins, and some riprap on the island at the dam. The bathhouse was never built.

In October of 1937, the crew reported that construction of the main part of the dam would be completed before the end of the month. Only a small amount of work remained to complete a small gap at the west bank where the dam tied into the cliff (Fig. 5).

With the concern for the completion of the dam over, the park was much less in the news in 1938. Some progress was still being made with regard to the details of finishing the lodge and the trails, and there was still hope that the four smaller cabins and a ranger's residence would be built. The park had received a great deal of publicity in the newspapers, and thousands of people were flocking to it to enjoy the trails and facilities as well as view the newly dammed-up river. The park had grown up around a spot that in the days of bicycles and bustles was one of the most popular resorts in the area.

The year 1939 was much more stable in terms of park operations. There seemed to be a status quo about the daily lives of those connected to the park, and Mr. Meyer and others could go about taking care of routine daily operations. With many of the park's new structures and trails in place, the park custodian was spending considerably more time tending to the daily needs of park visitors. The National Park Service had $3,500 it was willing to use to build a new custodian's residence at the park, and construction was started later that year. The work progressed steadily to a point where the electric service line, sewage system, and the residence itself was half completed by July of 1941.

It was also reported in the local papers that six modern overnight cabins (only four were ever built) were approved and construction was ready to begin. They would be located on the east side of the Palisades overlooking a bend in the Cedar River on the side hill between the stone lookout pavilion and the large garage. The work was to be done by the CCC men from the Solon camp. Between 1933 and 1937, the Iowa Conservation Commission, with funding and labor furnished by the CCC, accomplished nearly 70 percent of the park and preserve development recommended in the agency's twenty-five year plan. By 1942, when the last CCC Camp in Iowa was abandoned, even more had been accomplished. Not only did the CCC make a major contribution to the conservation and recreation needs of Iowa; they also left a legacy of work to be treasured.

In 1941 Bernard Vanetten and Errol Miller of Mount Vernon, who were working on the Howard Hall cottage on the west bank of the river, discovered a small opening in the side of the ravine below them. They entered the cave and out of curiosity dug a small hole in the center of the floor. Much to their surprise they uncovered several large fragments of an ancient pottery vessel that they turned over to the State Historical Society of Iowa. Jay Sigmund, a poet and businessman in Cedar Rapids, heard of the discovery and also did a bit of digging in the cave floor. All he found were a few small pieces of pottery.

Then in 1942, three Cornell College seniors who were majoring in sociology petitioned their professor, Dr. Charles Keyes, as well as Dr. Harold Ennis, to try an excavation of the cave floor to see what could be uncovered scientifically. The five decided to spend the first session of the summer school that year at the task in order to give the students practical knowledge in anthropology. Dr. Keyes obtained permission for the project from the State Conservation Commission and on May 21 of 1942 started digging in the earthen floor (Fig. 6). Every trowel of earth they turned over was carefully sifted for any buried foreign objects, and all discoveries were carefully marked and put in paper bags. The digging took six weeks.

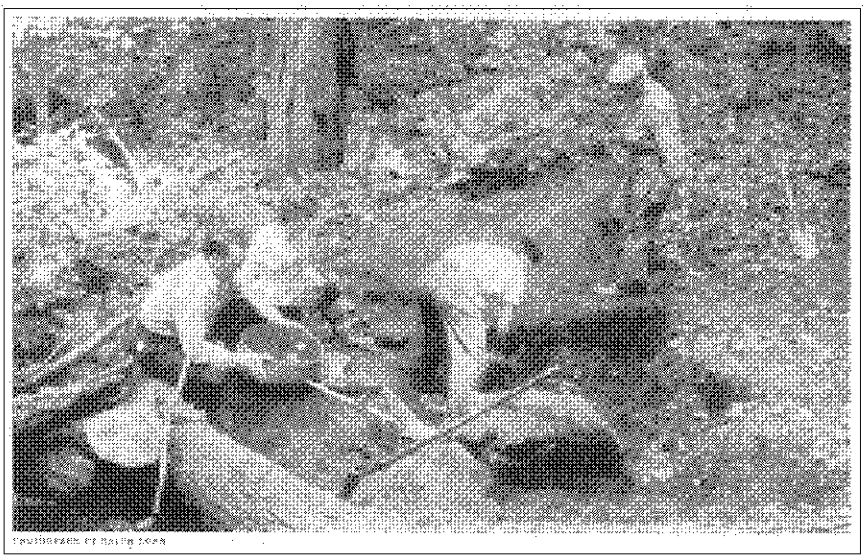


Figure 6. Excavation of artifacts at Minott's Rock Shelter in 1942. View looking southeast acrss the approach trench. Photo from Keys, 1943.

From the cave floor and a 10' by 20' space in front of the cave, the group uncovered 350 items left by Minott and buried by fallen leaves. But the Indian families who had lived in the cave had left 11,472 items. The excavators found flint knives, one curved canine tooth, hammer stones, fire drills, fireplace stones, flint chips, bloodstone for making red paint, nearly 1,000 medium-sized river mussel shells, and 1,400 fragments of pottery.

The troupe finished the excavation in late June and carefully refilled the cave in mid-July. They wished to leave it as it had appeared when Minott lived there. For additional information on this excavation and photographs of some of the artifacts recovered see p. 39 of this guidebook

In the mid 1950s approximately 20-25 years after its construction, the dam suffered a severe washout. An investigation was made at the time by the staff of the Iowa Conservation Commission, and some remedial measures were proposed but never carried out. Since that washout, the dam has been unable to maintain the higher pool elevations that were desired. The dam has been plagued with problems ever since.

By Christmas of 1957 Dr. Gordon and Kathryn Rahn of Mount Vernon were in business at the park's lodge with a concession for winter skiing. With approval of the chief of the Lands and Waters Division, Wilber Rush, the Rahns had established seven ski runs and four rope tows on the slopes leading away from the lodge. The Ski-Pal brochures advertised that the operation could handle some 500 skiers and had ski equipment for sale or rent, lighted slopes for night skiing, lunch counter, free transportation to trains and planes for overnight reservations, and ski schools. The Rahns operated the first season (winter of 1957-58) without snowmaking equipment. Dr. Rahn had purchased three rope tows to get the skiers back up to the lodge.

A coal furnace in the basement of the lodge provided the heat. One concessionaire remembered getting to the park early in the morning on weekends to fire up the furnace to get the large uninsulated building warm. He was paid one-half of his wage in cash and the other in trade on ski rentals and lift tickets. Food concessions at the lodge included hot dogs, chili, coffee, and hot chocolate. Business was very good, but since there was not enough parking for all the cars, some skiers had to walk from near the park entrance.

In the second year of Ski-Pal the Rahns installed artificial snowmaking equipment. It was actually irrigation equipment that had been retrofitted with compressors to create enough pressure to vaporize the water in the air. It worked much like a large lawn water sprinkler system above ground. The Rahns purchased some property across the river and downstream, near the Ivanhoe Bridge. They moved Ski-Pal to that location for the season of 1959-60 and the next couple of seasons until it went out of business. The Rahns also had the rights for boat rentals and other concessions for the summer months, which they called Boat-Pal.

The decade of the 1960s was another one of growth in park use but with very little money for maintenance or development. Palisades utilized inmates from the Men's State Reformatory at Anamosa. The Palisades was fortunate to get some of the money for new facilities that had been appropriated through the legislature in the 1960s. Specifically, three pit-vault restroom units and two new shelter houses were constructed.

Today Palisades-Kepler State Park encompasses over 848 acres and continues to thrive. In 1998 the campground was renovated, upgrading the roads, campsites and utilities for campers to enjoy. In 1999 the lodge experienced an extensive restoration project costing approximately $150,000. "The Pal" has long since and will continue to be a popular setting for picnics and hiking, reunions and weddings, as well as educating our children to the wonders of nature.

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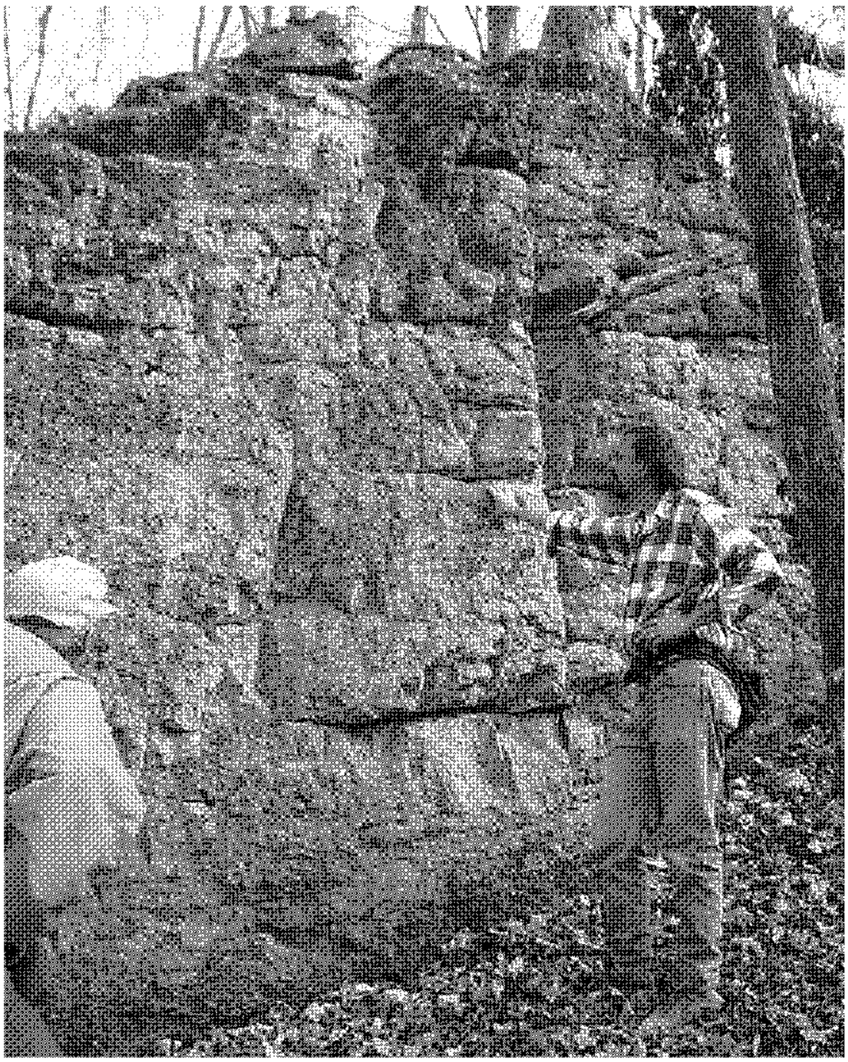
Reisinger, Jerry Palisades-Kepler State Park; The Fires Seventy-Five Years. unpublished report, Iowa Department of Natural Resources, 32 p.

Wiley, Debora, 1997, Our pal, 'The Pal'. *Cornell Report*, v. 21, no. 1, p. 14-17.

FIELD TRIP STOPS

Procede north along the Cedar Cliff Trail; at first fork in trail take left (western) route.

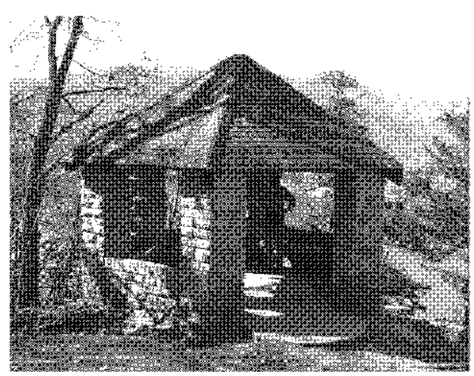
Stop 1: Palisades-Kepler Mbr at Central Mound Exposure "F"



Field Trip leader Brian Witzke examines rocks at Stop 1.

Stop 1 exposes a portion of the upper Scotch Grove Fm Palisades-Kepler Mbr central mound complex (localities F-D on Fig. 4 on page 7). These strata display gently dipping and rolling geometries. Participants should observe the abundance of crinoid material displayed at many of the exposures, and trip leaders will point out salient features, including the local preservation of crinoid cups and corals.

Continue north along the Cedar Cliff Trail; examining exposures of Scotch Grove Fm rocks along the route. Hike up hill to Gazebo.



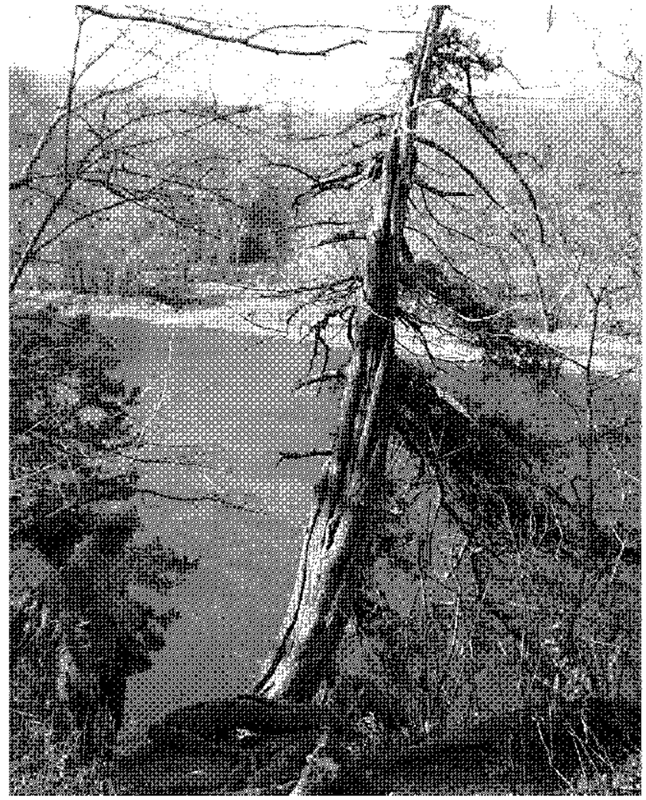
The Gazebo at Stop 2 was constructed by the CCC in the 1930s.

Stop 2: Ancient "Cedars" at Overlook of Cedar River Near Gazebo

From this overlook, you can view the rocky bluffs along the Cedar River. The Cedar River was originally known as the "Red Cedar River" due to the abundance of eastern red cedar trees clinging to the bluffs. Today's population of cedars appears sparse, but many of the individual trees are very old.

Two sets of researchers have investigated the old cedar trees here. In 1965, Delores Graf and William Poulter (then students of Iowa State University botany professor Roger Landers) documented a tree at least 438 years old. Graf and Landers returned to the site in 1975 and confirmed the continued existence of this tree, which was then over 448 years old. This tree is still alive today and is over 472 years old.

The most recent investigation at the Palisades was conducted in 1998 by Dr. Doug Larson and his students in the Cliff Ecology Research Group from the University of Guelph, Ontario, Canada. They found a 386-year old tree last year, plus several additional trees over 200 and 300 years old. Thus there appears to be an entire population of very old cedar trees on the Palisades, not just an isolated individual. Dr. Larson has encountered populations of very old trees on cliffs throughout the Midwest on Niagaran escarpments. The oldest Iowa tree he has found to date is a 601-year old cedar in Backbone State Park.



Ancient cedar tree near the gazebo has been determined to have sprouted in 1527.

Continue north along the Cedar Cliff Trail to location where trail crosses a minor drainage.

Stop 3: Upland Forest Community at Palisades-Kepler State Park.

Mature forest generally prevails on the sloping, dissected, loess-covered uplands on public lands in the Palisades area today (Fig. 2, page 25), but some variation in forest age occurs, reflecting the dates of previous logging and later suspension of logging on public tracts acquired from private landowners.

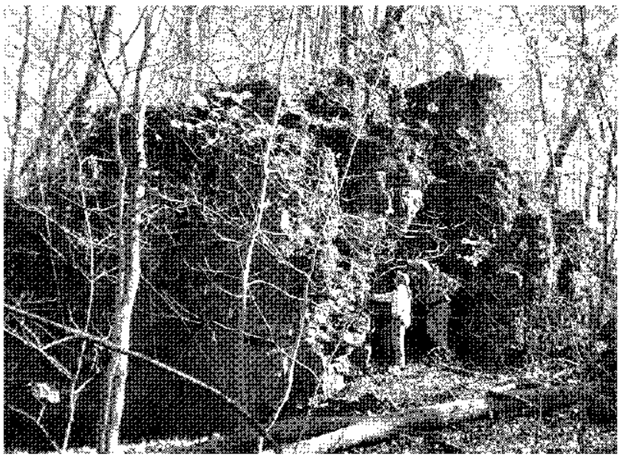
Continue north along the Cedar Cliff Trail to small bridge over drainage. Leave trail and move carefully down the drainage to the exposures south of the ravine.

Stop 4: Nautiloid Pocket in Palisades-Kepler Mbr at Central Mound Complex Exposure "C"

This exposure of the upper Scotch Grove Fm Palisades-Kepler Mbr central mound complex (locality C on Fig.4, p. 7) includes "pockets" of nautiloids as moldic fossils.

Hike back up the drainage to the Cedar Cliff Trail, then continue up-drainage on the trail on the south bank of the drainage. When the trail veers south and heads up the hill, leave the trail, cross the drainage, and proceed to the rock exposure to the east.

Stop 5: Exposure of Brady Mbr



Brady Mbr rocks display a suite of fossils dominated by brachiopod molds.

The Brady Member is characterized by dense dolomite lithologies in the central mounds, commonly only sparsely fossiliferous. This suggests that the bulk of the Brady mounds were originally composed of carbonate mud, although brachiopods, corals, and other fossils are present. Fossils are scattered in these mounds, but the dipping flanking strata commonly concentrate many of the fossils in graded debris flows, and literally millions of brachiopod molds characterize these deposits. The brachiopod-rich flanking strata form the bulk of the Brady Member exposure at Palisades-Kepler, with fossils typically preserved as ovoid molds creating Swiss-cheese porosity.

Move back down the drainage to the Cedar Cliff Trail and continue north up the steep hill to the bluff overlooking the river. Please be careful on the steep ascent.

Stop 6. Small Prairie "Glade" and Old White Oak Trees

A small patch or "glade" of prairie vegetation is located at the top of the steep trail ascent. These dry, semi-shaded habitats enhance local floristic diversity by harboring several prairie species which are absent from the rest of the park and preserve. A list of some of the species found in these "glades" is reproduced on page 30 of this guidebook.

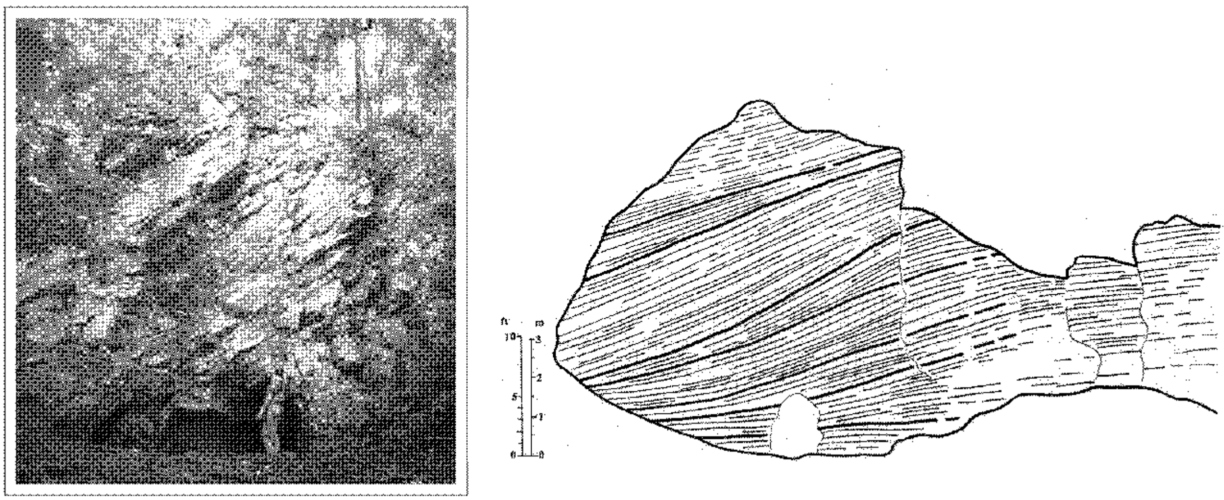
Several old white oak trees are located along the ridge near this glade. These trees have not been cored to count their rings, but have the visual appearance of being at least 100 years old, including thick trunk, knobby branches, patchy bark, and leaning orientation

Continue north along Cedar Cliff Trail to the next major drainage. We will split trip participants into two groups at this point. The descent to Stop 7 down the ravine is very perilous. Those who wish to descend to Stop 7 should proceed with great care. The leaves are very slippery and the slope steep.

Those who do not wish to descend to Stop 7 should proceed north along the Cedar Cliffs Trail. As the trail reaches the northern limits of Palisades-Kepler State Park it will loop around on itself. As the trail begins its loop, a poorly-defined trail to the left (west) heads down the hill to the base of the cliff. You may hike down this trial to join the rest of the group at a large, abandoned quarry to observe Anamosa Mbr rocks, or you may wait at the top of the bluff.

Stop 7. Flank Beds of the Palisades-Kepler Mbr at Central Mound Complex Exposure "B"

Near the northern margin of Mound B, the flanking strata of the Palisades-Kepler Member significantly steepen. These wonderfully displayed exposure of steeply-dipping crinoid-rich debris flows (see figure below) are, in part, wedge shaped, and each individual bed shows clear evidence of grading, with the coarsest crinoid debris at the base of each bed. Travel after this point will be primarily off-trail and is difficult hiking on steep partially vegetated slopes. We will continue off trail along the base of the cliff section to examine the northern segment of Mound B proceeding northward across and through Mound A into the old quarry workings at the northern boundary of the park.



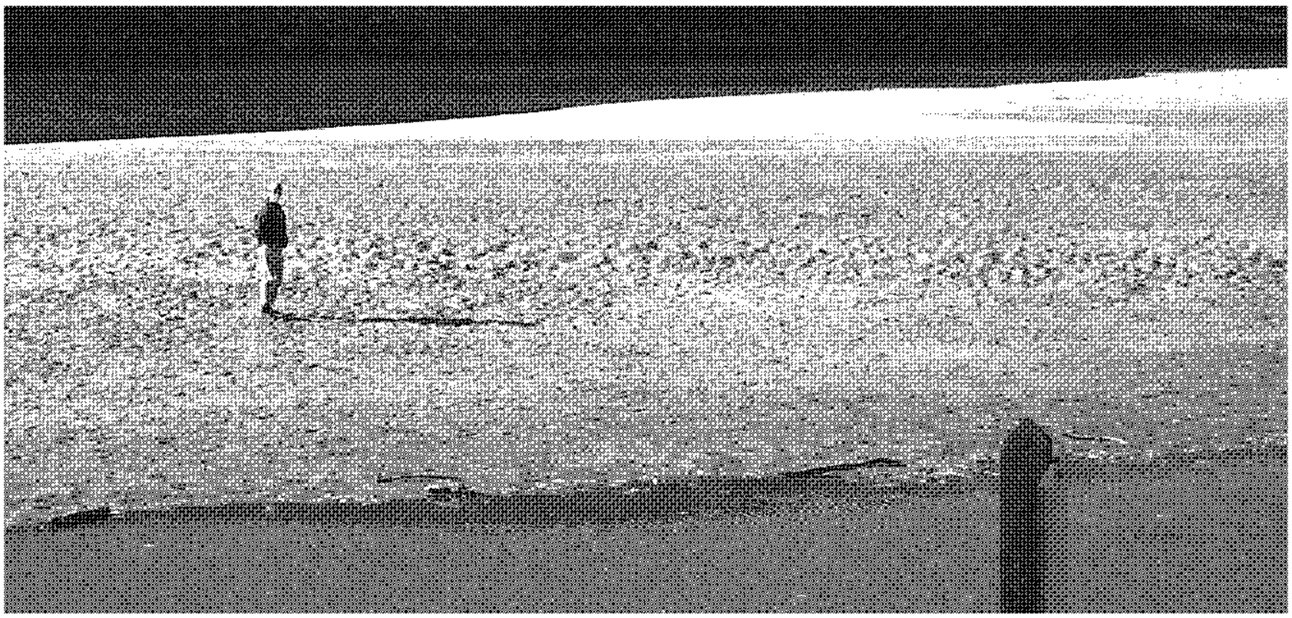
Photograph of Stop 4 and a line-drawing showing the dips of the bedding (see p. 9 for details).

As we continue northward from the steeply-dipping flank strata, we will follow the dipping units of Mound B to its contact with overlying brachiopod-rich Brady strata. The contact between the Scotch Grove and Gower formations can be seen at a few places between Mounds B and A, and we will see the general reduction of crinoid grain size and abundance upward to the contact. Dips will reverse (south dip) as we transect into Mound A, then the dips will change northward as we approach the northern margin of Mound A. Some interesting internal sediment fills can be locally seen within Mound A. The margin of Mound A is seen within an extensive old quarry area that occupies the northern part of the park. Steeply dipping Brady strata occupy this area, and large blocks of brachiopod-rich rock occur as talus at the base of the quarry faces. We will proceed the length of this quarry area to its northern margin; along the way the dipping Brady strata are observed to decrease their dip to the north. At the northern margin, the strata are largely horizontally-bedded, where brachiopod-rich Brady beds are observed to interfinger with laminated strata of the Anamosa Member. At this point, a trail spur can be followed up the slope to rejoin the main trail. We will return to the parking area via the main trail.

Hike up the bluff on trail at north end of quarry and proceed south along the Cedar Cliffs Trail toward the parking area. Continue along the up-slope branches of the trail, observing the vegetation along the route. We will have several informal stops along the trail to discuss interesting or unique vegetation. As we reach the trailhead proceed into the parking area for Stop 8.

Stop 8: Quaternary Geology of the Palisades-Kepler State Park at the Sand Bar

Palisades-Kepler State Park is situated along the Cedar River near the boundary between the Iowan Surface to the north and the Southern Iowa Drift Plain to the south (Fig. 1, page 19). The park area displays more landform characteristics of the Southern Iowa Drift Plain as this area did not undergo as severe erosional processes as the Iowan Surface. However, due to the close proximity of the Iowan Surface, both landform regions will be discussed. The surrounding landscape speaks to the geologic evolution of Palisades-Kepler State Park, but limited exposures of Quaternary deposits are located within the park.



The large sand bar in the Cedar River is the most apparent product of Quaternary sedimentation at Palisades-Kepler State Park

The sand and gravel bar located along the Cedar River comprises one of the more obvious Quaternary sedimentary deposits within the park. This elongate bar is located above and below the dam along the northeastern side of the river. The bar is composed predominantly of fine to medium sand and gravel. Sand and gravel bars form in rivers and streams as a result of a change in river discharge or velocity

Return to parking area for lunch.

After lunch we will hike south along the Cedar River (if water level allows) to Stop 9 near the old dam.

Stop 9: Waubeek Creek Mbr Exposure Along Cedar River Near Dam

Denser and more sparsely fossiliferous horizontally-bedded dolomite strata characterize the inter-mound equivalents of the Palisades-Kepler mounds. These strata were deposited in settings adjacent to and between the mound complexes, and were thereby deposited in slightly deeper-water environments than those that characterized the mounds themselves. These inter-mound strata, which comprise the bulk of the upper Scotch Grove Formation in eastern Iowa, are variably included within two named members within the formation (Witzke, 1992). Where chert is a prominent constituent of the dolomite lithologies, the strata are assigned to the upper part of the Buck Creek Quarry Member. Where chert is sparse or absent, the strata are included in the Waubeek Member. Inter-mound strata in the area of Palisades-Kepler are slightly cherty (as seen below the dam, at exposures immediately downstream from the park, and at the nearby Martin Marietta Quarry), and, therefore, assignment to the Buck Creek Quarry Member seems reasonable. However, chert is only sparsely represented in these strata and is nowhere prominent; inter-mound exposures a short distance downstream at Ennis County Preserve lack chert. The general paucity of chert in the area probably makes assignment to the Waubeek Member a better choice. In general, these inter-mound strata display scattered chert nodules, and inclusion in an undifferentiated Waubeek-Buck Creek Quarry Member seems appropriate.

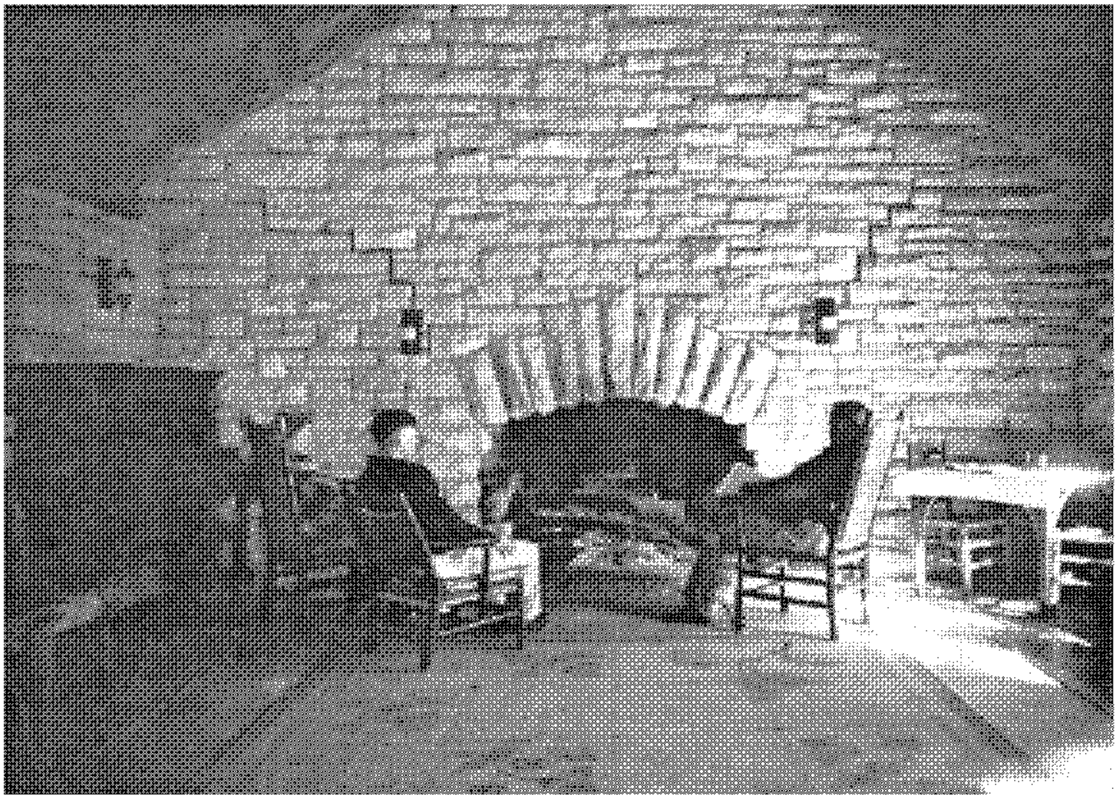
Inter-mound rocks of the Waubeek Mbr and leeward zone strata of the Palisades-Kepler Mbr are exposed in the area of the old dam at Palisades-Kepler State Park.

The inter-mound strata in the vicinity of Palisades-Kepler are dense well-bedded dolomites with scattered to common molds of small fossils (especially fine crinoid debris). Vugs are locally present. A different association of fossils (*Hedeina*-Gypidulid Community) contrasts with the coarse crinoid and coral fossils seen in the contemporaneous mounds. The inter-mound strata of the upper Scotch Grove are generally overlain by flat-lying laminated dolomites of the Anamosa Member, Gower Formation. By contrast, the upper Scotch Grove mound complexes are overlain and flanked by dipping brachiopod-rich strata of the Brady Member, Gower Formation.

Return to parking area, board cars, and drive to Stop 10 at Palisades-Kepler Lodge.

Stop 10: History of Palisades-Kepler State Park

Palisades-Kepler State Park and the surrounding area has a rich and interesting history. This history is reviewed beginning on page 37 of this guidebook.



The main room of the lodge as it appeared many years ago

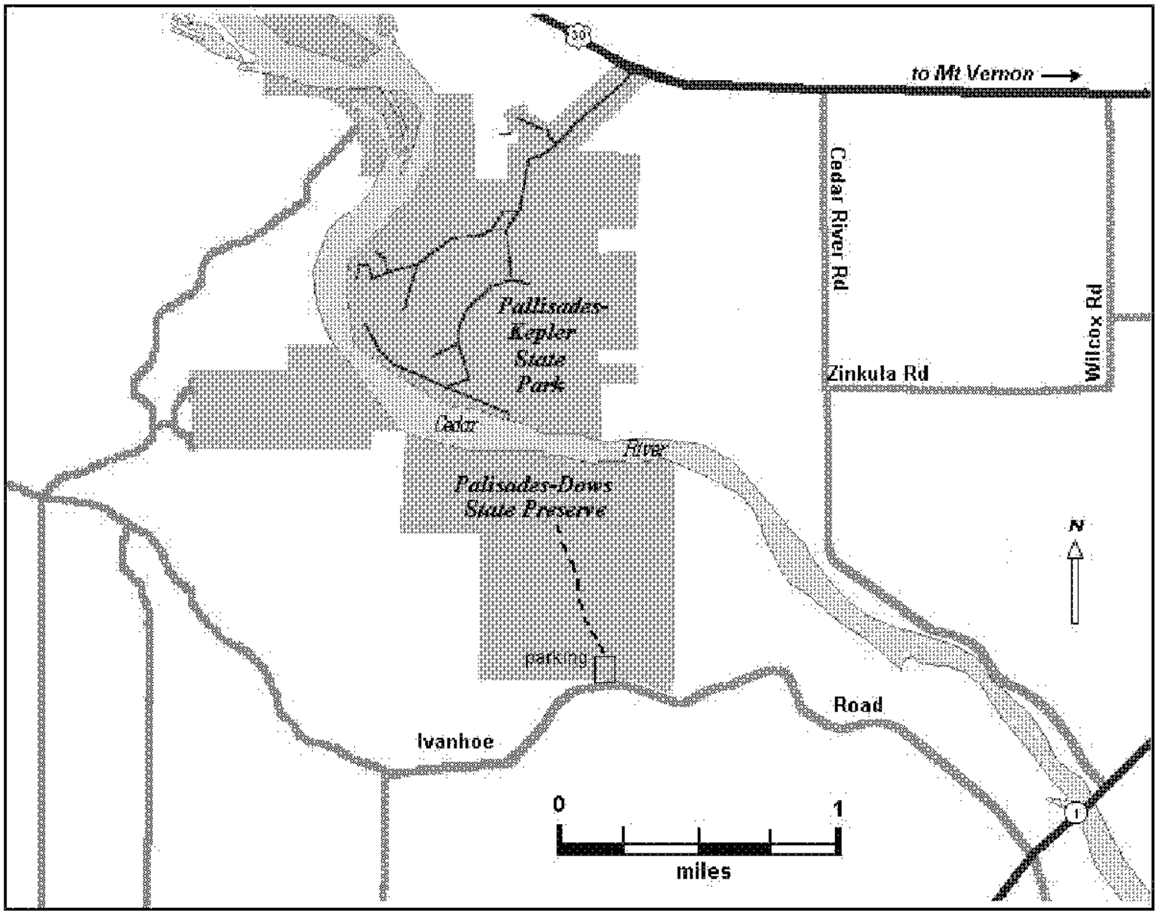
Return to parking area, board cars, and drive to the east end of the campground for the final scheduled stop of the field trip, Stop 11 at the Indian Mounds.

Stop 11. PreHistory of Palisades-Kepler State Park

As with recent the history, the prehistory of Palisades-Kepler State Park and the surrounding area is rich and interesting. More information on the prehistory is presented beginning on page 41 of this guidebook.

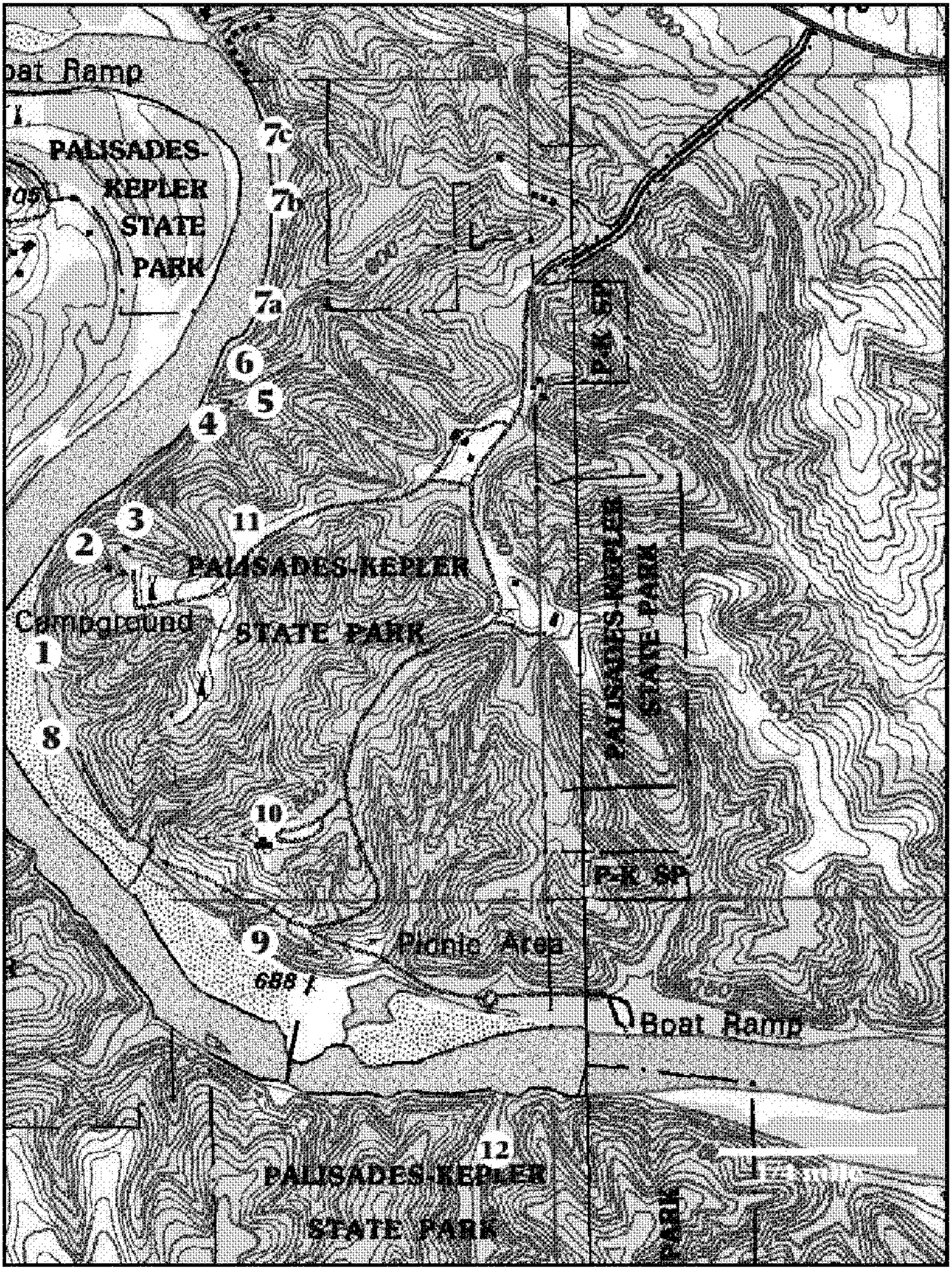
A series of seven burial mounds are preserved in the area east of the campground. These mounds probably date from the late Woodland culture.

Optional Stop 12 includes a look at exceptional exposures of Palisades-Kepler mound rock at the Palisades-Dows State Preserve on the west side of the Cedar River. This will require driving out of the park to Hwy 30 and east about ½ mile to Cedar River Rd the south to the Cedar River, east along the river to Hwy 1 (see map below). Cross the Cedar River on Hwy 1, then turn immediately right on Ivanhoe Road and continue to the Palisades-Dows preserve, and turn into the parking area of the preserve and observatory.



Depending on time and weather, an optional hike at the end of trip will be offered for those participants wishing to see the spectacular and pristine stream drainage that cuts through a separate mound complex on the opposite side of the river. We will park in the large parking lot for the Palisades-Dows Preserve and Observatory adjacent to the telescope facility. Much of the hike will be off-trail. There is a undeveloped trail that heads off into the woods north of the observatory, and we will follow this across the top of a ridge and descend into the stream drainage to the northwest. Following the stream drainage, we will encounter increasingly dramatic exposures of crinoidal mound-rock, most of which displays relatively gentle dips (sub-horizontal strata and gently-dipping beds, most northward dipping 0 to 10º, locally 15-20º in the northern part). The valley exposes some stunning cliff sections, towering above the creek.

For a dedicated few, a final optional stop can be arranged at the Palisades Natural Area, where an old quarry face exposes an instructive succession of laminated dolomite of the Anamosa Member (Fig. 8, p. 14).



Topographic map of the central areas of Palisades-Kepler State Park showing trip stops

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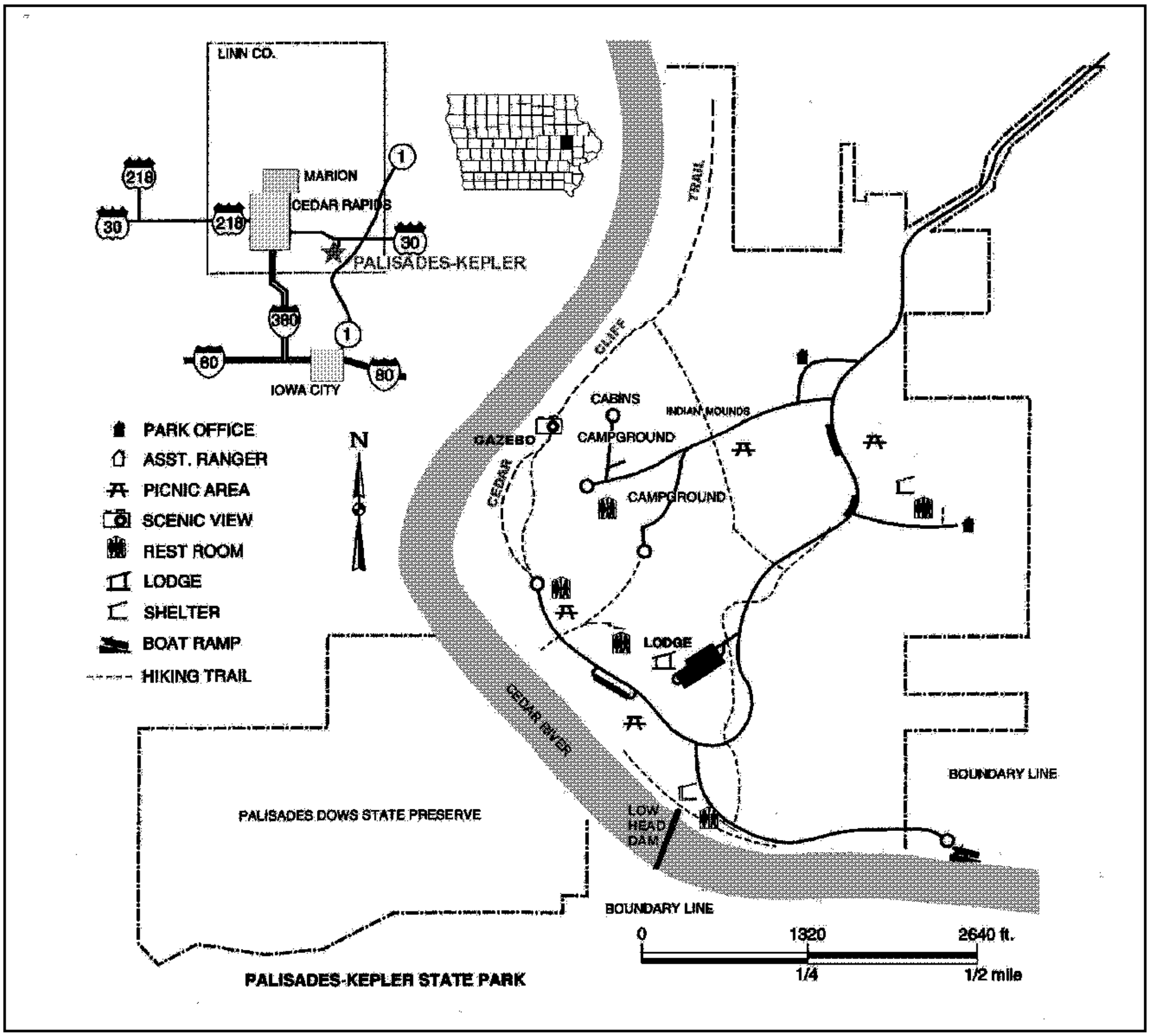
MAP OF REGION, PARK, AND TRIP STOPS FOR PALISADES-KEPLERS STATE PARK AND PALISADES-DOWSPRESERVE



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