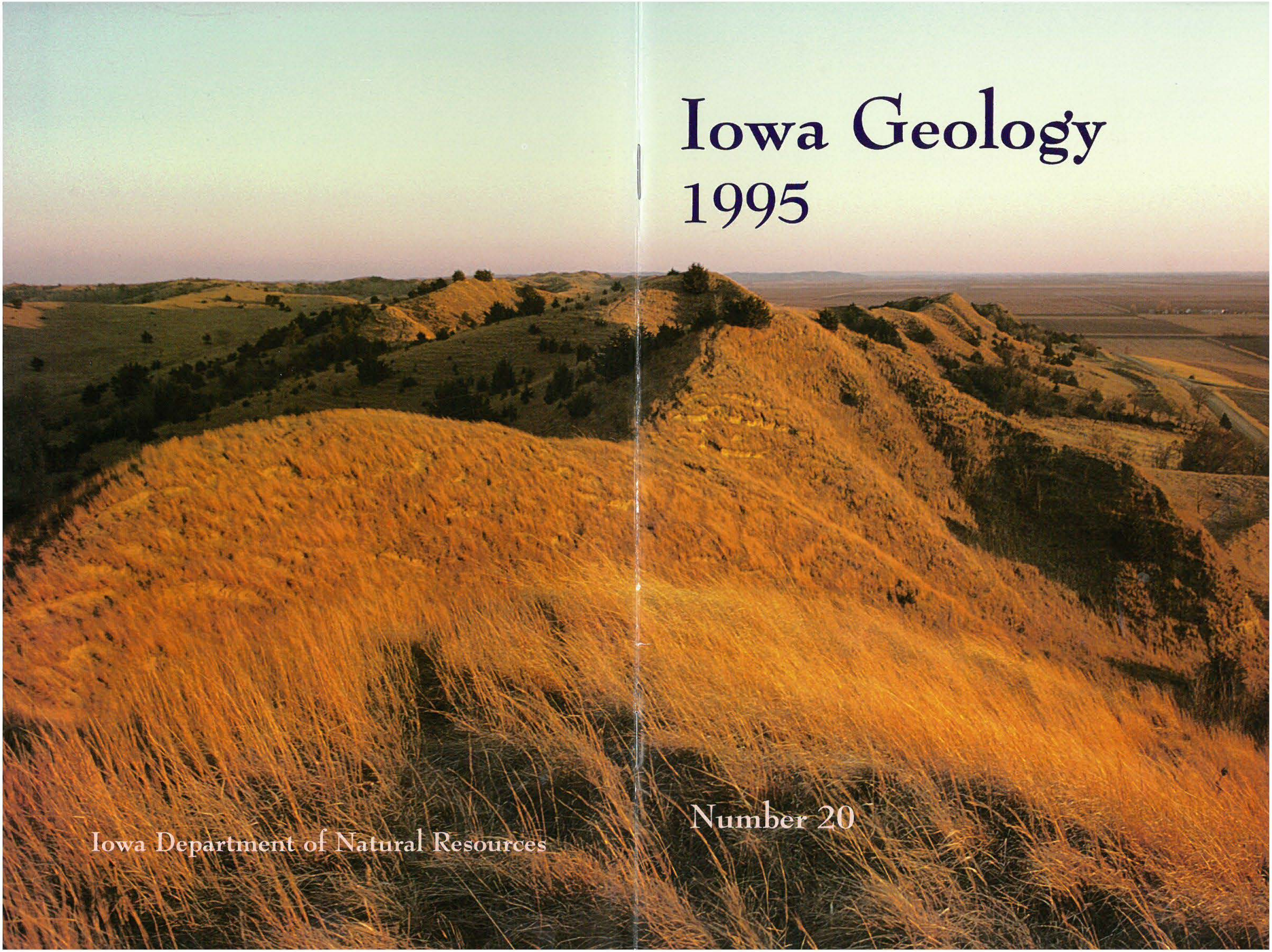
Iowa Geology 1995



Number 20

Iowa Department of Natural Resources

Iowa Geology 1995

Iowa Department of Natural Resources
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State Geologist and Bureau Chief

COVER:
Some of Iowa's most fascinating scenery is found in the Loess Hills. The alternating peaks and saddles along diverging ridge crests were sculpted from thick deposits of loess, carried by wind from the adjoining broad valley of the Missouri River. The loess originated as silt, left in the valley following glacial meltwater floods between 12,000 and 50,000 years ago.

Cover photo by Don Poggensee

Jean Cutler Prior *Editor*
Patricia J. Lohmann *Publication Designer*

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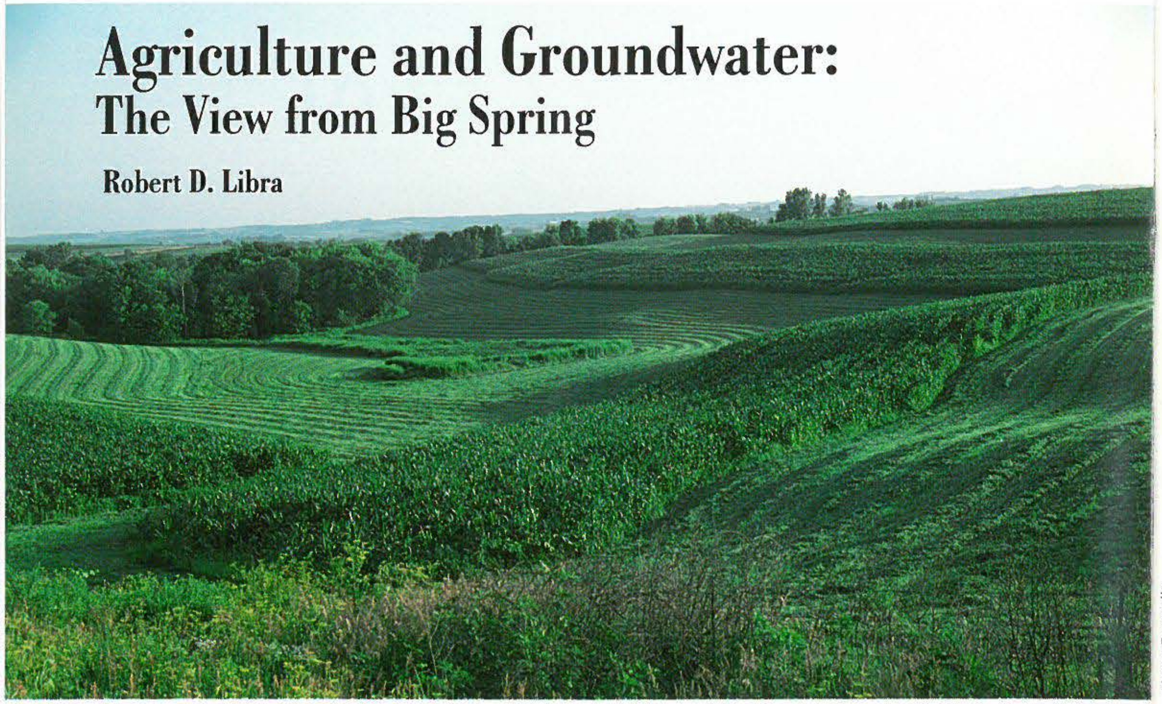


Aimee Donnelly

Left: The Big Spring watershed in Clayton County is dominated by agriculture.

Right: Sinkholes funnel surface runoff directly into the underground aquifer.

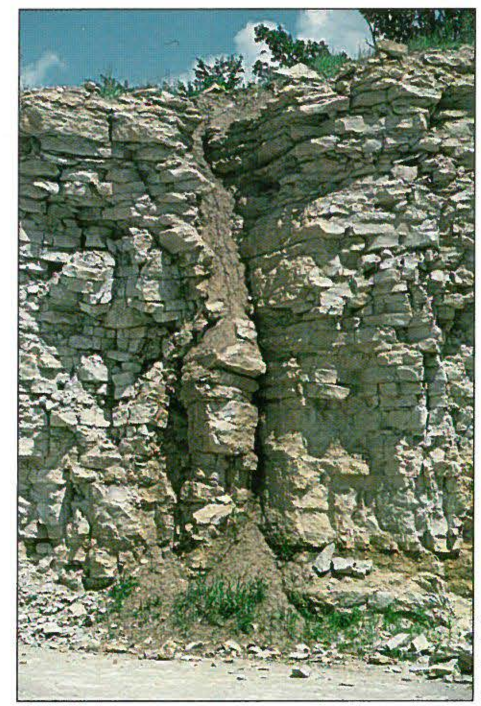
Bob Rowden

"My uncle Earl's dream was to find a spring large enough to rear more trout. ... In late fall of 1937, my husband Otto went to look at Big Spring. He was awed by its size and called Earl; he too was amazed. ... The spring is located at the base of a big bluff, about 550 feet from the Turkey River. It bubbles up through the ground on top of a shelf of layered rock four to five feet higher than the river level. In 1940 ... Big Spring deposited 33,000 tons of silt in the big fishing pond. We thought that by closing sinkholes, sediment to the spring could be controlled. We saw dead animals, trash and old DDT containers in those sinkholes that really scared us."

Mary Bankes,
The History of Big Spring

Big Spring is Iowa's largest, and it has been used as a water source for trout-rearing ever since Mary and Otto Bankes put it to work in 1940. Iowa's DNR has owned the spring since 1961. Typically, 15,000 gallons of groundwater flow from the spring each minute, fed by fractured rocks of the Galena aquifer. These rocks have been slowly dissolved by circulating groundwaters, forming features such as caverns and sinkholes. Across most of the 100-square-mile groundwater basin drained by the spring, the Galena aquifer lies near the land surface and readily receives downward-percolating water from large rainstorms or snow melt. Sinkholes are present in about one tenth of the basin, and when intense rains generate surface runoff, they capture and direct it into the aquifer. Shallow aquifers are vulnerable to contamination from activities on the land surface. In the Big Spring basin, and across Iowa, the major surface activity is agriculture, and the major contaminants are nitrate (from nitrogen fertilizer) and herbicides used on corn and soybeans.

The Geological Survey Bureau began investigating the relationships between agriculture and groundwater quality in the late 1970s. Anecdotal evidence, often from dairy farmers and water-well drillers, suggested that widespread increases in nitrate concentrations were occurring in the extensive, vulnerable bedrock aquifers of northeast Iowa. The Big Spring basin, which is almost entirely agricultural, allowed for a direct study of agriculture's environmental effects. Equally important, the presence of Big Spring and its definable groundwater basin provided a unique opportunity to measure the volume of groundwater



Lynette Seigley

Fractured dolomite of the Galena aquifer underlies most of the Big Spring basin landscape.

Art Bettis

Measurements are made of a newly formed sinkhole, caused by collapse of soil and shallow rock into a subterranean cavern.

leaving a known area. When discharge volumes are combined with contaminant concentrations, the total amount of a given contaminant carried by the water can be calculated. Since 1981, water quality and discharge and agricultural practices have been tracked in this natural laboratory.

Initial investigations in the basin, along with existing data, yielded valuable information on the agriculture - water quality connection. During the 1960s and 1970s the use of chemical nitrogen fertilizer in the basin increased almost three-fold, and nitrate concentrations at Big Spring had increased by a similar amount. By the early 1980s concentrations commonly approached the limit set by the U.S. EPA for drinking water (45 mg/L). Higher concentrations occurred during wetter recharge periods, a pattern also seen in basin wells, streams, and tile drainage. When the amount of nitrate emerging from the basin in surface and groundwater was totaled for typical years, it was equivalent to one-third of the chemical nitrogen fertilizer which basin farmers had applied. Additional losses of nitrate, such as uptake by aquatic plants, also occur and suggested the actual loss from fields was equivalent to half of the chemical fertilizer applied. Herbicides were also detected in the groundwater, with atrazine present in low but detectable concentrations year-round.

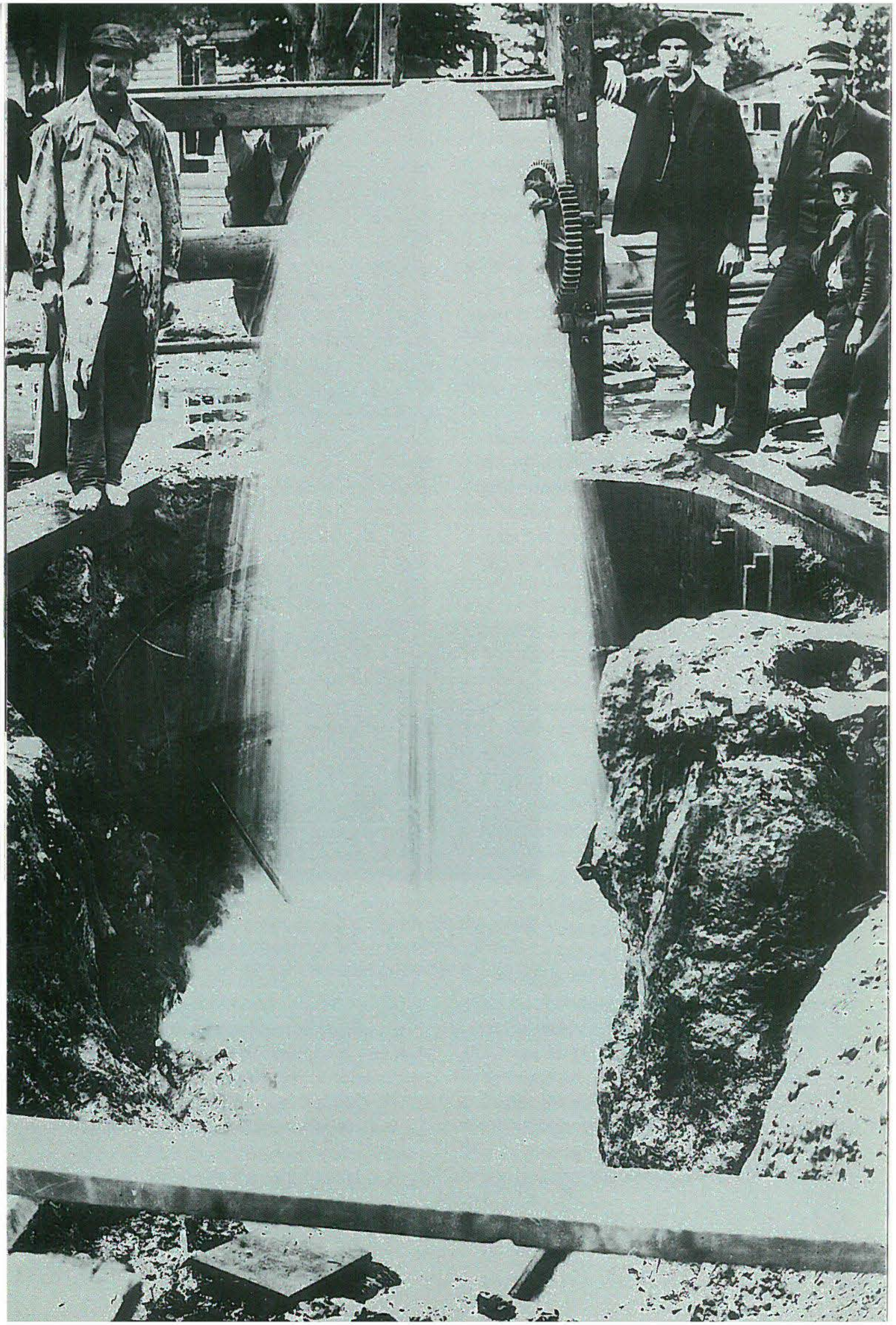
The initial findings at Big Spring resulted in the creation of the Big Spring Basin Demonstration Project, a cooperative effort involving basin farmers and numerous state, federal, and local agencies. The project, which began in earnest in 1987, increased the scope of water-quality and land-use monitoring, and greatly expanded education and demonstration programs aimed at improving the economic and environmental performance of agricultural practices. Improved nitrogen management was an important part of these efforts, as the magnitude of nitrate losses from fields in the basin indicated that reductions in application rates were possible. Indeed, significant reductions have slowly occurred as farmers became more confident that lower rates of fertilization would work for them. Nitrogen fertilizer input declined by a third from 1981 to 1993, from 174 to 115 pounds/acre, with no affect on yields. This represents a two million pound reduction in nitrogen use, saving basin farmers about $360,000 annually.

While nitrogen inputs have decreased significantly, relating these declines to changes in Big Spring groundwater remains a problem. The effects of nitrogen reductions, occurring gradually over a decade, are at present largely lost in the year-to-year climatic variables – particularly rainfall. On an annual basis, nitrate concentrations rise and fall with the volume of water discharging from Big Spring, which is a reflection of the volume of precipitation recharging the aquifer. Nitrate concentrations showed a general decline from 1982 to 1989, but so did the discharge from Big Spring, which reached its lowest point during 1989, the second year of extreme drought. While some of the decline may reflect the decrease in nitrogen applications, the effect cannot be separated from the decrease in recharge and nitrate delivery to the aquifer. Wetter-than-average conditions occurred after the drought, culminating in the "great flood of 1993." Nitrate concentrations increased dramatically during this period. This response resulted from both the increased water volume passing through the soil and groundwater system – four times more in 1993 than in 1989 – as well as from leaching of unused nitrogen left over from the drought. Any improvement in water quality resulting from decreased nitrogen applications was again lost in the effects caused by the extreme climatic variations.

The studies at Big Spring have provided the nation's longest running and most detailed record of the relationships between agriculture and water quality. Perhaps the most important thing we have learned is that water quality responds slowly to changes in agricultural chemical inputs, particularly when those changes occur slowly themselves. We need to take the long view when trying to document water quality improvements, and Iowa's Big Spring helps provide the focus. ❖

George Hallberg

Water samples from Big Spring, following a heavy rainfall across the basin, show the increase in suspended sediment carried by the emerging groundwater.



JUMBO

A RUNAWAY ARTESIAN WELL

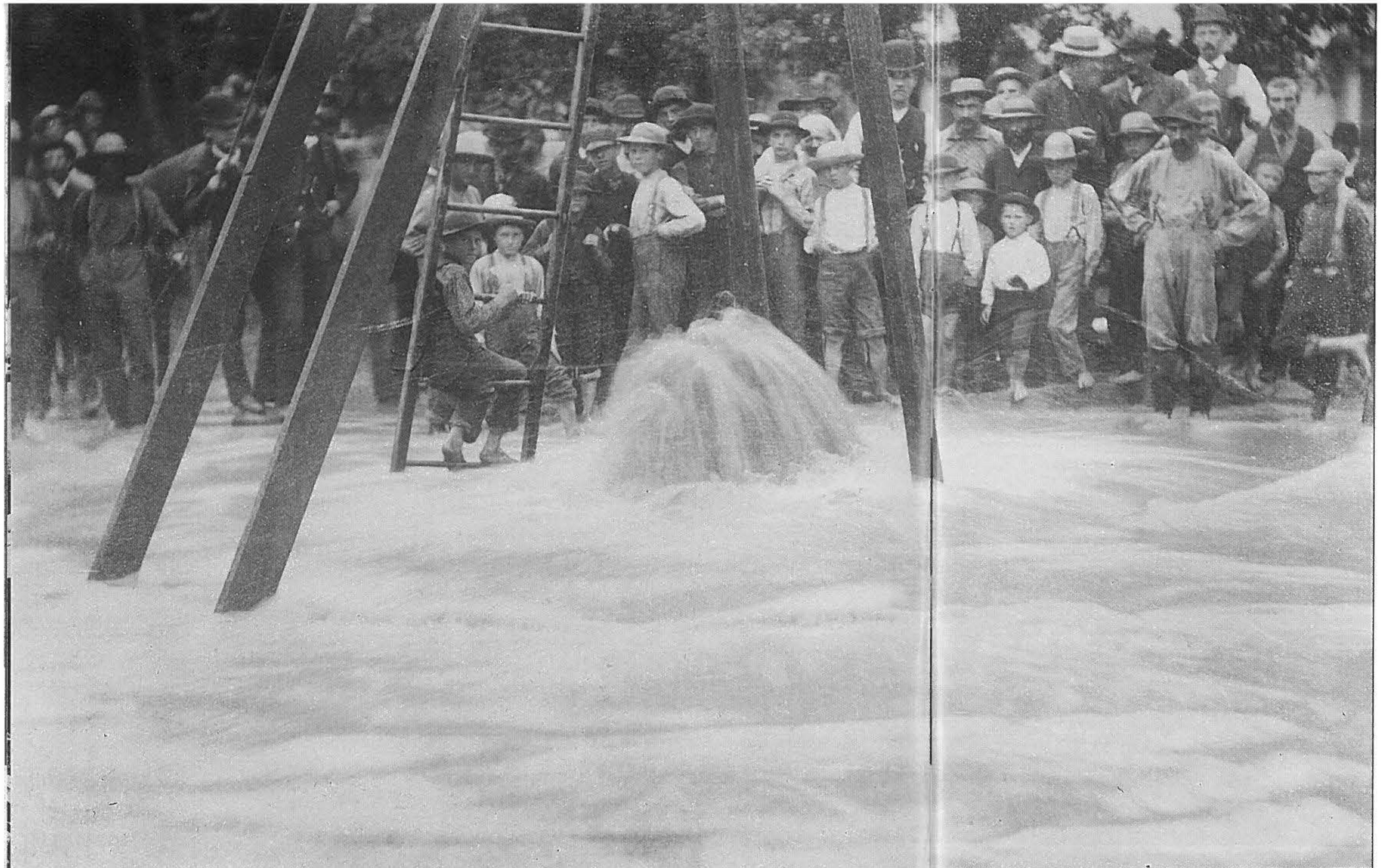
Robert D. Libra

Since the settlement of Iowa began in earnest over 150 years ago, tens of thousands of water wells have been drilled, bored, or dug. Drilling and construction of wells is at times a difficult and frustrating endeavor, as unseen conditions lying hundreds of feet below the land surface must be anticipated and dealt with. While the drilling of some water wells might be described as a "routine" operation, the drilling of others is decidedly not.

In the 1880s, a number of wells drilled north of Belle Plaine in Benton County encountered a sand and gravel aquifer at a depth of about 300 feet. The aquifer has since been shown to fill extensive parts of an ancient river valley, and to be overlain by relatively impervious glacial tills. These tills act hydrologically to seal the aquifer and create strong artesian pressures. The water levels in the wells north of Belle Plaine, which were located in the uplands above the Iowa River valley, rose to within 25 to 50 feet of the surface, depending on the surface elevation. These wells yielded large volumes of water that although somewhat salty, were acceptable to livestock.

In 1886, a well for a creamery was drilled at Belle Plaine in the Iowa River valley; this well also tapped the sand and gravel aquifer. The elevation of this well was about 100 feet lower than the previously drilled livestock wells, resulting in a strong flow of water from the well. At the well head, the artesian pressure level of the aquifer was sufficient to lift the water 67 feet above the surface. Several other wells were drilled into the aquifer at Belle Plaine, and while the strong flows complicated construction of the wells, they were completed without incident.

In August 1886, the city of Belle Plaine contracted to have a well drilled for fire protection. This well soon became widely known by the name "Jumbo." In the words of geologist W.H. Norton (1896): "The notoriety of Jumbo was strictly that of a member of the criminal class, and began with his resistance to control, and lasted only until his final imprisonment. The beginning of the trouble lay in the fact that the driller attempted to use the force of the flow in reaming out the two-inch bore, which he had put down for want of a larger drill, to three inches, the dimension specified in the contract. This task the water speedily accomplished in the unindurated clays and sands, but not stopping there went on and soon enlarged the bore to over three feet in diameter." H.R. Mosnat (1898) notes, "When the driller saw the result of his inexcusable carelessness, which result he ought to have foreseen, he hastily decamped and was not heard of until the popular excitement had subsided."



Photos of "Jumbo" courtesy The University of Iowa Calvin Collection.

The flow from Jumbo roiled out of the three-foot bore in a fountain that stood five feet high. Estimates of the initial, maximum flows varied from 30,000 to 50,000 gallons per minute. The flow diminished rapidly, and two weeks later was calculated to be about 2,000 gallons per minute, by Professor T.C. Chamberlain from the University of Chicago. Along with the water came sand – an estimated 500 to 1,000 carloads of sand. "The quantity was certainly so great that only with the greatest effort could the ditches be kept open to carry off the water" (Mosnat, 1898). Chunks of fossil wood and stones weighing over two pounds were also hurled from the well.

Norton (1896) describes the effort to stem the flow, which ultimately took over 13 months: "During this time the well, 193 feet deep, devoured, as the local historian recounts, 163 feet of 18-inch pipe, 77 feet of 16-inch pipe, 60 feet of 5-inch pipe, an iron cone 3 feet in diameter and 24 feet long, 40 carloads of stone, 130 barrels of cement, and an inestimable amount of sand and clay."

While Jumbo was obviously an unusual occurrence, Mosnat (1898) notes, "The accounts of the well given in newspapers were in many instances most sensational, their extravagance increasing according to the square of the distance from Belle Plaine. European papers published accounts of the water spouting hundreds of feet into the air, with a roar that could be heard for miles and even pictured people being rescued by boats from the third and fourth stories of houses!" Other reports connected Jumbo's unleashing with the great Charleston earthquake, which occurred four days later, and to renewed geyser activity in Yellowstone Park. This prompted Professor Chamberlain to comment "The only similitude of seismic disturbance, as the cause of this well, was in the moral faculties of said reporter."

Many other wells were drilled into the buried sand and gravel within the Iowa River valley between Belle Plaine and Marengo, and were often allowed to flow relatively unchecked. The great artesian pressures have therefore been decreased over parts – but not all – of the area. As the Belle Plaine weekly newspaper noted in 1986, "Beneath this city lurks a monster discovered 100 years ago." The Geological Survey's research driller, Darwin Evans, found the aquifer was still a force to be reckoned with when he drilled a test hole into it in 1984. While his efforts to control and plug the hole took a few hours, as opposed to 13 months, the situation prompted him to comment: "We were about five minutes away from making "Good Morning America." Meanwhile, in Belle Plaine, a bronze plaque attached to a granite boulder still marks the spot where the runaway artesian Jumbo entered the history books. ❖

The Cambrian - Ordovician Aquifer and the Northeast Iowa Landscape

Robert M. McKay

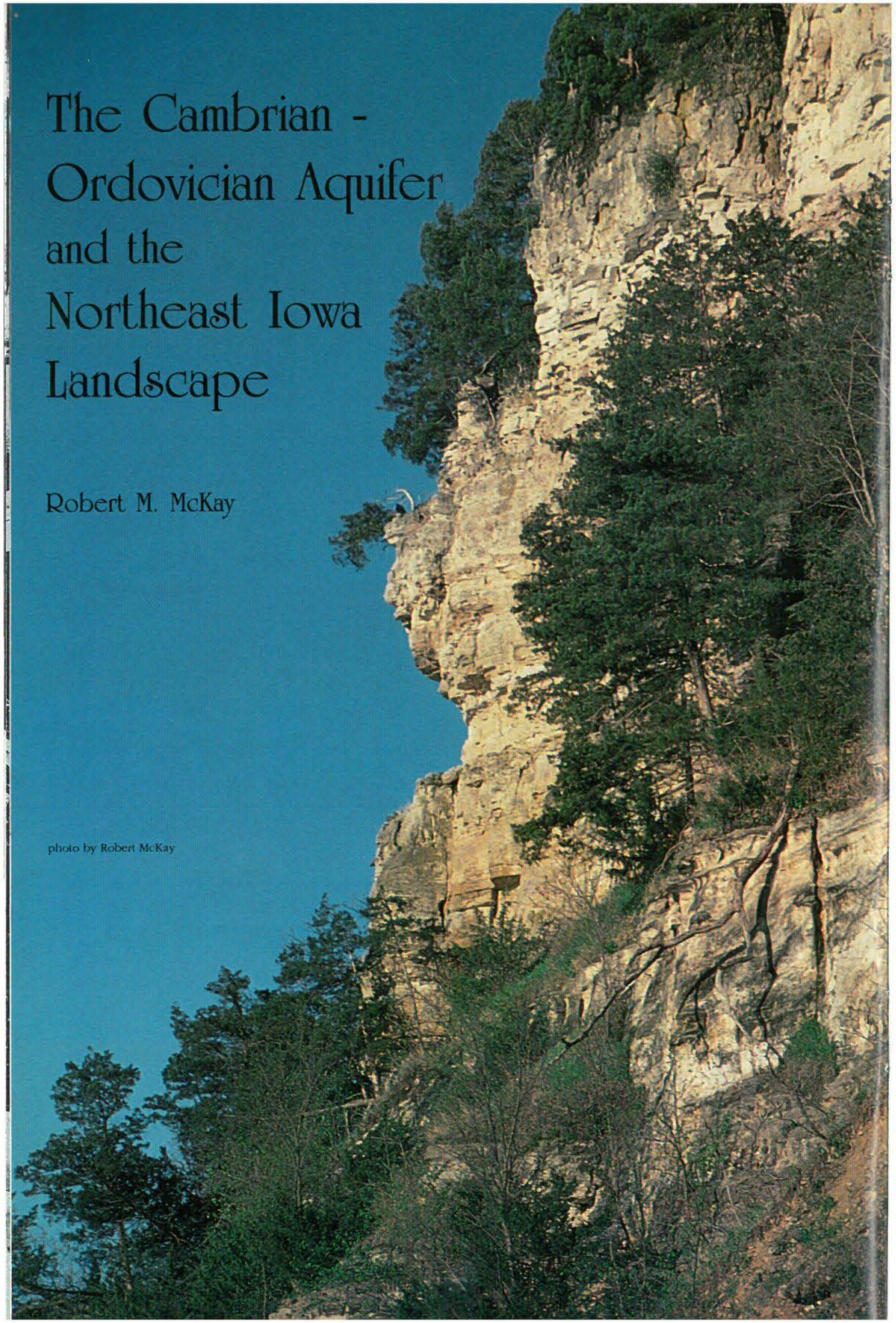


photo by Robert McKay

Along the eastern margins of Allamakee and Clayton counties, towering rock bluffs form a picturesque backdrop for the Mississippi River. The river's flow of water and commerce toward the Gulf of Mexico is obvious, yet life-sustaining water also moves through the rocky cliffs above. The cliffs, which form some of the most spectacular scenery along the upper Mississippi Valley, are outcroppings of one of Iowa's most widely used sources of groundwater – the Cambrian-Ordovician aquifer.

Near Waukon Junction in Allamakee County (photo left), rugged cliffs expose almost the entire sequence of strata that comprises this aquifer. The rocks at road level consist of the porous, loosely cemented Jordan Sandstone. Higher in the bluff, the better cemented, more resistant dolostones of the overlying Oneota and Shakopee formations stand out as cliff-formers. These same rock units outcrop from McGregor northward into Minnesota, and they dominate the landscape of many well-known points of interest, such as Yellow River State Forest, Effigy Mounds National Monument, and Mt. Hosmer City Park at Lansing.

The aquifer's name is derived from the geologic age of its constituent rocks – Cambrian and Ordovician (480 to 510 million years old). This widespread source of groundwater, also referred to as the "Jordan aquifer," is one of the most dependable sources for large capacity wells in Iowa. The name "Jordan" comes from the sandstone in its lower portion, but the aquifer actually includes the dolostone and sandstone units in the overlying Oneota, Shakopee, and St. Peter formations. Across the eastern two-thirds of Iowa, the "Jordan aquifer" provides water for food processing, manufacturing, irrigation, and cooling, in addition to drinking water for both municipal and non-municipal users. Properly developed wells generally yield several hundred to over 1000 gallons per minute (gpm) and occasionally may produce in excess of 2000 gpm.

From its outcrop belt in the northeast corner of Iowa, the Cambrian-Ordovician aquifer dips southwestward beneath the landscape at about 18 feet per mile. This gradual tilt buries the aquifer to depths greater than 2500 feet in south-central Iowa, where the town of Murray, in Clarke County, is the last community along the aquifer's slope to withdraw water for drinking use. Along the slope of the aquifer, or downdip, the dissolved mineral content of the water gradually increases to undesirable levels. In the western third of Iowa, elevated concentrations of sulfate, sodium, magnesium, chloride, and bicarbonate prevent the aquifer's use as a water supply. Downdip, water yields are also reduced significantly because of an increase in the mineral cement holding the rock grains together.

Additional uses for the rocks of the Cambrian-Ordovician aquifer include high-quality concrete aggregate in northeast Iowa, reservoir rock for the storage of natural gas in Dallas, Louisa, and Washington counties, and the potential for purified freshwater storage for the City of Des Moines. ❖

IOWA'S SESQUICENTENNIAL

George Hallberg

In 1996 Iowa will celebrate 150 years of statehood. Sesquicentennials are historical milestones, and comparisons between then and now are inevitable. Geological perspectives on 150 years of human history may seem like a mismatch of time scales. People tend to think of the landscape as a permanent, unchanging feature of our lives, with modifications during such a geologically brief span of time as being almost insignificant – but that is not true. Geologists recognize that Iowa's floodplains, hillslopes, gullies, and karst regions are dynamic, naturally changing portions of today's landscape. People, however, are also part of the landscape, and their mechanized earth-moving ability also makes them a major force altering the land surface.

In just 150 years, people have imprinted a variety of cultural patterns across the state's terrain. Glacial boulders stranded in Iowa thousands of years ago have been moved by generations of farmers from fields to fence rows (photo above). Plows and planters annually turn over the upper few inches of most of rural Iowa, loosening the soil in furrows to the forces of wind and rain. A grid of

Drake Hokanson

roads intersecting on one-mile squares helps us navigate the countryside. Hay is mowed and bailed, seasonally scoring Iowa's hillslopes with intricate webbed patterns (photo above). Dams and levees regulate the flow of water through the state's lowlands, while artificial ponds and reservoirs hold water in place among the rolling hills. Terraces are bulldozed into place across the steeper hillsides to slow the loss of soil and moisture from the land. Meandering river channels have been straightened and confined between narrow embankments, forcing rivers to erode deeper courses, in turn lowering local water tables and draining adjacent wetlands. Miles of clay tiles and plastic tubing have been laid beneath acres of landscape to redirect infiltrating rainwater and hasten drying of the land surface. Deposits of non-renewable minerals, stone, sand and gravel that were geologically stored for thousands or millions of years have been mined and quarried from the earth. Urban lands are excavated and rearranged to suit builders and conform to legal regulations. The leftovers of our daily lives are buried in landfills. And the quality of one of our most basic needs – the drinking water supplied by underground geologic strata – can be compromised by this human activity, sometimes in unexpected ways and over long periods of time.

In few other states having rural, dispersed populations does the impact of 150 years of human activity dominate the landscape as completely as it does here in Iowa. ❖

Landscape Features of Iowa

Jean Cutler Prior

The topographic features seen on the following pages illustrate the range of picturesque diversity that is present across our state. In addition to their beauty, each of these landscape views reflects some aspect of Iowa's geologic history. Understanding the geologic setting of various types of terrain is essential for citizens concerned with farming, urban expansion, recreation, excavation of mineral resources, pumping of groundwater supplies, landfilling of waste materials, and other environmental and natural resource issues. Also, it is useful to think about these landscapes in terms of their influence on the distribution of native plant and animal habitats, on various soil types, on the potential for archaeological remains, and on patterns of historic settlement. Learning more about the features of Iowa's landscape increases our understanding and appreciation of the views around us and the ground beneath our feet.

Jean Prior

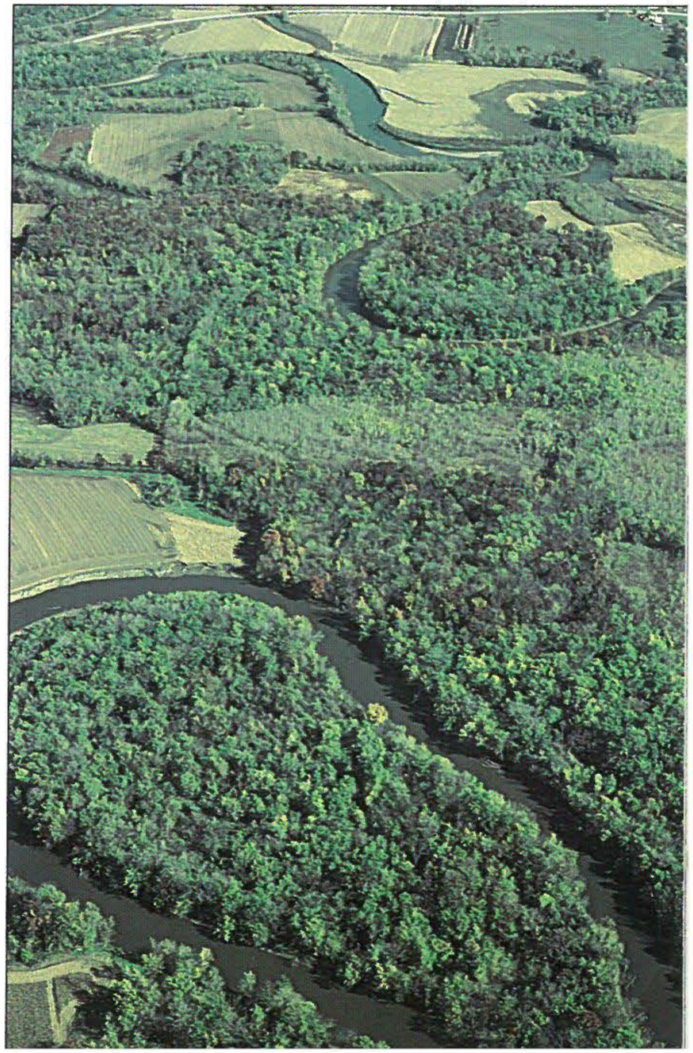
Shifting ***sand dunes*** *occupy part of an abandoned channel of the Upper Iowa River in Allamakee County. The sand accumulated when water flowed through this meander much earlier in the valley's history. Wind also deposited sand here during later dry periods.*

Gary Hightshoe, Iowa State University

Left: The ***island-braided channel*** *of the Mississippi River occupies the floor of a gorge eroded through steep rock-lined bluffs in Clayton County. The deeply entrenched river valley was shaped by glacial meltwater floods between 18,000 and 9,500 years ago.*

Right: The Iowa River forms sweeping ***meander loops*** *as it flows across its floodplain in Tama County. Scars of earlier migration channels of the river are visible in the fields and woodlands. Floodplains are underlain by porous alluvial deposits that yield valuable groundwater supplies. These shallow resources are vulnerable to contamination from the land surface.*

Gary Hightshoe, Iowa State University



Tim Kemmis

Hump-backed ridges rise from the gently rolling landscape in southeastern Linn County. These ridges, known as ***paha****, are always oriented NW to SE. They are all that remain of a once higher glacial plain and are often capped with wind-blown loess and sand.*

Pat Lohmann

A ***glacial moraine*** *in Dickinson County appears as a series of irregular broken ridges crossing the landscape. These are the hummocky accumulations of pebbly debris that settled out of stagnant, slowly melting glacial ice about 13,000 years ago.*

Crooked ridges with steep sideslopes characterize the ***Loess Hills*** *of western Iowa. They are composed of thick deposits of silt carried by the wind from the adjoining Missouri River valley during seasons when glacial meltwater flood sediments were exposed. There is a sharp contrast between prairie and encroaching woodlands in this topographic setting.*

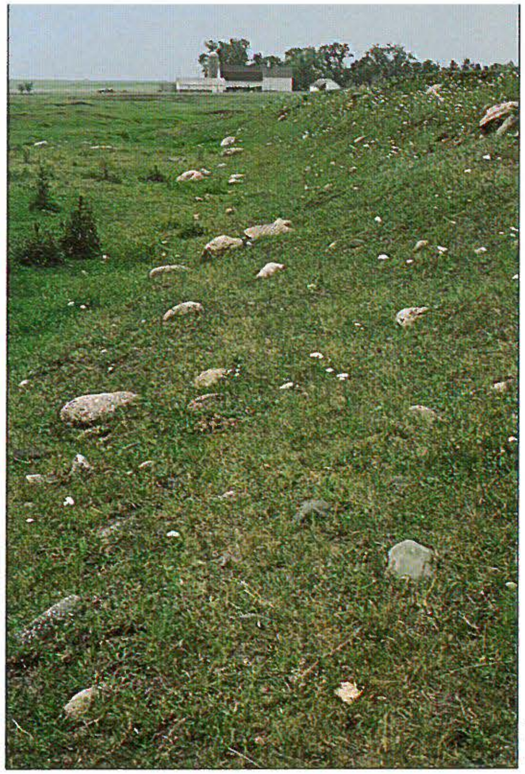
Doug Harr

Above: Ocheyedan Mound is an isolated, conical hill composed of sand and gravel. It is an excellent example of a ***glacial kame****, formed as meltwater carried sediments off the glacier surface and deposited them into a cavity in the slowly melting ice.*

Stan Mitchem

Right: ***Gullies*** *are deep, narrow erosional cuts through the landscape. Their development and growth is an active geologic process within the silt-dominated Loess Hills topography of western Iowa. Gullies widen and lengthen headward (upslope), eroding quickly, especially after heavy rains.*

Gary Hightshoe, Iowa State University



Pat Lohmann

Glacial erratics *are boulders of igneous and metamorphic rock, native to geographic regions well north of Iowa. The erratics in this Black Hawk County pasture were carried into Iowa by glacial advances over 500,000 years ago. They were concentrated at the land surface by later erosion, which removed the fine-grained deposits once surrounding them.*

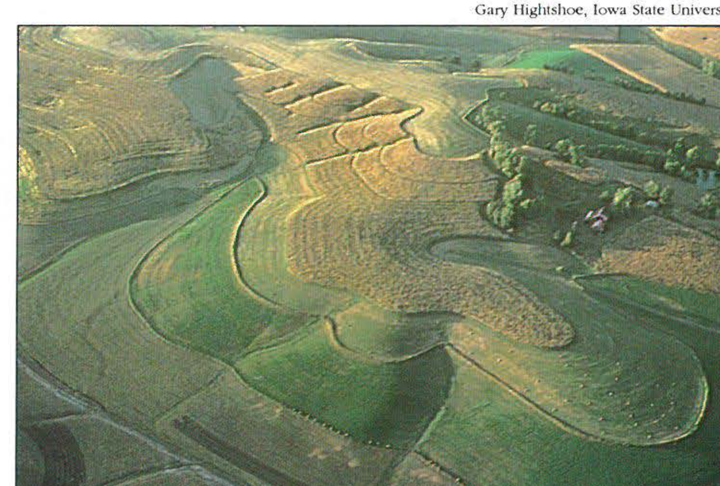
Gary Hightshoe, Iowa State University

Circular depressions, some filled with water or clumps of trees, mark the location of sinkholes in this Clayton County aerial view. ***Sinkholes*** *form by collapse of thin soil and unstable rock into underground crevice or cave openings. Shallow aquifers are vulnerable to contamination problems in this geologic setting. Though most common in northeastern Iowa, sinkholes are also seen in Floyd and Mitchell counties and in the Burlington area of southeastern Iowa.*

Gary Hightshoe, Iowa State University

These shallow wetlands are a series of ***glacial kettles*** *on Doolittle Prairie State Preserve in Story County. A subtle drainage system connects them, as noted by the soil moisture and vegetation patterns. These linked "prairie potholes" mark a route taken by glacial meltwater through a maze of slowly disintegrating glacial ice about 13,000 years ago.*

Gary Hightshoe, Iowa State University



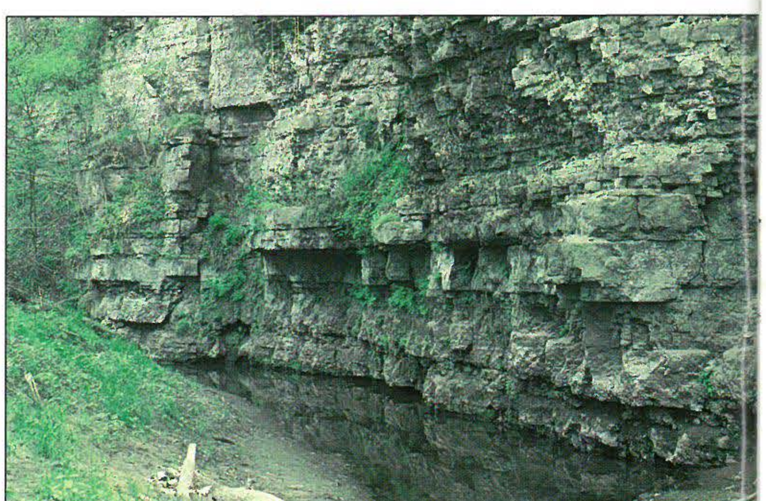
Dendritic drainage *patterns crease these cropped fields with branching routes along which precipitation runoff is channeled into rills, creeks, and rivers. This effective drainage network has reshaped the glacial plains left after southern Iowa's last contact with glaciers, over 500,000 years ago.*

Gary Hightshoe, Iowa State University

Long continuous rock bluffs, called ***palisades****, line the Upper Iowa River valley. These picturesque cliffs result from the river eroding against dolomite, a resistant rock unit formed 450 million years ago. Such scenic landscapes in northeastern Iowa reflect the presence of sedimentary bedrock formations close to the land surface.*

Greg Ludvigson

This inside view of a ***cave*** *entrance at Maquoketa Caves State Park illustrates an example of* ***karst topography****. Such features also include springs and sinkholes, landforms which result from groundwater movement slowly dissolving shallow limestone or dolomite bedrock.*

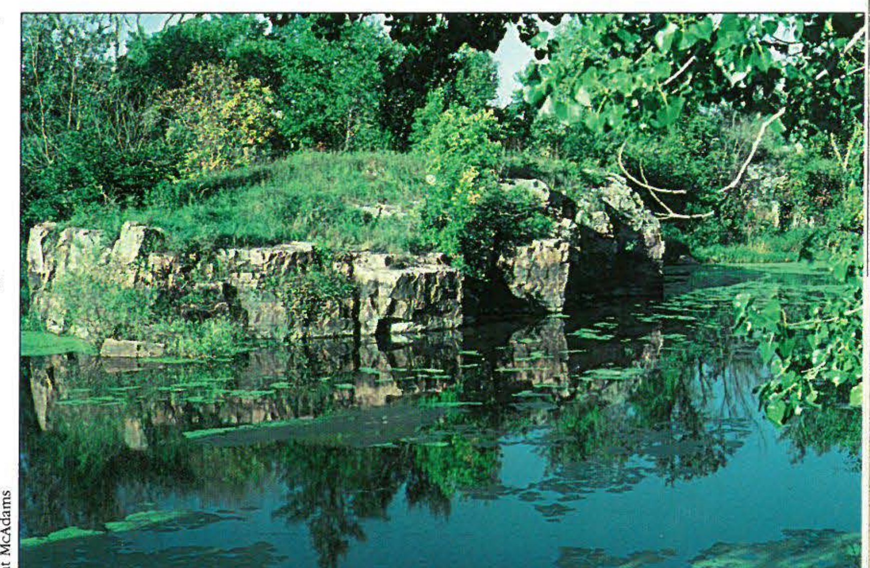


Jean Prior

An outcrop of ***sedimentary rock*** *displays horizontal layering, which reflects the rock's origins in a marine environment. Vertical fractures, caused by later earth stresses on the brittle dolomite, contribute a blocky appearance to the outcrop. These various planes of weakness are flowpaths for groundwater movement.*

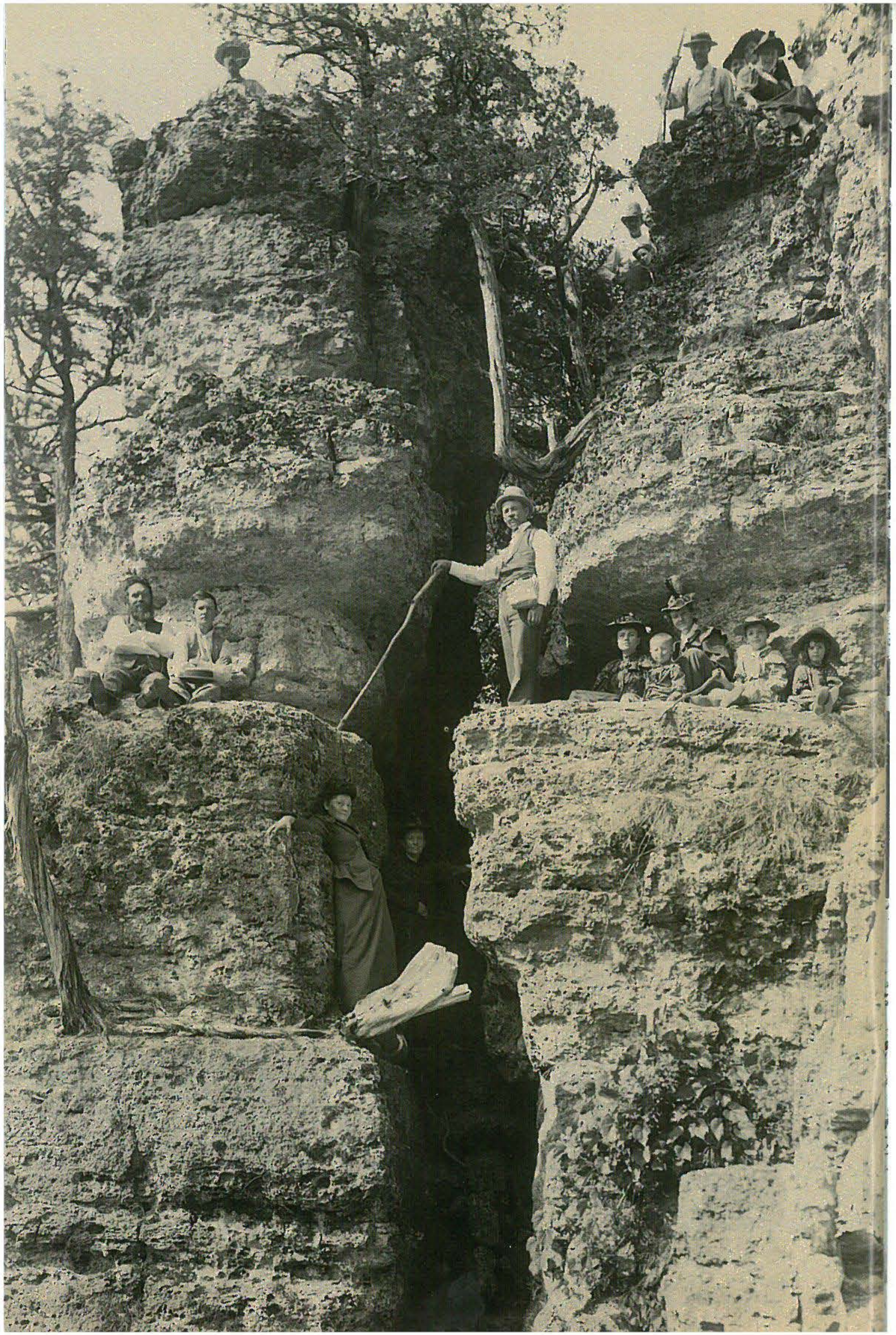
Art Bettis

The discharge of water from Cold Water Spring crosses a series of rock riffles as it flows away from a bluff of dolomite bedrock. ***Springs*** *develop where groundwater flow is intercepted by the land surface, usually along the steep sides of valleys.*



Pat McAdams

The oldest bedrock formation visible anywhere in Iowa outcrops at Gitchie Manitou State Preserve in Lyon County. The distinctive reddish cast of the ***Sioux Quartzite*** *is seen here along the edges of "Jasper Pool," an 1800's-era quarry on the preserve. These durable, quartz-rich rocks are 2.6 billion years old. Glacial erratics of this formation are easily recognizable and may be found for many miles to the southeast.*



The University of Iowa Calvin Collection

GEOLOGY OF BACKBONE STATE PARK

BRIAN J. WITZKE

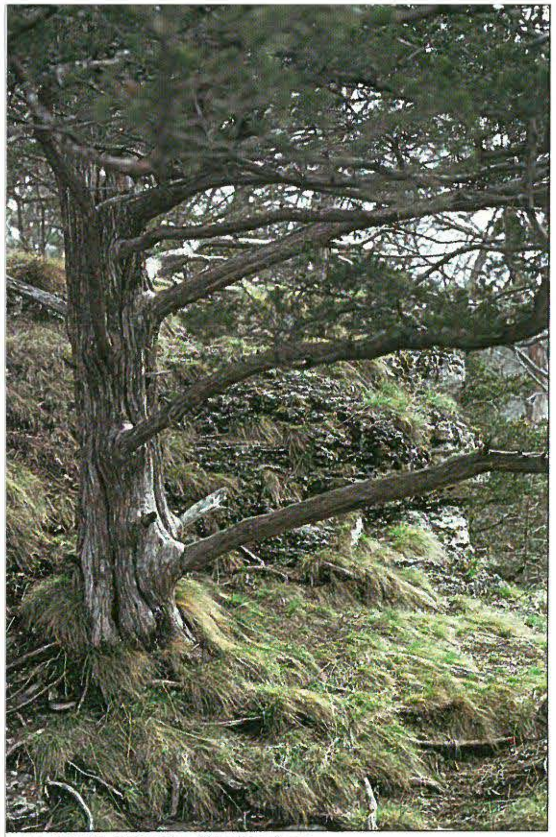
A narrow and precipitous ridge of rock, once termed the "Devil's Backbone," towers prominently above an entrenched meander loop of the Maquoketa River north of Dundee in Delaware County. This ridge provided both the inspiration and namesake for Iowa's first state park, which now encompasses a region of river bottoms, wooded slopes, and dramatic rocky cliffs. Backbone State Park was dedicated in 1920 to preserve the natural beauty of this special area for the enjoyment of future generations. As we move beyond the 75th anniversary of Iowa's state park system, we are mindful of the important role our public parks play in providing recreation, education, and inspiration for both young and old alike. We owe a debt of gratitude to the foresight and wisdom shown by the Iowa leaders who established our state parks as lasting treasures for all the people.

Ledges and crevices in weathered Silurian-age dolomite form the backdrop for this family outing in the late 1890's at Backbone State Park.

The preservation of unique or dramatic geologic features has been a significant goal in the establishment of many of Iowa's state parks, and an understanding of the geology of these park lands can enhance our appreciation of Iowa's natural heritage. It is to this end that the Geological Survey Bureau is undertaking a program to summarize the geologic features of our state parks, beginning appropriately at Backbone.

The rocks so wonderfully displayed in Backbone State Park were originally deposited as lime sediments in a shallow tropical sea that covered the Iowa area about 430 million years ago, a time geologists term the Silurian Period. These sediments were chemically altered to form rock composed of dolomite, a magnesium and calcium carbonate mineral, with scattered nodules of chert. The Silurian rocks at Backbone belong to the Hopkinton Formation, an interval of dolomite strata that forms a productive part of the Silurian aquifer across much of eastern Iowa. Solutional openings, fractures, caves, and active springs provide evidence of water movement through these strata at Backbone.

Fossils are preserved in the rocks at Backbone as natural molds or as silica (quartz) replacements. The lower strata display an abundance of corals and sponge-like stromatoporoids, all fossils of long-extinct forms. The upper strata are crowded with molds of clam-like brachiopod shells, many oriented as they would have appeared in life. Geologists have termed these shell-rich layers the "Pentamerus Beds," named



Daryl Smith, University of Northern Iowa

Forested rocky bluffs dominate the picturesque views seen throughout the park.

after the characteristic brachiopod fossil. The fossils seen at Backbone provide a glimpse of ancient life that once inhabited the tropical sea bottom.

The rocks now seen at Backbone lay buried beneath younger rocks and sediments for untold millions of years. It was the inexorable onslaught of erosion that ultimately exposed these rocks at the surface. The bedrock surface in Iowa evolved in response to recurring episodes of erosion, interrupted by periods of renewed deposition and burial. In particular, the waxing and waning of continental ice sheets across Iowa over the last 2 million years or so was accompanied by a complex record of erosion and sedimentation on the Iowa landscape.

Eastern Iowa was not covered by glacial ice during the last glaciation, the Wisconsinan, but significant modification of the park's landscape occurred as ice sheets spread into the north-central part of the state. A large amount of sediment was delivered to the eastern Iowa valleys during the period of maximum glacial cold about 16,000 to 21,000 years ago. Iowa was in a periglacial zone; frost action and erosion were intense, and the valleys of Backbone park filled to a level about 25 feet above the present floodplain. Remnants of this valley filling are preserved in the park as terraces of sand and gravel. Also, wind-blown sand and loess deposits associated with this glacial episode accumulated along large southeast-trending ridges forming "paha." Such a feature extends southeastward from the park's old fish hatchery.

A complex cumulative history resulted in the rocky landscape we see today in the park, amplified by the latest stages of erosion and sedimentation operating during the last 20,000 years or so. The geologic processes that continue to modify the delightful landscape of Backbone Park are slow by human standards, ensuring countless future generations the opportunity to enjoy this special area along the Maquoketa River. ❖

Ray Anderson

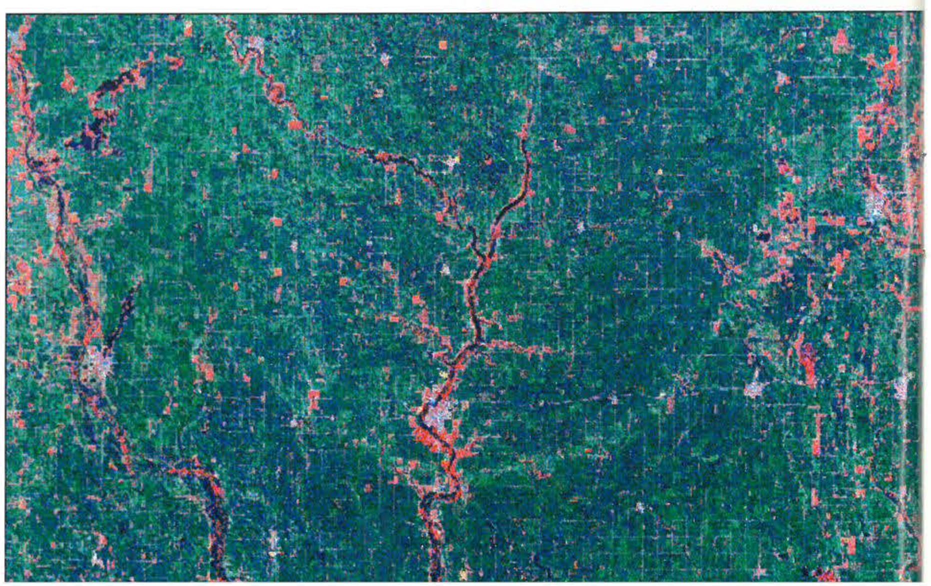
Rainwater moving slowly through shallow bedrock along vertical and horizontal fractures dissolves the dolomite, resulting in caves and springs. Such "karst terrain" features are visible at Richmond Spring, a popular stop within the park.

SATELLITE IMAGES
OF IOWA LANDSCAPES

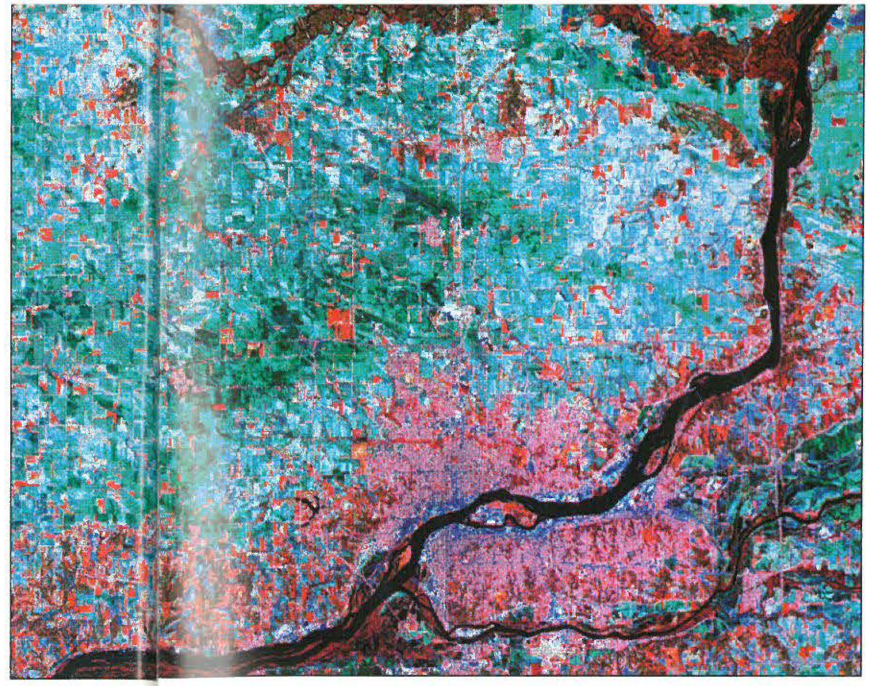
James D. Giglierano

Satellite images taken from over 400 miles in space provide a unique perspective on Iowa's landscape. Broad geologic features can be seen underlying farm fields, forests, roads and towns. Geological forces have modified these landscapes for thousands of years, while human activity is a recent, but also significant agent of change.

These views were taken by the Landsat 5 spacecraft and are shown in "false color." Blue and green represent bare soils with varying degrees of moisture. Pink and red indicate healthy pastures and forests. Open water is black, while roads and towns are white and magenta.

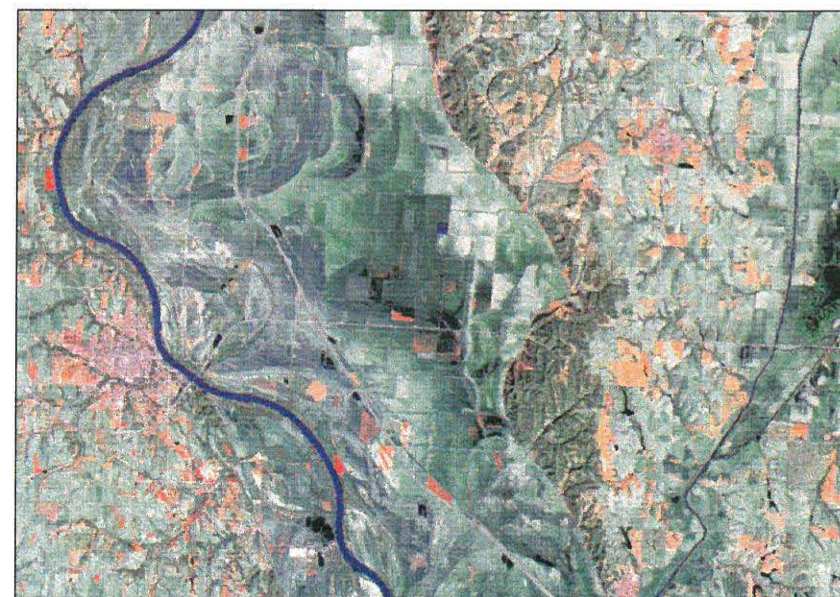


This June 1991 image reveals the broad arc of the Algona glacial moraine across Kossuth County. Remnants of countless lakes and wetlands are seen as darker areas beneath the bare soils of drained and plowed cropland.



The Mississippi River flows through a narrow valley between Davenport and Rock Island–Moline. Streaked deposits of wind-blown sand and silt cross the landscape between the Mississippi and its tributary, the Wapsipinicon River.

The wide Missouri River valley in Fremont County was excavated by glacial meltwaters. Since then, the river has meandered from side to side, leaving the scour marks evident here. Today the river is confined to a narrow portion of its floodplain by engineered levees, but the Flood of '93 again covered much of the area between the bluffs.



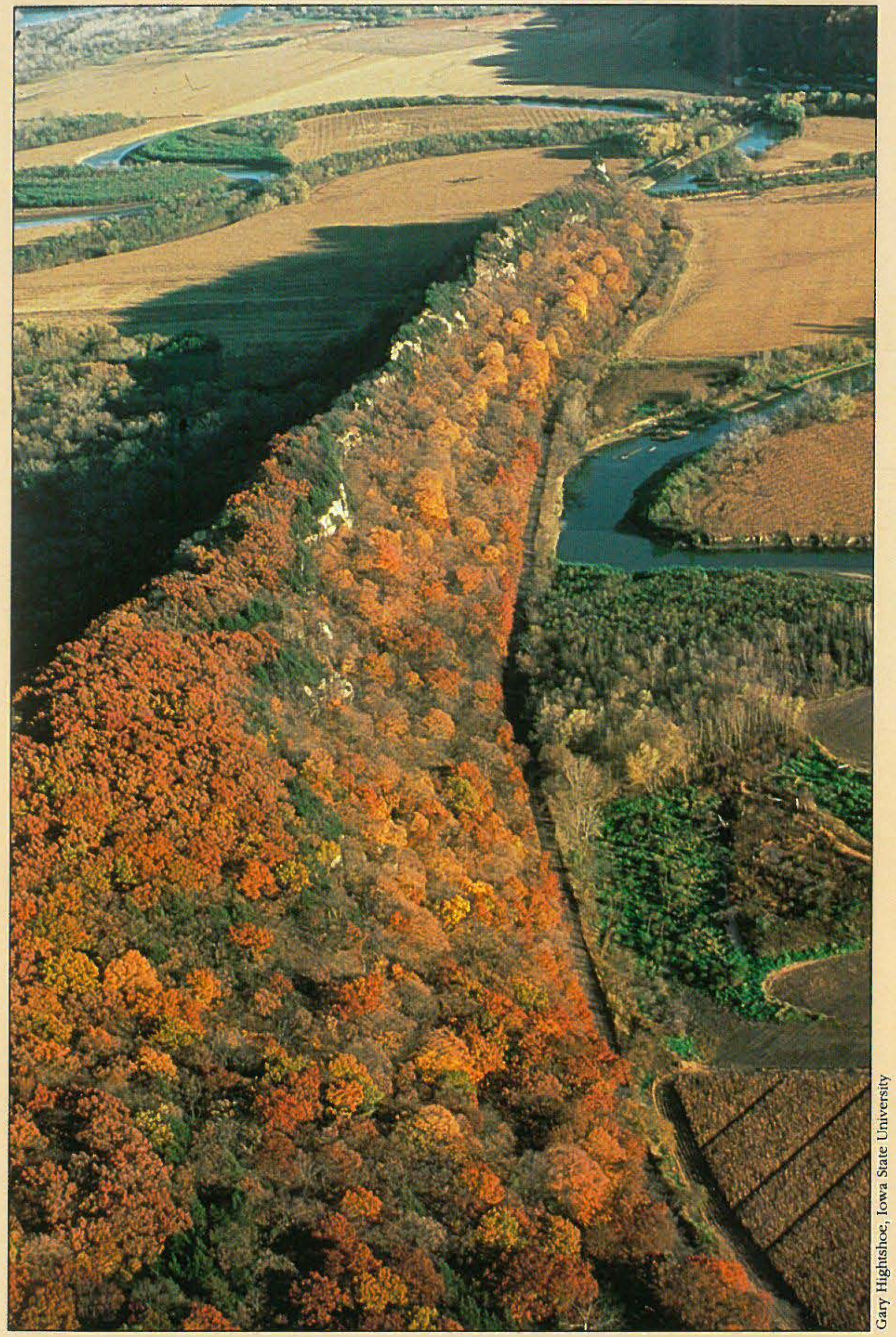
Living with the Land . . .

In anticipation of Iowa's sesquicentennial, Iowa Geology highlights the state's natural beauty as reflected in its landscapes. Landscapes are one of the most obvious aspects of the state's geology. A change in appearance of the terrain is usually the first tip-off that a change in geologic materials occurs beneath the ground. Satellite images show us the breadth and scope of differences in terrain, and that these features coexist with the effects of human activity. Differences in geologic materials need to be recognized at both local and regional scales.

Within a bold northeastern Iowa rock bluff lies the essence of an aquifer that below ground supplies thousands of Iowans with drinking water. Within the flow of a spring lies the opportunity to measure how groundwater quality responds to changing agricultural practices. And in the uncontrolled rush of groundwater from a well in Belle Plaine is a reminder that we don't always know what to expect.

Beneath the landscapes we live on today are older materials from land- and seascapes that existed here in the geologic past – sea floors, coral reefs, shore lines, coastal swamps, tropical river systems, and melting ice sheets. In a practical sense, we live with these buried landscapes as well, for we depend on their characteristics in many ways. We need to understand Iowa's past and present landscapes, their shapes, depths, and compositions in order to bring reliable information to bear on the environmental and resource issues of today and tomorrow.

Jean Cutler Prior
Editor



Gary Hightshoe, Iowa State University

Turkey River Mounds State Preserve
Clayton County