number 10

# Iowa Geology

1985

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IOWA GEOLOGICAL SURVEY

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State Geologist and Director

Cover:

This photograph of stream-deposited sediments shows the composition of materials found beneath floodplains in Iowa. This water-worn alluvium was originally supplied by melting glaciers, and now provides an important source of groundwater for wells along major valleys in the state.

Cover photo by Carol A. Thompson
Cover design by Patricia Lohmann

Jean C. Prior . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . Editor
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*Editor's Note: I would like to acknowledge the valuable secretarial assistance of Lois Bair and Mary Pat Heitman as well as the timely cooperation of the individual authors.*

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# THE DIRECTOR'S VIEWPOINT

This is the 10th issue of *Iowa Geology.* During this decade we have presented a host of topical articles on water and mineral resource investigations to keep you informed about IGS programs and projects. With this issue I hope we have continued to be responsive to your special interests.

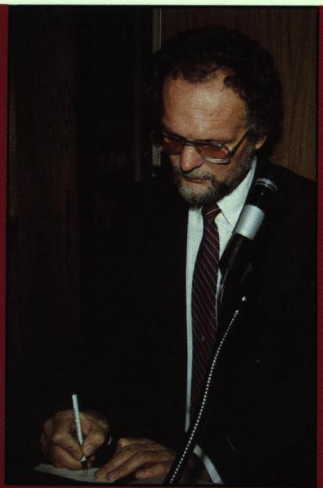
It is difficult to maintain a progressive program that addresses critical information needs about our natural resources during an extended period of economic stress and reduced budgets. Many questions remain unanswered about the quantity and quality of our water resources. Communities that develop water supplies from sand and gravel deposits along stream valleys encounter ever-increasing occurrences of nitrate concentrations that exceed the standard for public drinking water quality. When a new, safe well field is located, it may be a matter of only months or a few years before that supply too, becomes "unsafe." Even bedrock aquifers that are more regional in extent are not immune. Often, however, the question here is whether the bedrock aquifer is only locally contaminated, or whether the contamination is widespread. Either way, just as with communities that utilize alluvial aquifers, the economic impact is severe. The community must develop a new supply, by drilling in a different location or by drilling a deeper well.

The nitrate problem certainly is not unique to Iowa, but there is a possible common solution to the problem. Changes in land management practices that could begin to effect a reduction in nitrate concentrations will take an undetermined period of time to reverse the current condition of increasing nitrate concentrations. Relaxation of the 45 parts per million nitrate (as $NO_3$) standard for public water supplies would effect immediate relief. After all, the nitrate standard is largely an arbitrary number, and no data exists to demonstrate that 50 or 55 parts per million would pose a health problem. Increasing the permissible concentration of nitrate by 5 or 10 parts per million would bring into compliance a large number of public water supplies that now, or will in the near future, slightly exceed the standard. At a minimum, special variances should be considered for communities burdened with the double yoke of difficulty in developing an adequate quantity of water and still complying with the current nitrate quality standard.

A similar logic can be applied to the standard for radionuclides. Under the current standard, if the concentration of radium-226 exceeds 3 pCi/l (picocurie per liter), a sample must be analyzed for radium-228. The combined radium-226 and radium-228 cannot exceed 5 pCi/l. Although as much as 90 percent removal of the radioactivity is possible through zeolite, reverse osmosis, or lime-soda ash softening, such treatment is a severe economic burden for small communities and noncommunity public water supplies. A minor adjustment to the radioactivity standard, or issuance of special variances for low levels of exceedance, would place a large number of public water supplies in compliance.

Aside from the institutional controls that impact upon the utilization of water supplies, and in light of the economic constraints on research programs that I mentioned earlier, we are striving to maintain an information collection and distribution program that will aid in the proper conservation, development, and management of our natural resources. Although funds are becoming more limited, we still are obtaining federal contract funds to supplement state appropriations. With fieldwork and laboratory analytical costs provided by the U.S. Environmental Protection Agency, we continue to improve our knowledge about nitrate and pesticide contamination of groundwater in the karst terrain of northeast Iowa, and through a multidisciplinary approach by state and federal agencies, we are examining land management practices that can be utilized to reduce groundwater contamination. Seismic profiles and follow-up drilling in central and southwest Iowa will help to assess alternative locations for well fields along stream valleys where communities encounter problems of both water availability and water quality.

Our long-term cooperative program with well drillers has provided the bulk of available geologic and hydrologic information. That data base is increased periodically by spurts of drilling activity for metallic minerals and oil/gas exploration. It is likely that nearly two-million acres of land have been leased for oil/gas exploration in southwest, central and north-central Iowa over the past three years. Despite the current tight economy and condition of the market place, I am confident that at least one deep hole, possibly as deep as 10,000 feet, will be drilled in this untested geologic terrain within the next year. As geologists, we are especially excited about this prospect. One deep hole will not necessarily prove or disprove interpretations that have been made principally upon geophysical information, but a single hole can greatly advance our knowledge of the deep earth. Whether or not oil or gas is discovered, there is great potential to learn more about water resources and even the existence of metallic mineral deposits.



As society recognizes the need for intelligent decision making in planning and environmental concerns, the demand for geological, hydrological, and mineral resources information continues to intensify. We will continue to apply our limited financial resources so that we can best meet that demand.

Donald L. Koch

Donald L. Koch
State Geologist and Director

# IOWA'S RIVER SYSTEMS

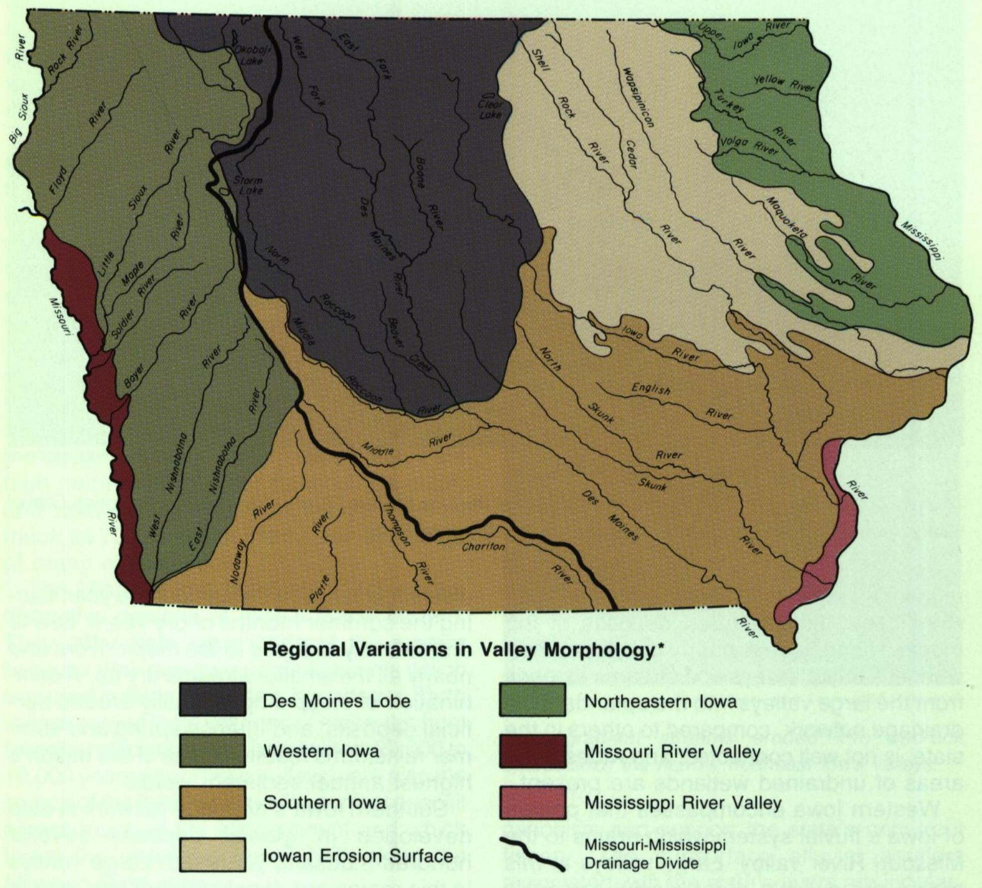
E. Arthur Bettis III, Timothy J. Kemmis, and Deborah J. Quade

All portions of the Iowa landscape are influenced by water flowing across the land surface. Since the melting of glaciers thousands of years ago, the action of rivers and streams has been the single most important geologic activity to affect the state. The result is an erosional landscape. The local appearance of the terrain in any part of Iowa is the product of water carving into glacial-age or older geological materials. This network of rivers and streams is termed the "fluvial system," from the Latin *fluvius,* meaning "river." Iowa's fluvial system consists of a hierarchy of streams ranging in size from small rills seen on any steep slope to the broad Missouri and Mississippi Rivers on the state's western and eastern borders. These streams are organized into a drainage network which transfers water and sediment from the higher, smaller portions of the system to larger rivers, and eventually to the Mississippi delta in the Gulf of Mexico at the lowest part of the system.

The fluvial system is also an historical system. Its appearance at any one time is dependent on what the system has experienced in the past. Sediment and water do not move through the drainage network at a uniform rate. Larger and heavier particles (boulders, cobbles, and pebbles) usually roll along the stream bed during high water flow and travel only a short distance before they are temporarily stored. Smaller particles of sediment (silt and clay) are carried in suspension and may travel long distances before being deposited. Sediment actually spends most of its time deposited within the floodplain or terraces of a valley. The floodplain is that portion of a valley floor covered with water during a flood, and is the area of active deposition in a modern valley. Terraces represent former floodplains now elevated above the present floodplain because of periodic downcutting of the stream through time. Numerous mechanisms, such as long-term variations in sediment load or water discharge, a change in bedrock composition, or lowering of sea or lake levels into which the stream flows, may act alone or together to trigger the downcutting and form terraces within a valley. Different terrace levels reflect the complexity of the fluvial system through time.

Terrace and floodplain deposits are composed of alluvium, or the sediment deposited by a stream (see cover). The age and history of this alluvium can be deciphered by examining the various sediment layers. During deposition, sediment is arranged into various structures such as channel fills, cross-bedding, and sand and gravel bars which form under specific water-flow and sediment-supply conditions. These features and other properties, such as particle size, are studied by geologists in order to reconstruct past fluvial environments.

In addition to sedimentary structures, alluvium may contain deposits of volcanic ash and wood or peat zones which can be radiometrically dated to indicate when these deposits accumulated (see "Geologic Timekeepers"). During the last two million years, Iowa's fluvial system has undergone dramatic adjustments in response to changing climate and vegetation. This record is complex and contains sediments deposited under ice-age environments as well as conditions similar to those of today. Deposits accumulated during the last 40,000 years, during the Wisconsinan (glacial) and Holocene (post-glacial), make up most of the alluvium found in today's valleys.

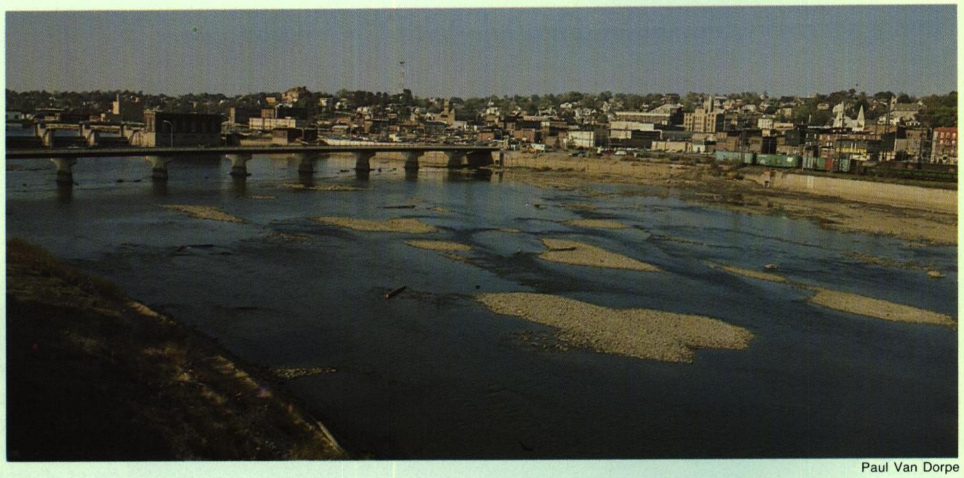


**Regional Variations in Valley Morphology***

*size and shape of landscape features

In order to discuss the variations seen in Iowa's present fluvial system, it is convenient to divide the system into regions reflecting differences in history. All Iowa streams are part of the Mississippi-Missouri basin, the largest drainage system in the world. The accompanying map shows that streams in the western one-third of the state drain southwestward to the Missouri while those in the remainder of the state drain southeastward to the Mississippi.

Six regions are present in Iowa within which the deposits and overall appearance of stream valleys are similar. The youngest drainage network is present on the Des Moines Lobe in north-central Iowa. Between 14,000 and about 11,000 years ago, glacial ice retreated from this area leaving a low-relief landscape with abundant lakes and marshes and a poorly developed drainage network. A few relatively large valleys, such as the Des Moines, Raccoon, and Iowa were initiated during melting of the ice and carried large volumes of meltwater. Extensive sand and gravel deposits, originating from the melting glacier as well as from erosion of the underlying materials, accumulated on the broad floodplains of these late-glacial valleys. Today these former floodplain deposits are found either as high, sandy and gravelly terraces stepping down to the



Paul Van Dorpe

*The city of Ottumwa occupies the broad floodplain of the Des Moines River valley in southeast Iowa. Gravel transported along the river bed is exposed by low-flow conditions.*

modern floodplain, or are buried by younger, significantly finer-textured deposits of the modern floodplain. A poorly developed network of smaller valleys and streams extends from the large valleys into the uplands. This drainage network, compared to others in the state, is not well connected, and widespread areas of undrained wetlands are present.

Western Iowa encompasses that portion of Iowa's fluvial system which drains to the Missouri River valley. Large valleys in this region are cut into older glacial materials deposited several hundred-thousand years ago. These valleys contain extensive, high sandy and gravelly terraces, some of which are mantled with windblown silt (loess) originating from the Missouri River valley during late-glacial time. The drainage networks of several rivers in this region, particularly the Little Sioux, were extensively modified and rearranged by ice blockage produced by the advance of late-Wisconsinan glaciers into north-central Iowa. Gullies cut into thick loess dominate upper portions of the drainage network in western Iowa. This network extends across the entire western Iowa landscape and very few permanent wetlands are present. Western Iowa streams are characterized by extreme discharge variation throughout the year. During the summer months of dry years, flow is dramatically reduced in the major rivers and nearly all the smaller streams dry up. A combination of steep slopes, easily eroded surficial deposits, and intense spring and summer rainstorms result in some of the nation's highest annual sediment yields.

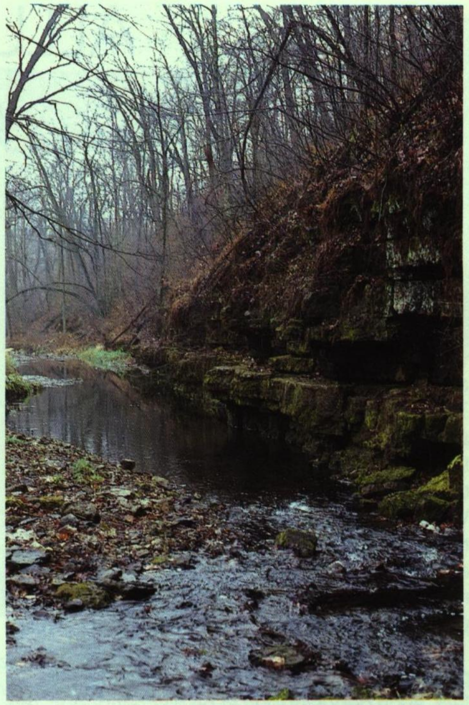
Southern Iowa's drainage network is also developed in glacial deposits several hundred-thousand years old. Large valleys in this region are deeply eroded into, and in many cases through, the old glacial deposits and contain loess-mantled terraces. Rock outcrops are common. The drainage network is extensively developed across the landscape and, with the exception of a few flat upland areas largely in the eastern part of the region, the landscape is rolling to steeply sloping.

The Iowan Erosion Surface of northeastern Iowa contains a drainage network similar to that present in southern Iowa. The major difference between the two is that valleys on the Iowan Surface are generally wider and shallower. These valleys contain extensive deposits of sand and gravel derived from the old glacial deposits and bedrock into which the drainage network cut during erosional development of this region. Some of the major valleys, such as the Shell Rock and Cedar, also carried meltwater and outwash from the late-Wisconsinan ice in north-central Iowa.

The drainage network in extreme northeastern Iowa is quite distinct from others in the state. It has entrenched deeply into bedrock, and it derives a significant portion of its annual flow from the groundwater in bedrock aquifers. Valleys in this region contain thick sand and gravel deposits in high terraces flanking the modern streams. These deposits originated from erosion of both old glacial deposits and the underlying bedrock. Late-glacial ice sheets did not drain into these valleys. Gradients (the steepness of the stream) in northeastern Iowa valleys are high compared to other parts of the state, and cold springwater can account for as much as 70 percent of the annual discharge of many major rivers.

The Missouri and Mississippi Valleys are distinctive portions of Iowa's fluvial system. They differ from other parts of the system because they owe their origin to events which occurred outside the state's boundaries. Both valleys carried large volumes of meltwater from receding glaciers in their headwaters 20,000 to 10,000 years ago. These valleys were also the source of the loess which is the surfical deposit across much of the Midcontinent and which forms the distinctive Loess Hills along the Missouri River valley.

Today, two essential resources, water and alluvium, are the focus of our use of Iowa's fluvial system. The Mississippi and Missouri Rivers are major avenues for industrial and agricultural commodities. The transportation channel in these rivers is maintained by the U.S. Army Corps of Engineers and is aided by a series of locks and dams on the Mississippi and extensive channelization and upstream dams on the Missouri. Iowa's fluvial system is also used extensively for recreation. Several large reservoirs and numerous lakes and ponds provide excellent areas for boating, swimming and fishing, and help to control water and sediment discharge from portions of the drainage network. Northeastern Iowa contains several fast-flowing rivers and streams which attract canoeists and support the state's only trout fishery. The subsurface alluvial aquifers associated with the state's rivers are increasingly drawn on to provide needed groundwater resources (see "Alluvial Aquifers"). The characteristics of both the alluvium and the valley determine the amount and in some cases the quality of the available groundwater. Sand and gravel pits also dot these valleys. The sand and gravel industry ranks third in production dollar value among the state's mineral extraction industries.



Ken Formanek, Iowa Conservation Commission

*Steep-gradient streams eroded into bedrock characterize the narrow northeast Iowa valleys.*

Ongoing geologic studies of Iowa's fluvial system will increase our understanding of the nature and extent of alluvial deposits, the valleys that contain them, and the water resources present within them. This increased knowledge will aid in future planning to accommodate the many and varied activities that rely on the state's river systems. ☐

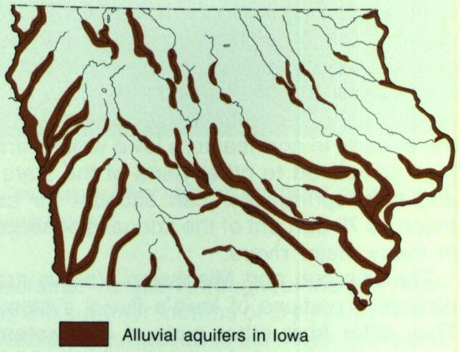
# ALLUVIAL AQUIFERS

## Carol A. Thompson

Important sources of good quality groundwater are found in sand and gravel deposits associated with Iowa's major river valleys. These deposits are contained within terraces and floodplains and have been size-sorted by the action of flowing water. Collectively, these deposits are termed alluvium (see cover). Water-bearing formations that consist of these materials are correspondingly referred to as alluvial aquifers. An aquifer is a body of earth materials that has sufficient saturated permeability and capacity to yield water to wells.

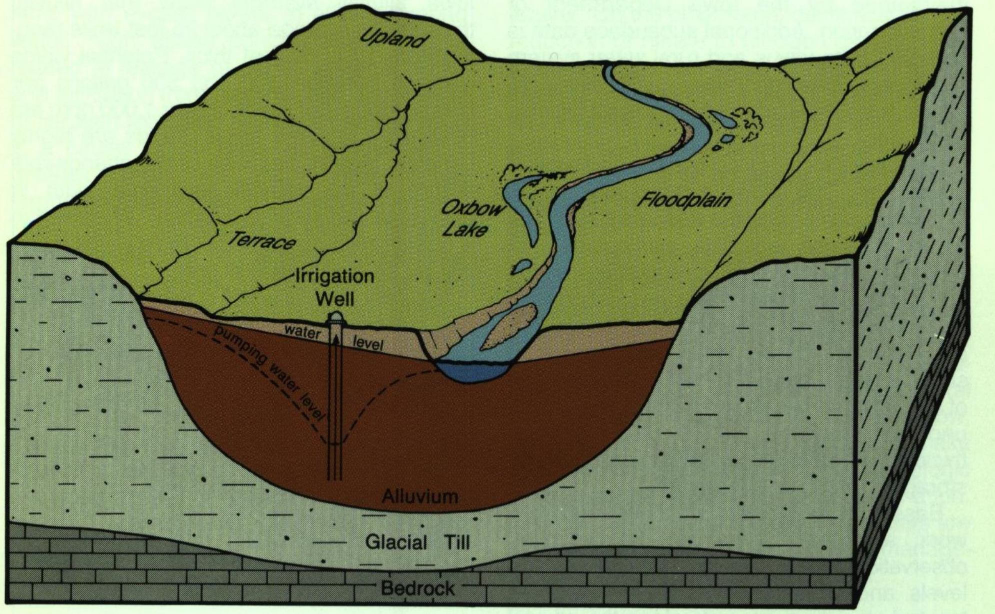
Accumulations of alluvial sediments are not present at all locations along a river system. In fact, such deposits tend to be discontinuous, the result of geologic controls and the history of a river system's development (see "Iowa's River Systems"). Large quantities of groundwater, however, can be extracted from beneath the floodplains of the state's rivers at many locations.

In an alluvial aquifer, the groundwater that saturates it is usually unconfined, meaning that the water is not under pressure nor is it overlain by impermeable materials that retard the upward flow of water within the aquifer. The top of an alluvial aquifer is defined by a water table which corresponds with the zone of saturation. Where an alluvial aquifer is intercepted by a stream, the surface of the stream marks the position of the water table. These relationships are shown in the accompanying diagram. The source of water stored in an alluvial aquifer is precipitation and runoff which percolates into the aquifer through overlying soils. Thus, groundwater levels can change noticeably throughout the year in response to the frequency and intensity of rainfall. A water table generally slopes from upland recharge areas to points of natural discharge such as seeps, springs, and streams. Along streams, the slope of the water table can be reversed during periods of high stream flow, when the water will move from the stream into an adjacent aquifer. A pumping alluvial well will lower the water table in the vicinity of the well and eventually induce flow from the stream.



A key consideration in the development of an alluvial aquifer is this close hydraulic connection between alluvial groundwater and an associated stream. In time, all large-scale alluvial water withdrawals negatively impact the volume of stream flow. During periods of moderate to high stream flow, these effects can be negligible. At low flow, however, the pumping of a nearby well can drastically reduce instream flow, possibly causing the stream to "go dry." To prevent such situations, Iowa law limits the withdrawal of surface water for consumptive purposes during periods of low flow.

Because alluvial groundwater is shallow and easily developed, generally requires little treatment, and can be produced at low cost, it is a favored source of supply for municipal, industrial, rural water system, and irrigation usage. In regions where alluvial supplies represent the sole source for high quality water, intense competition can develop for its use. In addition, alluvial aquifers occur beneath floodplains which, in turn, are favored sites for intensive cultivation, for sewage lagoons, and in the past, for locating dumps. Because surface contaminants can readily infiltrate alluvial systems, each of these activities poses a potential threat to alluvial water quality. Along most interior rivers in Iowa, except for a few points of heavy groundwater withdrawal, the hydrology, water production potential, and quality characteristics of alluvial systems are poorly known.



*Valley floodplains and terraces are underlain by deposits which furnish shallow supplies of groundwater to wells. An alluvial aquifer and its relationship to a river and pumping well are shown.*

Because of this limited knowledge and the potential conflicts relative to the management and development of these important groundwater resources, the Iowa Geological Survey initiated a program in 1982 to systematically study alluvial aquifers along the state's principal interior rivers. The key objectives of the program are to determine the location and extent of alluvial systems, their subsurface flow patterns, yield potential, and water-quality characteristics. The research has focused on alluvial systems in north-central and northwest Iowa. In much of this region, alluvial aquifers are the sole source of high quality groundwater, and competition for the water is increasing. The project began with the investigation of the Des Moines River alluvial system from Boone County northward to the Minnesota state line. Studies presently underway include evaluations of the Upper Raccoon, Ocheyedan, Little Sioux, West Fork Little Sioux, the Maple, and Rock River alluvial aquifers.

Each alluvial system study is to be completed within a two-year period. Reconnaissance work includes mapping of the geologic substrate using available soils data. Geological information, used to define the distribution and characteristics of alluvial materials, is obtained from well-log records on file at the Iowa Geological Survey, and from records on bridge construction borings and sand and gravel pits maintained by the Iowa Department of Transportation. Additional subsurface data is collected from towns and rural water system developers. Preliminary water-quality data is obtained from the University of Iowa Hygienic Laboratory.

Field work includes on-site observations of gravel pits. This allows a direct look at the sediments comprising the alluvial system. The nature of these materials, particularly with regard to the structural arrangement of the sediments, can directly affect the local groundwater flow patterns. Seismic refraction surveys are also done during these early phases of study. These surveys help define the thickness of alluvial materials as well as the nature of the underlying material. Knowledge of alluvium thickness is necessary in order to calculate the storage capacity of the system.

Based on information obtained from this work, a series of two-inch, gravel-packed observation wells are installed to monitor water levels and water quality. These wells are located at various intervals along the alluvial system being investigated. Where possible, some observation wells are located near major pumping centers such as municipal, rural water system, or large irrigation wells. This permits measurement of the impact of pumpage, and provides the data needed to calculate the important hydrologic coefficients which relate to transmissivity, storage, and yield capacity of the aquifer.

Monitoring of these observation wells comprises the second year of field investigations. Water levels are recorded monthly in the wells and at selected points along the river. These allow calculation of water-level gradients. Measurements of nested wells (pipes set to different depths in the same hole) allow estimates to be made of vertical recharge and discharge and also can be used to estimate the possible effects of surface contaminants on the aquifer. Water quality sampling is done monthly, or on a more frequent basis if needed. Water samples are analyzed on a one-time basis for minerals and then on a monthly basis for nitrate and bacteria. Occasional sampling for pesticides and herbicides is also done.

Results from the Des Moines River study and preliminary results for other northwest Iowa alluvial systems show that alluvial thicknesses average about 25 feet while ranging from 10 to 60 feet thick. Potential yields average between 100 and 500 gallons per minute (gpm), but yields of over 1,000 gpm are obtainable in some areas. Yields are highly variable, in part, because of the changeable nature of the alluvial sediments, both in thickness and sediment pattern. Wells within a quarter-mile distance can have yields differing by as much as 800 gpm.

Typically, alluvial water in the study area can be classified as a calcium-magnesium-bicarbonate freshwater. Total dissolved solids are usually less than 1,000 milligrams per liter (mg/l), and the water is hard. As determined by recent Survey studies and other reports, it has been concluded that all wells less than 50 feet in depth are highly susceptible to nitrate contamination. Over the past few years, the Survey has consulted with numerous individuals and communities experiencing problems with excess nitrate in alluvial groundwater. High nitrate concentrations can be related to leakage of septic systems, runoff and infiltration from feedlots, and applications of nitrogen fertilizers. Nitrate in drinking water is a cause for concern, as concentrations greater than 45 mg/l can cause methemoglobinemia ("blue baby") in infants. More recent studies have linked nitrate to higher incidences of intestinal cancer, cardiovascular diseases, and birth defects. High nitrate levels in the water may also indicate the presence of other, more harmful, agricultural chemicals.

Marc Morton

*Observation wells enable researchers to monitor water levels and quality in alluvial aquifers.*

Preliminary findings on the nitrate distribution in the Des Moines alluvial aquifer demonstrate the complexity of the system, but appear to vary with soil type and depth below the water table. For example, soils with high infiltration capacities in areas where the water table is not too close to the surface (5 to 8 ft.) will permit leaching of nitrate directly to the aquifer. On the other hand, denitrification (the reduction of nitrate to nitrogen gas) appears to be an important factor in reducing nitrate levels in portions of the alluvial system where water tables are high (0-3 ft.). Furthermore, wells located ten feet or more below the water table show little or no nitrate contamination, perhaps because of groundwater flow patterns.

Historically, Iowa's pattern of settlement and growth has been along rivers. Though these landscape corridors occupy a small percentage of Iowa's land area, increasingly large demands are being placed on them to produce water. Urban, industrial, and agricultural utilization of valleys, combined with a shallow, unprotected groundwater resource make these regions especially sensitive hydrologic environments, vulnerable to contamination. Geological studies of the alluvial aquifers are essential to the future use and wise management of these important resources. □

Tim Kemmis

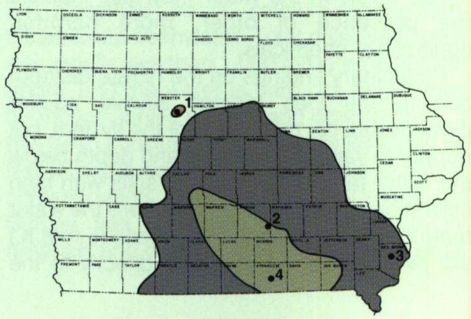
*The physical arrangement of alluvial sediments, such as the channel cut-and-fill sequences within this sand and gravel deposit, will affect local groundwater flow patterns and yield potential.*

# GYPSUM RESOURCES OF IOWA

## Robert M. McKay

One of the softest minerals known to exist is the basis for one of Iowa's most durable mineral resource industries. Gypsum is a gray to white-colored mineral that can be easily scratched with a fingernail, and is referred to chemically as a hydrous calcium sulfate. Some of its other, perhaps more familiar, names are based on its various forms of occurrence. For example, alabaster is a massive form; satin spar is a fibrous variety; and selenite is its crystalline form. Gypsum often occurs in varying proportions with anhydrite (calcium sulfate), a slightly harder and more dense mineral that lacks water in its chemical make-up. Both gypsum and anhydrite belong to an interesting group of minerals called evaporites, which are sedimentary deposits composed of salts precipitated from sea water.

Evaporites form in shallow or near-shore marine and lake environments where evaporation has produced an unusually high concentration of dissolved salts, and where there is little or no circulation of fresh water. The precipitation of sediment from these hypersaline brines is associated with hot and relatively dry climatic conditions. The Great Salt Lake in Utah is a good example of an evaporite-producing environment. Iowa's paleogeography at several times in the state's geologic past duplicated these environments of deposition and resulted in major accumulations of evaporite minerals. As a result, several geologic units in Iowa's underlying sedimentary rock sequence host economically significant deposits of gypsum. These include Jurassic, Mississippian, and Devonian-age formations.



**Bedrock areas of gypsum occurrence**

🟫 Jurassic

🟩 Mississippian and Devonian

⬛ Devonian

**• Location of gypsum mines**

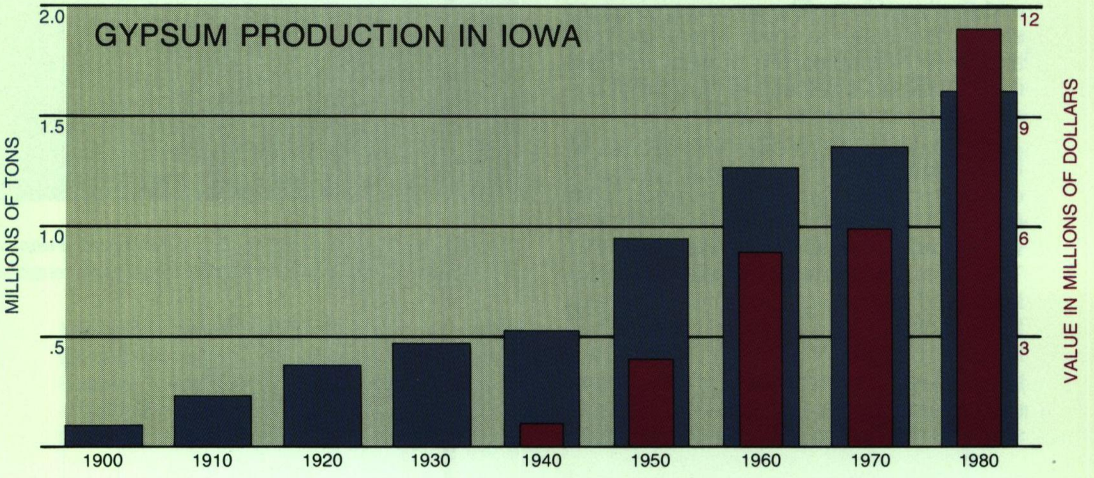
**1** Fort Dodge
**2** Durham Mine
**3** Sperry
**4** Centerville

Gypsum has several principal uses. Ground gypsum is added to portland cement to slow the setting time of the cement. Pulverized gypsum, and to a lesser extent anhydrite, is used in agriculture as a soil conditioner and as an animal-food additive. The best known use of gypsum is as the principal ingredient in the manufacture of wallboard and plaster. This is possible because of gypsum's unique property of rehydrating with the addition of water after having been ground, calcined (baked to a powder), and mixed with other wallboard ingredients. Anhydrite is considered a contaminant in this case because it cannot be hydrated like gypsum.

Since the 1850's, people have utilized the gypsum deposits found in Iowa. The first published report of the large gypsum resource was by geologist David Dale Owen in 1852 after noting outcrops along the banks of the Des Moines River valley in the Fort Dodge area during an 1849 trip into Webster County. The "Fort Dodge Beds," as the gypsum-bearing formation subsequently became known, were regarded by Charles Keyes in 1893 to be "by far the most important bed of plaster-stone known west of the Appalachian chain, if not in the United States." A report by State Geologist Charles A. White in 1870 reported, "For want of direct railroad communication between this region and other parts of the state, the only use yet made of gypsum by the inhabitants (of Ft. Dodge) is for the purposes of ordinary building stone. It has been so long and successfully used (for this purpose) that they now prefer it to the limestone of good quality, which also exists in the immediate area." During this time, the dimensioned gypsum stone was taken from the Cummin's quarries along Soldier Creek northwest of Fort Dodge. Natural exposures of gypsum still can be seen along this creek in Snell Municipal Park. It was in 1872 that Captain George Ringland, Webb Vincent, and Stillman T. Meservey formed a partnership, known as the Fort Dodge Plaster Mills, for the purpose of mining, grinding, and preparing gypsum for commercial products. These men constructed the first gypsum mill west of the Mississippi, at the head of what is now Gypsum Creek, and initiated the long and continuing history of gypsum production in Iowa.

Since the industry's founding in Ft. Dodge, the tonnage of crude gypsum mined statewide each year and its dollar value have steadily increased. In 1983 over 1.6 million short tons of crude gypsum were extracted from four surface mines and two underground mines operated by five companies at sites located in Des Moines, Marion, and Webster Counties. The average unit price was $8.39 per ton and the total value exceeded 13.5 million dollars. Nationally, Iowa ranked second among the states in value of crude gypsum produced during 1983, surpassed only by Texas. Production from the Jurassic-age Fort Dodge Beds accounted for almost 75 percent of Iowa's 1983 output. The companies operating surface mines and plants at Fort Dodge are: National Gypsum Company, Georgia Pacific Corporation, Celotex Division of Jim Walters Corporation, and the United States Gypsum Company. The U.S. Gypsum Company's Fort Dodge Mine ranked tenth among 69 mines reporting production in the United States. The U.S. Gypsum Company's Sperry Mine in Des Moines County and Kaser Corporation's Durham Mine in Marion County also had significant production.

The Jurassic gypsum deposits in the Fort Dodge area occur close to the land surface. This aided their initial discovery and also



made the deposits economically attractive for surface-mining techniques. Scrapers first remove most of the overburden, and backhoes then clean out the clay-filled fractures at the gypsum's surface. Final preparation involves washing the residual clay off the gypsum using a high-pressure water system. The exposed area of gypsum is then progressively blasted into piles of broken rock which are loaded into trucks and hauled to the crushing and wallboard plant. The accompanying photo shows a freshly exposed surface of gypsum ready to be mined. The overburden materials, consisting mostly of glacial deposits, have been removed. The unusual pattern of deep grooves seen on the uncovered surface is the result of solutional channels eroded into the easily soluble gypsum along planes of weakness or fractures in the rock. Following extraction of the gypsum, extensive reclamation of the mined area is undertaken to restore the land surface and establish an effective vegetative cover.

Although the Fort Dodge area has been Iowa's premier gypsum producing region for more than a century, current estimates indicate that reserves will be exhausted within 50 to 60 years. If Iowa is to continue as a major gypsum producer, other deposits need to be explored and developed. Fortunately significant sulfate evaporites occur in the older and deeper Mississippian and Devonian rock systems in central, south-central, and southeast Iowa. The accompanying map shows the areas in Iowa where gypsum-anhydrite evaporites are present in these rock systems as well as the location of present and past gypsum mines.

Mississippian evaporites occur in the St. Louis and Spergen Formations and were first discovered near Centerville in Appanoose County during exploratory drilling for coal by the Scandinavian Coal Company in 1910. The Centerville Gypsum Company eventually opened an underground mine to develop this deposit, but the mine closed in the early 1930's because of a slump in demand and because of high percentages of the contaminant anhydrite. Interest in Mississippian gypsum was renewed after World War II, and exploration efforts at Albia in Monroe County, and Bussey and Harvey in Marion County proved the existence of significant subsurface gypsum deposits. Currently, Mississippian gypsum is extracted at the Durham Mine in Marion County by Kaser Corporation. Well records at the Iowa Geological Survey contain abundant notations of Mississippian evaporites, and their relatively shallow depths (200 to 600 feet) should encourage future development of these deposits.


Tim Kemmis

*In mining gypsum at Fort Dodge, overlying glacial deposits are removed and the deeply creviced surface of the gypsum is exposed. These crevices resulted from movement of water along intersecting fractures in the easily eroded gypsum.*

Devonian evaporites are present in the subsurface over a broad area of the state. These deposits occur at several horizons in the Wapsipinicon and Cedar Valley Formations, and their existence was first noted in the early 1900's during the drilling of deep water wells. Iowa Geological Survey well records show that gypsum-anhydrite occurs in zones ranging in thickness from five to greater than 100 feet, and at depths between 400 and 2,000 feet. In 1960, the U.S. Gypsum Company opened the Sperry Mine in Des Moines County to become the first company to mine gypsum from the Wapsipinicon Formation. This room-and-pillar mine, at a depth of 616 feet, is the deepest mine in Iowa and the only mine from which Devonian gypsum is extracted. The potential for economic deposits of Devonian gypsum appears to be good, especially along the northern and northeastern margins of evaporite occurrence, where thick horizons of evaporite have been encountered in drilling at depths of between 400 and 700 feet.

The future of the gypsum industry in Iowa seems bright, and it appears certain that Iowa will remain a major gypsum producing state well into the twenty-first century. □

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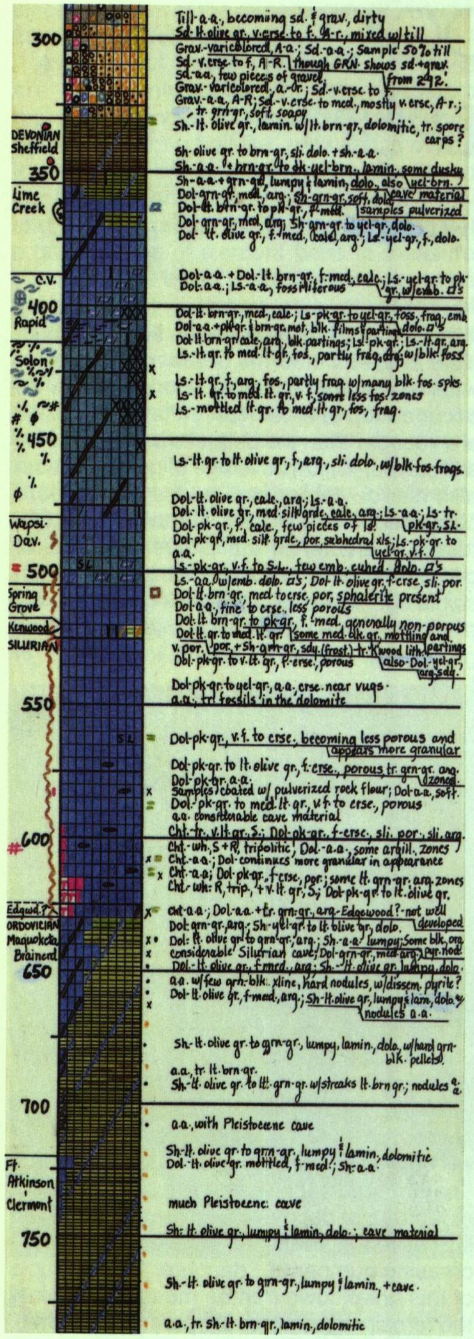
# SAMPLING THE SUBSURFACE

## Michael J. Bounk and Michael D. Farmer

Bill Bunker

*Core samples are vertical columns of rock collected with special hollow-type drill bits.*



*Well logs prepared from microscopic study of drill cuttings identify depths, rock characteristics, and geological formations.*

The samples collected during drilling of wells account for over 90 percent of the information used to interpret Iowa's geology and groundwater resources. This important effort has been underway since the late 1800's and became better established about 20 years ago under the direction of then-State Geologist H. Garland Hershey and through field contacts with the state's drillers by Earle "Bud" Scheetz. The result of this continuing program has been the expansion and maintenance of one of the finest sample libraries in the country. This valuable reference collection is possible because of the cooperation and assistance of Iowa's well contractors and drillers. To date, over 29,000 sets of drill cuttings and cores are reposited with the Iowa Geological Survey.

Several times a year arrangements are made with drillers throughout Iowa for picking up well samples and for delivery of sample bags and log books which are furnished to the drillers at no charge. The three-by-five inch cloth bags are filled with soil and rock samples cut up by the drill bit, flushed from the hole with circulating drilling fluids, and collected at five-foot intervals. The bags are labeled as to well and footage interval. A driller's log accompanies the sample set and contains on-site notations of the rock types encountered in drilling, depth of the well, casing, water level and pumping information, and most importantly, an accurate location of the well.

Once the samples are brought to the Survey, they are processed for study. Sample preparation includes mechanical reduction, sorting, selective washing, and packaging after which they are boxed and reposited in the sample library to await logging. In this phase, the samples are examined by microscope to determine which rock types are present in each collected interval and in what percentages. This data is recorded as a color-coded strip on a log form. An abbreviated description of each rock type and its characteristics is written in the margin, along with notations on fossil and mineral content. Finally, contacts between geological formations are drawn. In addition to microscopic and simple chemical analysis, the samples may be subjected to more rigorous preparation for age-dating, pollen analysis, or thin-section study.

Occasionally, well cores are brought into the sample library. Cores are solid cylinders of rock obtained by using special drill bits and techniques. While expensive to obtain and bulky to handle and store, cores supply a tremendous amount of detail regarding the subsurface geology. The opportunity to examine rock cores actually improves the subsequent study of well cuttings from the same region. Sets of core are always a welcome addition to the sample library.

The sample and strip-log libraries serve a variety of important purposes. The strip log with casing lengths, diameters, and water-level data provide a base-line record of the well at the time of construction, a record similar to a background medical history. In case of future problems with the well, Survey geologists can refer to the log and often are able to pinpoint the source of problems. The log data also enables Survey staff to prepare water-availability forecasts which summarize well depths, water quality, and potential yield information at prospective drilling sites. Drillers also find Survey well records useful when preparing to bid on a job in unfamiliar territory, or for answers to inquiries that arise during on-site drilling.

A drilled well can yield more than water. Its sample record can be a solid piece of geologic data, to be used many times over. When combined with sample sets from other wells, it becomes part of a data base essential for both immediate and long-range use in solving the underground puzzle of the state's geology, water, and mineral resources. □

# GEOLOGIC TIMEKEEPERS

## Robert D. Libra

The concept of geologic time is intriguing to anyone who has picked up a rock or fossil specimen and wondered about its age. When geologists state that the oldest rocks seen in northeast Iowa are 500 million years old, or that a glacier occupied the Statehouse grounds in Des Moines 14,000 years ago, people often ask how these ages are known.

In no other science does time play as important a role as it does in geology. Time provides the frame of reference necessary to the interpretation of past events and processes in Iowa's earth history. In the field, it is possible to speak in terms of the *relative age* of what is seen. For example, younger rock units occur on top of older rock units; and, valleys are younger than the deposits into which they are carved. The relative age of geologic strata also can be determined by the fossil record contained in the rocks. Certain distinctive fossils characterize the different periods of geologic time. It is the establishment of *absolute age,* however, that gives geologists the precision to tie the earth's deposits and geological events to actual increments of time.


University of Iowa

*These bison bones found near Cherokee contain a built-in "clock" for measuring geologic time.*

Finding a built-in clock, or chronometer, to measure time within the geologic record was possible after the discovery of radioactivity at around the turn of the twentieth century. Certain elements, such as uranium, have unstable internal atomic structures and are constantly making adjustments toward more stable isotopes or elements by emitting particles from their nucleus. This spontaneous breakdown is called radioactive decay, and it continues at a predictable rate over long periods of time. According to the principles of radioactive decay, the time required for one-half of the radioactive element to decay to its more stable form is expressed as its "half-life." After each half-life interval has passed, one-half of the remaining radioactivity will be present, and so on through time. Each "parent" radioactive element has its own unique rate of decay, and its own known half-life, stated in years. As time passes, the increasing number of "daughter" by-products of this breakdown can be measured against the remaining number of "parent" elements, and the amount of time that has elapsed since formation of the mineral or rock in question can be determined.

A number of different radioactive isotopes are commonly used to date geologic materials. Long-lived radioactive elements, those with a long half-life, are used in dating the most ancient rocks, while the short-lived radioactive elements can be used effectively to date more recent materials. For example, a good choice of element pairs to measure the age of the earth's oldest rocks would be the use of the known rate of decay of Rubidium-87 to Strontium-87. Rubidium has a half-life of about 50 billion years. This method has been used to date ancient igneous and metamorphic rocks, as well as lunar samples brought back from the moon. Because of its very long half-life, the Rubidium-Strontium method loses accuracy with rocks younger than 50 million years or so. A better choice for dating these younger rocks would be the decay ratios of Uranium-238 to Lead-206, with a half-life of about 4.5 billion years, or the decay of Uranium-235 to Lead-207, with a half-life of about 700 million years. In Iowa, the Uranium-Lead methods have been used to date the igneous granites that underlie the thick sequence of sedimentary rocks in parts of the state. The resulting ages of these "basement" rocks range from 1.4 to 2.5 billion years. The durable, pink outcrops of Sioux Quartzite in extreme northwest Iowa at Gitchie Manitou State Park fall within this age category.

Earth materials of very old to intermediate age are commonly dated using the known decay ratios of Pottasium-40 to Argon-40, with its half-life of 1,300 million years. A variation of radioactive time-keeping called fission-track dating is also widely used toward the younger end of this interval, especially for that awkward age between 40,000 and one million years, a period for which neither Carbon-14 nor Pottasium-Argon methods are suitable. In this method, an electron microscope is used to observe the trails left by fragments fired off during the spontaneous fission of uranium. Fisson-track dating of different beds of


George Hallberg

*Fisson-track dating of this volcanic ash bed (whitish color) in Ringgold County has established a time benchmark important for interpretation of past glacial events in Iowa.*

Tim Kemmis

*The amount of Carbon-14 remaining in this Webster County log can be measured to determine the age of the wood and thus the age of the surrounding glacial deposits of pebbly clay which buried it.*

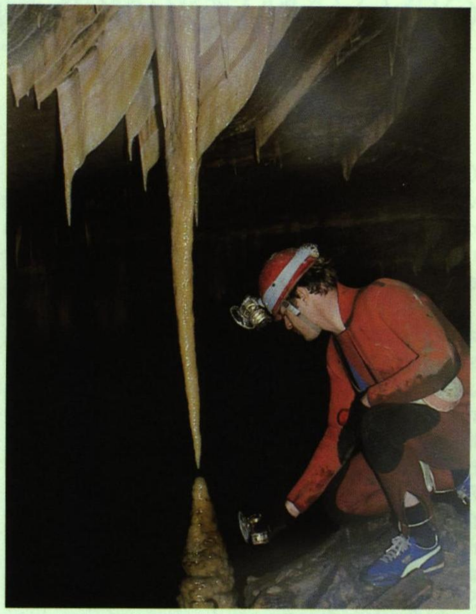
volcanic ash (Pearlette Family) located within the glacial deposits of western Iowa, has been instrumental in establishing benchmarks in time which, in turn, have enabled geologists to redefine both the number of glacial advances into Iowa and when these events occurred. For example, geologists now believe at least seven major glacial events occurred prior to the two more recent, and thus better-known, Illinoian and Wisconsinan advances. In addition, glacial deposits are present below an ash bed in Union County that has been fisson-track dated at 2.2 million years. This places the beginning of glaciation in Iowa at more than 2.2 million years — considerably older than previous estimates.

Another technique that is especially useful for sediments too old to be dated with Carbon-14 is Uranium-Thorium. Speleothems, or the calcium carbonate formations which decorate caves, lend themselves to this method. Stalactites from Cold Water Cave in Winneshiek County, and Mystery Cave in southeast Minnesota were dated as being about 160,000 years old by the Thorium-Uranium method. Because caves form below the water table, and stalactites form after the water table drops below cave level, we know that parts of these caves had already developed, and the local water table had dropped below cave level, prior to 160,000 years ago. Sampling cave formations for material to date is done with considerable care, from inconspicuous locations, so that the beauty of these special environments is not impaired.

Perhaps the best known of the age-dating techniques is the Carbon-14 method. It is widely used for determining the age of geologically young materials, including archaeological evidence of early man. This short-lived radioactive isotope forms in the atmosphere by the interaction of Nitrogen-14 and cosmic rays. Thus Carbon-14, in the form of carbon dioxide, is present in air and water, and therefore is present in all living organisms. When a plant or animal dies, the Carbon-14 is no longer replenished and begins to diminish in accordance with its own rate of decay back to Nitrogen-14. Because of its relatively short half-life rate of 5,730 years, only materials 40 to 45,000 years old or younger can be dated with this technique. Some geologic materials, such as the glacial deposits that mantle much of Iowa, cannot be directly age-dated. If pieces of wood or other organic materials are present within these deposits, they can be dated using Carbon-14. The sediments surrounding the wood are thus determined to be about the same age. Such dates have helped pinpoint the southernmost extension of the Wisconsinan glacial advance into north-central Iowa as being marked by the course of the Raccoon River at Des Moines 14,000 years ago. Radiocarbon dates have also been applied to unraveling the landscape evolution of extreme northeastern Iowa. Although the old, Paleozoic sedimentary rocks are the key ingredients in this scenic, high-relief terrain, current geologic research demonstrates that much of this relief is remarkably young. Radiocarbon dating of stream deposits shows that the deepest entrenchment, or erosion of streams into the landscape, occurred only 20,000 to 40,000 years ago.

Radiocarbon dates are frequently seen expressed, for example, as 11,800 ± 200. This additional range of time allows for any unavoidable margin of error. Also, in referring to radiocarbon dates, they are often written as a number followed by BP or RCYBP, meaning "radiocarbon years before present." The "present" has been arbitrarily assigned to the year 1950, not long after W.F. Libby and his associates devised this technique in 1947.

Carbon-14 has applications other than determining the age of geologic strata. Bone and charcoal also can be dated making this technique an invaluable tool for archaeologists. The oldest archaeological sites that have yielded dateable materials show that early man inhabited Iowa over 8,500 years ago. In addition, Carbon-14 may be dissolved in groundwater, so that it is possible to estimate the period of time groundwater has been in an aquifer and isolated from the atmosphere. In Iowa, the only dating of this type that has been done was on a sample of water from the deep-lying Jordan Sandstone aquifer. The sample was collected in southwestern Iowa where the Jordan occurs at a depth of approximately 3,300 feet and was subjected to Carbon-14 analysis. The water sample proved "dead;" that is, it was too old to date, using this technique. At a minimum this indicates the groundwater in the Jordan Sandstone in this region of the aquifer is more than 45,000 years old.



Mike Bounk

*Uranium-thorium ratios from Cold Water Cave aid geologists in dating the cave's origin.*

Age dating of materials using radioactive methods has become an invaluable tool in the geological and related sciences. It is not without its problems, as unavoidable losses or gains of isotopes can occur through interactions with the surrounding environment, and erroneous ages can result. Improvements in radiometric geochronology, however, are continually being made and will permit future refinements in the calibration of these built-in clocks which measure geologic time. ☐

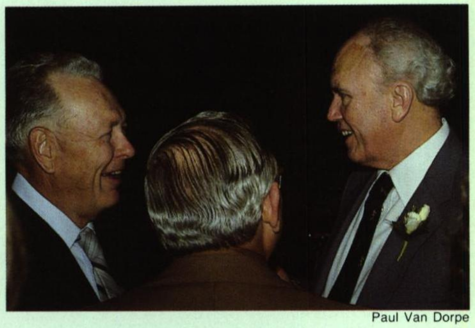
# ORV VAN ECK COMPLETES SURVEY CAREER

Donald L. Koch

Orville Van Eck has retired from the Iowa Geological Survey after thirty-one years of service. He participated in some of the most significant changes in the Survey's history and made substantial contributions to our knowledge of the state's geology.

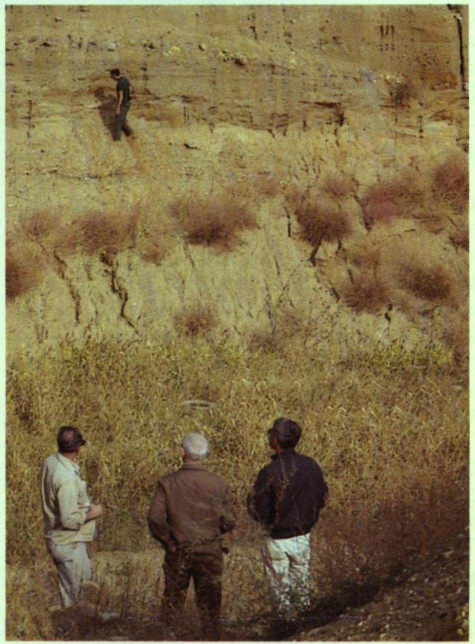
His Survey career began in 1953 when the agency consisted of five geologists and one secretary housed in a small brick building on Jefferson Street. Improved information was needed on the state's coal deposits and on limestone resources in southwest Iowa. Orv became Iowa's expert in coal geology and Pennsylvanian stratigraphy. His 1960 publication on highway construction materials from the rocks of southwestern Iowa still stands as the authoritative work on the geology of this region. Survey investigations also focused on groundwater resources, and Orv's contacts with Iowa's water-well and quarry industries helped to build our important repository of well and core samples. The protection of groundwater quality through proper abandonment of unused wells was a special concern, and Orv prepared practical guides for well-plugging procedures. He also supported acquisition of geophysical data such as gravity measurements and aeromagnetic surveys, and he implemented microearthquake research in southwest Iowa. As new and expanded programs required more detailed planning and budgeting, Orv moved into a supervisory and management role. He became Assistant State Geologist in 1970 and advanced to Associate State Geologist in 1975. As Orv grew with the Survey, the Survey grew with Orv, and in 1975 a staff of 38 moved into nearby Trowbridge Hall. He was a strong advocate of the topographic mapping program, and is justifiably pleased this year to see completed state-wide coverage.

Orv's stabilizing influence and friendship mark his career at the Survey as sharply as do his professional contributions. Those with questions on policy, procedure, or protocol also found guidance, counsel, and friendship in his office. □



Paul Van Dorpe

*Orville Van Eck renews old friendships with Leon Steele (left) and Walt Steinhilber at his recent retirement dinner.*



Jean Prior

*Orv (left), Fred Dorheim, Sam Tuthill, and Don Koch (distance) examine a gravel pit during a 1971 environmental study in the Sioux City region.*

# SEISMIC SURVEYING IN IOWA

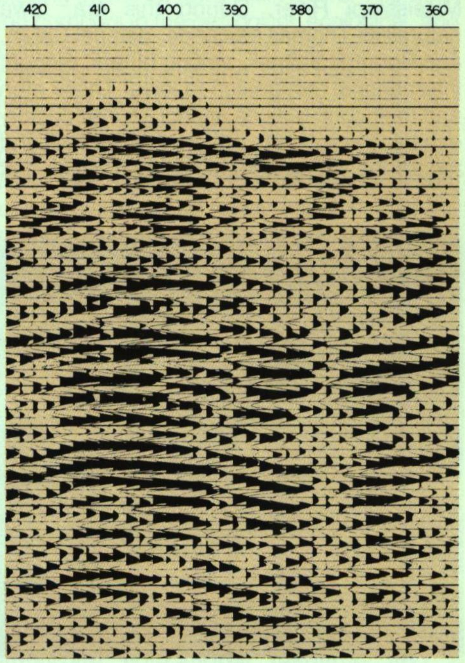
Raymond R. Anderson

For the past two years a number of unusual trucks have been seen moving along the back roads of central and southwest Iowa. These trucks and their support crews play an important role in the stepped-up search for oil in the state. They are seismic survey crews, and their job is to produce a sonic "x-ray" of the rocks beneath Iowa's surface. The technique they use is called "vibroseis," short for vibration seismic. Vibroseis, like other seismic techniques, takes a "picture" by sending low-frequency sound waves into the earth and recording the reflections that bounce back, a concept similar to submarine sonar.

While more traditional seismic techniques utilize explosives to generate sound waves, the vibroseis technique uses specific vibration frequencies generated by specially designed motors mounted on large trucks. The sound waves are transferred to the ground through six-foot diameter steel plates which are lowered by jacks and which then support nearly all of the 50,000 pound weight of the truck. To increase the strength of the sound wave, two to four trucks spaced at calculated intervals vibrate in unison, controlled by computers.

As the sound waves pass downward into the earth, they reflect off various rock layers and return to the surface where they are detected by a series of microphones called geophones. These are organized in clusters of 24, at 120 locations along the cable that may be more than five miles in length. The sound waves received at each geophone are transformed to electrical signals and are transmitted along the cable to tape recorders in a control truck. By accurately recording the signals from each geophone and their arrival times, a detailed data set is obtained. After the trucks have vibrated about 20 seconds, they are moved ahead, and geophones from some of the area already surveyed are moved to new areas at the forward end of the cable for another cycle of vibration and data collection. A vibroseis crew of 25 people can survey about 25 miles in a week.

Because of the complex nature of the taped record, extensive computer analysis, requiring as long as five months, is necessary to produce a usable product. Once completed, a seismic section similar to the one reproduced here can be examined, the rock layers identified, and their thickness and structural configurations determined. It is estimated that more than 1,000 miles of vibroseis data has been collected in Iowa. After compilation and interpretation of these data, drilling may begin on promising geologic structures. □



*These patterns record a sonic "picture" taken of Iowa's subsurface rock units using a low-frequency sound wave technique called vibroseis.*

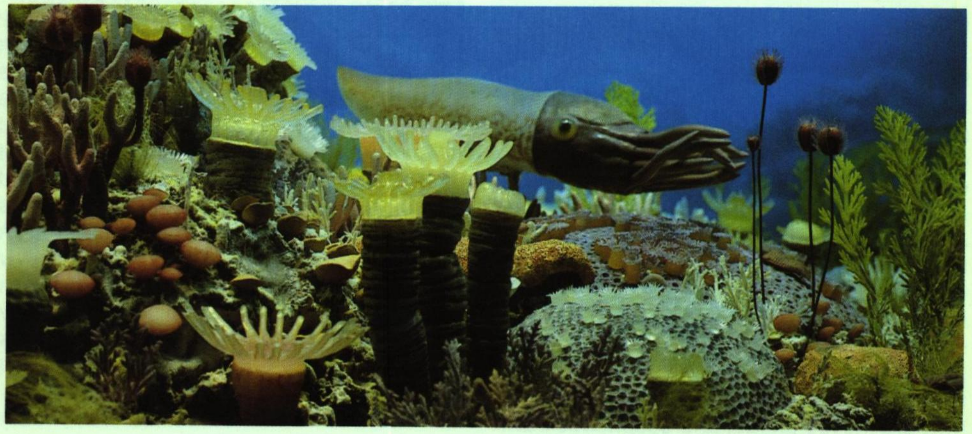
# STATE'S GEOLOGY ON VIEW

Jean C. Prior

This spring the University of Iowa Museum of Natural History unveiled a major new exhibition gallery known as Iowa Hall. The gallery offers a visual feast of information about the state's natural and cultural history. Leading exhibit-design studios, artists, and craftsmen have joined with resident geologists, archaeologists, botanists, and zoologists to transform an historic building and a renown collection of specimens into a distinctive presentation focused entirely on the natural history of Iowa.

This unique effort is housed in Macbride Hall, a building completed in 1907 to accommodate the programs and collections of the oldest university museum (1858) west of the Mississippi River. During this era, Iowa naturalists Thomas Macbride, Samuel Calvin, and Bohumil Shimek, among others, brought international recognition to Iowa. These men and their contributions anchor an introductory exhibit which greets visitors to Iowa Hall and recalls the strong natural history tradition that exists here. Today, the Museum is under the curatorship of George Schrimper, who also directs the longest continuing program in Museum Training offered in the United States.

The dramatic geologic changes that have affected Iowa during its four-billion-year history are prominent themes among the Iowa Hall exhibits. These interpretations are expressed through a series of displays that include reconstructions of ancient environments, audiovisual presentations, graphic murals, and rare fossil and mineral specimens from Iowa. Highlights of the geological exhibits are four large detailed dioramas: a bright, undersea view of the diverse marine life associated with a Devonian coral reef; a dank, lush tropical swamp representative of Pennsylvanian coal-forming environments; a time-lapse, bird's eye view of the movements of Pleistocene ice sheets across Iowa; and a life-size re-creation of a giant ground sloth that roamed the state during these glacial episodes.



Kay Irelan

*Among the outstanding exhibits at the newly opened Iowa Hall gallery is this diorama of a Devonian coral reef. The diverse marine life associated with this reef contains numerous forms recognized today as fossils in Iowa's limestone deposits.*

Kay Irelan

*The panoramic Marquette and Joliet diorama, which displays their historic entry into the Upper Mississippi Valley via the Wisconsin River, is seen from the vantage point of what is today Pikes Peak State Park in Clayton County.*

Kay Irelan

*The tropical swamps in which Iowa's coal deposits formed are shown in this reconstruction of Pennsylvanian coastal environments.*

These graphic scenes of Iowa's past life, climate, and geography demonstrate geologic processes which have molded Iowa through eons of time. Information is also presented on Iowa's geologic framework — the influence of rock units and glacial deposits on state-wide drainage patterns, surface relief, landforms, and soils. The geologic exhibits serve as a foundation for other displays that focus on the state's native cultures and biological ecosystems. Organized in this way, geology is seen not only as an independent arena of interest, but as an integral part of today's environment. Geological processes and materials have shaped the physical habitats which now sustain mankind and the animal and plant species which share Iowa's land.

This interrelationship among the natural science disciplines is both an opening and closing theme for Iowa Hall visitors. The viewing corridors to the geological, ecological, and cultural exhibits leave from and return to the dramatic Marquette and Joliet diorama. This keystone exhibit focuses on that significant moment in history when the two French explorers, having canoed down the Wisconsin River, first enter the Upper Mississippi Valley, closely watched by Ioway Indians. This important cultural contact takes place in a panoramic setting of waterways, bluffs, islands, woodlands, and rock, and is seen from the vantage point recognized today as Pikes Peak State Park.

The accuracy of these exhibits has been guided by University of Iowa faculty and by geologists at the Iowa Geological Survey. This project underscores the spirit of cooperation that exists between the university communities in Iowa and the Survey. Though seen primarily in the role of technical consultant, efforts such as Iowa Hall demonstrate another facet of Survey operations, that of working to bridge the gap between scientist and citizen. The result is an important educational resource and a valuable opportunity for Iowa's citizens and visitors to deepen their understanding of the state's natural history. □

# MUNICIPAL WATER-SUPPLY INVENTORY

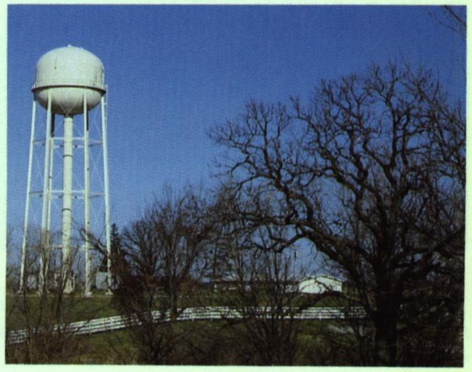
### Paul Van Dorpe

About 93 percent of the cities and towns in Iowa that are served by municipal water systems obtain their water supplies from wells. These wells range in depth from a few tens of feet to over 3,000 feet. Each year the Iowa Geological Survey (IGS) responds to about 100 requests for assistance with developing new municipal wells, maintaining older wells, or determining the cause of specific well problems. In order that our service to these communities is more effective and efficient, a Municipal Water-Supply Inventory was initiated in July, 1981. The primary purpose of this project is to consolidate information about Iowa's municipal wells, particularly the number of active wells, their locations, depths, construction records, and geologic sources of groundwater, as well as yields and quality for each community.

To complete this information, we asked the Department of Water, Air and Waste Management (DWAWM) for assistance, as they regulate Iowa's public drinking-water supplies. With the cooperation of the six regional DWAWM offices, we have combined municipal-well data from their files with existing IGS geologic well-log information. Water-quality data are included, and are identified as to individual well and to geologic formations from which the groundwater is being withdrawn. These data were summarized and an inventory record sheet was prepared for each well researched. There are approximately 2,000 active municipal wells and probably an equal, or greater, number of inactive or abandoned wells. These inventory records form the nucleus of the newly created municipal file.

The Iowa Geological Survey is also in the process of developing an interactive computer file which will combine existing computer files of water quality analyses, geologic well-log records, and census figures with data obtained from the municipal file. Together, this master municipal file will be updated and maintained as a current file. When new data on a municipal well are supplied by DWAWM, individual communities, or the University of Iowa Hygienic Laboratory, they can be added to the system immediately. The municipal files will eventually be available for distribution via computer printout, allowing IGS to tailor responses to fit specific requests.

Already the Municipal Water-Supply Inventory has provided needed information for state water-planning activities, as well as for answering numerous individual requests from consulting engineers, drillers, water-plant operators, and local and state officials. Continuing information from several sources will keep the file active and up-to-date. We will rely heavily on DWAWM and Iowa community officials to supply information regarding new water sources, removal of sources from service, changes of treatment, well reconstruction, and status of rural water systems. Considering that 73 percent of Iowa's population is served by these municipal supplies, and an additional percentage by rural water systems, we feel that the acquisition of this information greatly enhances our data base and thereby increases our ability to aid state and federal agencies currently addressing the state's important water-related issues. ☐



Kay Irelan

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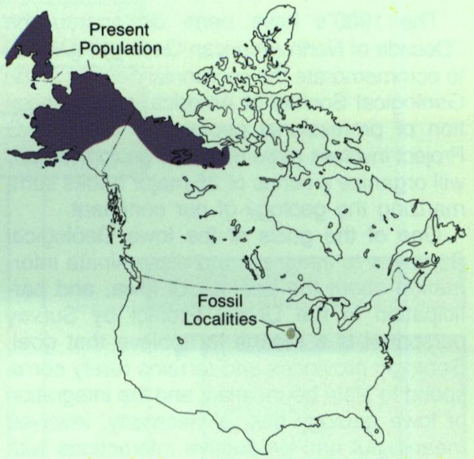
# FOSSIL BEETLES IN IOWA

### George R. Hallberg and Donald Schwert

Fossil remains of mammoths and mastodons that roamed Iowa during the Ice-Age are well known. Now some less-obvious, but still important glacial inhabitants have come to light — fossil beetles. Remains of these insects (see photo) have been found in buried water-laid deposits near Iowa City and Elkader. Studies of the beetle faunas are being coordinated by Donald Schwert and Alan Ashworth from North Dakota State University, and are providing fresh insights into Iowa's past climates, as well as new explanations for the present-day distribution of beetles in North America.

The Iowa sites from which the fossil beetles are being recovered date from 17 to 20,000 years, or the last (Wisconsinan) glacial period. Many of these species live today only in parts of Alaska and adjacent portions of northern Canada and Siberia (see map). They show that Iowa's environment at that time may have been similar to the northern treeline of Canada and Alaska — perhaps a patchwork of tundra and spruce forest.



In turn, the Iowa localities suggest reasons for the present distribution of some of the North American beetle fauna. Though suitable environments occur across northern Canada, these flightless beetles are found only in the Alaskan-Yukon region. As the ice sheets slowly expanded and climates cooled, the beetles were able to migrate and live in the relatively cold environments surrounding the ice margins — in places like Iowa and Alaska. The ice sheet melted rapidly in the Midwest, and the beetles could not migrate north as quickly as the climate warmed and thus became extinct, except in their Alaskan-Yukon-Siberian refuge. Today the beetles are slowly spreading across Canada into available habitats. Thus, Iowa's fossil record continues to provide significant clues for studies of life on earth. ☐

Donald Schwert

# DECADE OF NORTH AMERICAN GEOLOGY

Brian J. Witzke

The 1980's have been designated the "Decade of North American Geology" (DNAG) to commemorate the centennial decade of the Geological Society of America, an organization of professional geologists. The DNAG Project involves more than 500 geologists who will organize a series of 35 major books summarizing the geology of our continent.

One of the goals of the Iowa Geological Survey is to integrate and disseminate information about the geology of Iowa, and participation in the DNAG Project by Survey personnel is a means to achieve that goal. Geologic provinces and terrains rarely correspond to state boundaries, and the integration of Iowa geology has, of necessity, involved meaningful and productive interactions with geologists in surrounding states. Such cooperation is the key to success of the DNAG Project, and is vital to the effectiveness of Survey geologists as a whole.

The synthesis of Iowa geology contained in the DNAG reports will come at a most opportune time, as geologic interest in Iowa continues to accelerate. Although Survey geologists are comparatively few in number, the staff is recognized for their expertise in geologic matters of regional concern. Survey geologists are contributing to DNAG syntheses of central North American stratigraphic correlations, Phanerozoic geologic history, Quaternary geology, and the history of geology in America. □

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