University of Nebraska Lincoln
NATURAL RESOURCES SURVEY

The Earth All Around Us

Selected Building Stone in Lincoln, Nebraska

A Walking Tour

William J. Wayne
Department of Geosciences
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Institute of Agriculture and Natural Resources
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Educational Circular 19

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March 2006

Acknowledgments

This discussion of building stone in Lincoln is an outgrowth of a brief guide prepared for students in some of my classes at the University of Nebraska-Lincoln. Much of the material here is the result of many hours spent examining exterior surfaces of buildings on the UNL City Campus and the Central Business District and some of the older residential neighborhoods of Lincoln. I have been helped by discussions of building stone used in Lincoln with Ed Zimmer, Lincoln-Lancaster County Planning Department; Jerry Berggren, restoration architect; J.D. Schwarck, owner, Schwarck Quarries, Roca; Bob McCabe, Cornhusker Tile and Marble Company; Bob Ripley, resident architect, Nebraska State Capitol building; and Donald Carr, head, Industrial Minerals Section, Indiana Geological Survey. Charles Flowerday of the UNL School of Natural Resources and David Murphy of the Nebraska State Historical Society edited the manuscript.

Cover photo: Linoln's old city hall, between 9th and 12th streets, built from fusilinid limestone quarried from Dyson Hollow north of Plattsmouth.

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Introduction

Stone has been a primary building material for millennia. Cities, therefore, are treasure troves of earth materials. A wide variety of stones from many places are used for walls, as foundations to support entire buildings, as trim, and more recently as *cladding* (facing, an overlay). The Earth science teacher can find, in the limited space of an urban environment, a superb collection of stones with which to introduce students to these materials. The surfaces of stones on the outsides of buildings illustrate the durability and the vulnerability of each kind of stone to the local climate. And the history of the architecture of a community can be traced by observing the way stone has been used in construction and in decoration.

Background

Mineral materials have long been used in construction by humans. Large volumes of earth material are needed for this purpose, so building material has a high place value – that is, it can absorb little in the way of transportation costs. Most building materials are used near the places where they are removed from the Earth. Throughout human history, where usable stone was available, blocks of it were used for foundations and walls. Where stone could not be found reasonably close to a construction site, mud was formed into blocks to make bricks. Only where labor was plentiful and cheap could stones be moved long distances from their sources, as they were in Egypt for pyramid construction. In very early cultures, most stone blocks placed in walls were simply undressed stone. Squared stones, though, were an early development in many cultures, and the fitting of such blocks, without mortar, in walls and foundations may have reached its peak in the structures of the Inca culture in western South America.

Rock removed from the Earth for use in construction is referred to as *stone*. Both *building stone* and *dimension stone* are terms for stone that is prepared and sold in blocks or slabs of specific shapes and sizes for use in construction (Thiel and Dutton, 1935; Bowles, 1960; Currier, 1960). They include field stone, rubble, rough building stone, squared stone (ashlar), cut stone, monument stone, ornaments carved from stone, paving blocks, curbing, and flag stone. Many kinds of stone have been used in the construction of buildings, but only a few have the properties that make them suitable for use today as commercial dimension stone. Generally, dimension stone must have attractive colors and patterns, uniform texture and grain size, freedom from impurities that may result in stains or disintegration of the rock, and it must be in sources that permit removal of large blocks that can be readily worked.

Hardness can be variable, although extremely soft rocks would not be usable, and nearly all sound rocks, otherwise suitable for use as dimension stone, have a crushing strength far in excess of that needed in construction. However, durability – the capability of remaining sound without flaking or disintegrating in weather – is critical. Because atmospheric conditions in the urban environment are especially harsh in many parts of the world, study of stone decay and stone preservation has become increasingly important (Winkler, 1994).

Not all kinds of rock are suitable for use as building stone. Those used often are selected for their uniqueness or special pattern, as well as for their durability and workability. Where only local material is available, stone may be used that would be otherwise discarded as unsuitable because of various flaws in appearance. The increasing use of machinery in stone processing and preparation, and improvement of transportation methods during the past century, have made it possible to use stones that are distinctive, yet produced far from their place of origin.

Architectural stone is used primarily as facing or veneer over some other internal construction, such as wood or steel and concrete framing, in contrast to the stone used in squared blocks for foundation and wall construction. *Rubble* refers to pieces of broken stone used in walls or foundations. *Field stone* is the term applied to pieces of slabby rock found on the surface that can be used with little or no shaping in wall construction. Bedding planes of sedimentary rocks such as limestone and sandstone permit removal of layers that can be cut into squared blocks with chisels and laid in courses. Such stone, referred to as *ashlar*, must be set so that the bedding is parallel to the horizontal mortar joints to take advantage of maximum strength and durability.

Today in North America, little stone is used that cannot be cut and handled by machinery. Gangsaws, which are soft steel bars set in a frame, use a slurry of sand or carborundum as grit to slice large blocks into slabs. Diamond or carborundum saws are then used to cut stone slabs to the dimensions and shapes desired for structural stone (foundation blocks, steps, sills, lintels, etc.). Some of the more dense kinds of stone are polished for application as exterior or interior facing slabs or panels. The direction of the bedding is unimportant for massive and uniformly cemented material, and igneous rocks are not bedded, so these rocks can be machined as necessary to produce the shapes needed in construction, regardless of their original orientation in the Earth.

Most rocks worked for building stone are removed without the use of explosives. Before the development of modern machinery for this purpose, wedges were driven into the bedding planes to separate the layers, and hand-hammered star drills were used to make a row of holes back from the edge where the block would be broken off (fig. 1). Separated beds of rock were broken along the row of holes with what are called *plugs* and *feathers*. These are tapered plugs that are driven into the hole inside a steel split tube (the feathers). The stone blocks obtained in this way are then *dressed*, that is, shaped and given a smooth

Fig. 1. Small hand-worked quarry near Wabash, Indiana, from which limestone for foundations, walls, and flagstones was produced; it was active until 1949, when this photo was taken.

face, with hammers and chisels. This method of obtaining stone for building is still in use in many parts of the world, but in the United States the hand labor involved is very expensive, so nearly all the stone currently in use can be removed and milled with machinery (Bowles, 1934; Thiel and Dutton, 1935; Currier, 1960; Patton and Carr, 1982).

In order to remove large blocks of dimension stone from a limestone or sandstone quarry, channeling machines were used to cut a slot back from the main wall. The kinds of channeling machines used include steam- or gasoline-powered engines that travel on a narrow-gauge track and pound a set of bits on the ends of flat rods into a channel or narrow trench to the depth desired, generally between 6 and 12 feet. In recent years, wire saws have become more common for separating large blocks from the quarry. Quarry blocks are then cut into shorter mill blocks with large circular diamond saws or by the use of plugs and feathers in pneumatic drill holes. Granites, which are much harder than limestone and sandstone, cannot be channeled in the same way. In granites, channeling is done with wire saws or by drilling a series of closely spaced holes, then cutting out the webs between them.

History of Stone Used in Lincoln

Most cities that have existed for a century or longer are a treasure house of stone. Stone was used in the construction of the more permanent buildings, particularly churches and government buildings, but also many of the more substantial houses. Many of the buildings in the central business district of Lincoln and the City Campus of the University of Nebraska-Lincoln (UNL) have been constructed of or faced with distinctive kinds of stone. Although recent construction has been dominated by concrete and brick, buildings erected prior to the mid-20th century, as well as some more recently completed, provide a varied display of stone. These buildings are faced or cladded with both local and imported stone that serves as a public display of many distinctive geologic environments. Some of the structures of rocks that cannot be seen in the small pieces used in a museum or as teaching laboratory specimens become readily apparent on a larger piece, such a those used in facing on buildings.

When Lincoln was founded, local sources of stone provided the only materials available for foundations, and it was also used for the entire exterior of some early buildings. Some of the stone found in eastern Nebraska is of high quality, but it is limited in quantity and accessibility. When transportation methods improved, and it became possible to import high quality stone from many other places at lower cost than that produced locally, the local stone fell into disuse.

Architecture reflects not only the periods when certain buildings were designed and erected but also the materials available for use in construction. Prior to about 1900, dimension stone was cut into massive blocks of sufficient size to stand as solid stone exterior walls of most buildings. Stone walls 8 inches or more thick were common; squared stone blocks 6 to 9 inches high, 2 feet long, and 6 to 8 inches deep can be seen as the above-ground foundation materials of many of the houses of the period that still stand (fig. 2).

Limestone and sandstone quarried from locations within a few miles of Lincoln were used from the 1860s until about 1887, when railroads had been completed and stone could be brought from greater distances. The Burlington and Missouri River Railroad reached Lincoln

Fig. 2. Sandstone foundation blocks and trim used in the Tyler House, built in 1890, 8th and D streets, Lincoln.

in 1870, but the importation of stone from outside Nebraska evidently didn't begin until the 1880s.

Construction methods began to change during the period following the First World War. Terra cotta and brick replaced stone in many commercial buildings. Since World War II, dimension stone, and especially limestone, was cut into 4-inch-thick blocks to be used as veneers over a wood or steel framework and no longer served to support major walls. In addition, sheets about 1-inch thick of polished stone, especially granites and marble, came into use as cladding for the exterior of some commercial and governmental buildings. Limestone, in particular, has continued to be used as facing on residences and small commercial buildings, but during the last part of the 20th century, the exteriors of many large public structures have been cladded with sheets of polished stone. A brief but very useful list of references on building stone was compiled by Hannibal and Park (1992).

Early Lincoln and Eastern Nebraska Building Stone

Although most of Nebraska is in the Great Plains Physiographic Province (Fenneman, 1941), Lincoln is located near the west edge of the Dissected Till Plains Section of the glaciated part of the Central Lowland Province (Fenneman, 1938). In this physiographic region, the underlying materials are a thin veneer of loess (wind-deposited silt) over glacial till, which in turn rests on a highly dissected surface eroded prior to the glaciations. The underlying bedrock consists of nearly horizontal sedimentary rocks – sandstone, shale, and limestone – that are Late Cretaceous, Permian, and Pennsylvanian in age. At least five rock units in southeastern Nebraska have been used as local sources of dimension stone since the region became a state (fig. 3), but only one of these is currently in use for that purpose.

The first stone quarried for building construction in Lincoln may have been sandstone from the Dakota Formation of Late Cretaceous age. Samuel Aughey, Nebraska's first state geologist, pointed out that sandstone in the Dakota furnishes some of "the hardest and the softest stone in the State." The best quarry, he wrote (Aughey, 1880), is in Dakota County, and that rock unit furnishes building stone in several other counties, including Lancaster. Most of the sandstone in the Dakota Formation is poorly cemented and of no value as building stone.

A few beds, however, have been cemented with iron oxide and are durable. This dark brown sandstone was used in several of the early buildings in Lincoln (Barbour, 1903). Sandstone quarried from a site about 8 miles northwest of Lincoln was used for the first bank building in the city, erected in 1868, at the northeastern corner of 10th and O

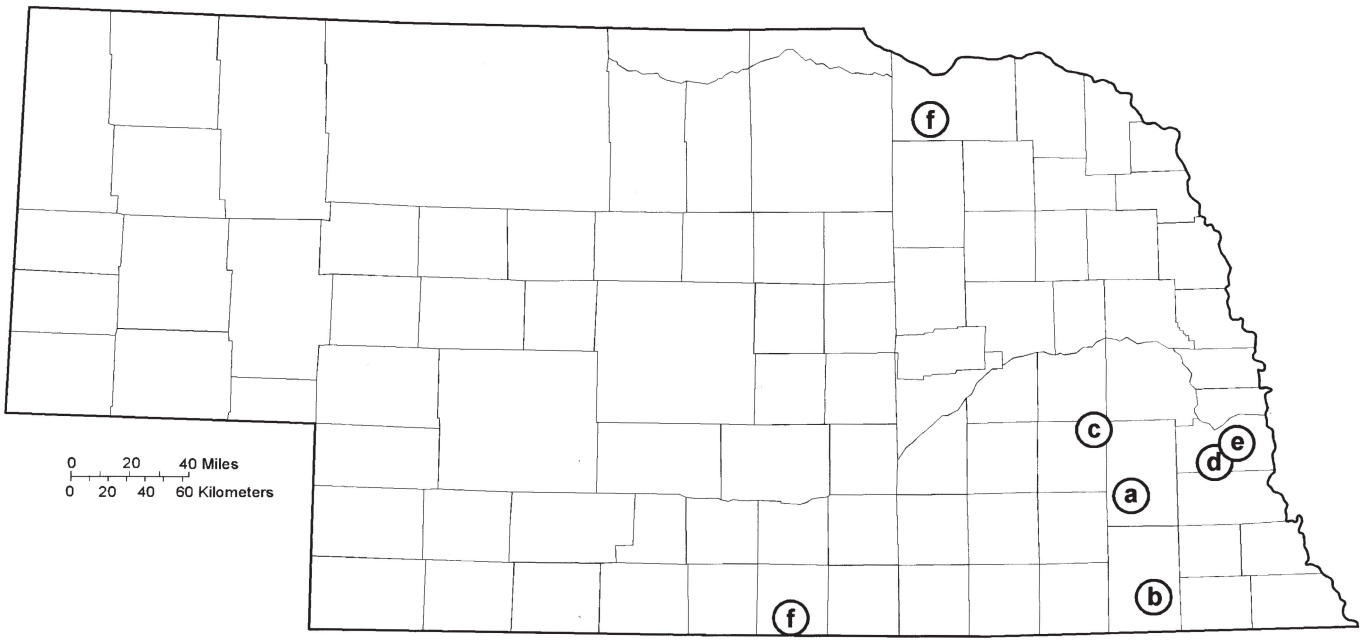

Fig. 3. Where dimension stone has been quarried in eastern Nebraska: a) Roca (limestone); b) Wymore-Blue Springs (limestone); c) North-central Lancaster County (sandstone); d) Weeping Water (limestone); e) Plattsmouth, Dyson Hollow quarries (limestone); f) Franklin County, near Bloomington, and Knox County (green quartzite).

streets (McKee, 1996). Similar stone was used in 1869 for the foundation of the Kennard House (fig. 4), 1627 H Street. Some beds of light brown fine-grained sandstone were also quarried for use as building stone. Clay in the Dakota Formation is the major source of the raw material used by the Yankee Hill Brick Company of Lincoln and the Endicott Brick Company of Fairbury for the manufacture of brick and tile, and uncemented sand from the Dakota was dug near Yankee Hill in southeastern Nebraska for plaster sand.

Some beds of the lower part of the Ogallala Formation of Miocene age are a greenish-gray quartzite, called the *Bloomington quartzite* by Barbour (1915) – sandstone cemented with silica. In a few places in south-central and northeastern Nebraska, beds of this stone have been used in wall construction and squared for use as foundation blocks. In Lincoln, one can see this distinctive green stone in the fireplace chimneys of a shelter house on the west side of Antelope Park, located east of Memorial Drive, south of A Street (fig. 5). During the late 19th century, it was installed as paving blocks in some of the alleys of downtown Lincoln, where it still can be seen in the alley that runs between 8th and 9th streets north of N Street.

Both Permian and Pennsylvanian limestone beds from Nebraska were a source of material for construction of homes and other buildings in 19th-century Lincoln and the surrounding communities. Aughey (1880) reported active limestone quarries produced stone for construction in Richardson, Pawnee, Gage, and Johnson counties, as well as in Nemaha, Otoe, and Cass counties. Quarries near Roca, about 15 miles south of Lincoln, were opened in the 1860s, and dressed blocks of stone from these operations were shipped to many places in southeastern Nebraska. Several houses in and near Roca built of it still stand (fig. 6). Unfortunately, some of the limestone from the Roca quarries is shaly and does not stand up well when exposed to weather.

"Blue limestone" from the quarries at Roca was selected for the first Nebraska State Capitol building in Lincoln (Hays and Cox, 1889). The east wall, constructed with this stone, began to disintegrate soon after it had been built. A search for a more durable stone resulted in discovery of suitable stone near Beatrice (Hays and Cox, 1889; Sawyer, 1916), and the building was completed with that stone. The Fort Riley Limestone, quarried in Kansas for building stone, crops out along Big Blue River and may have been the rock unit used. Because the first capitol building had been poorly built, it began to disintegrate, and the legislature voted to replace it.

The first capitol building in Lincoln had been built with a north-south orientation, so that new wings could be added on the east and west sides (Luebke, 1990). Those wings were added before the center was demolished to begin construction of the second building. Limestone from a quarry on the north side of the Platte River, opposite South Bend, was used in construction of one of the new wings on the state capitol building (Aughey, 1880). The wings could then be occupied by the government while the second capitol building was completed.

Some of the exterior of the first state capitol building had begun to crumble, and the north wall was condemned in 1878, so it was torn down and rebuilt. The structure was

Fig. 4. Dark brown sandstone from the Dakota Formation in the foundation of the Kennard House, 1627 H Street in Lincoln.

Fig. 5. Green quartzite from the Ogalalla Formation in the chimney of the shelter house at Antelope Park in Lincoln, east of Memorial Drive, not far from Capitol Parkway and A Street.

replaced by the second state capitol building. The cornerstone was laid in 1881 and the building was completed in 1888 with "white limestone from Nebraska" (Nebraska State Journal, 1888b). Some of the stone in that building probably came from the quarries along the Big Blue River southeast of Beatrice, although part of the stone came from the "old Stout quarry" a mile east of Louisville (Woodruff, 1906).

Most of the stone in the Ager Play Center at 27th and B streets is reported to have come from the Roca quarries in the 1930s. A few of the stone blocks in the walls of that building are a limestone that may have come from the Plattsmouth area, however. Today, beds of the Neva Limestone of Permian age at Roca are still quarried (fig. 7), but it is now used almost exclusively for retaining walls and landscaping. On the City Campus of UNL, the limestone beds around Love Library, 13th and R streets, that were set to resemble outcrops came from this quarry (fig. 8), as did the roughly squared blocks of the retaining wall around the Mueller Bell Tower.

The Rock Bluff Limestone of Pennsylvanian age supplied dimension stone in the late 1800s for the construction of houses and churches in Weeping Water. Beds of this formation contain large masses of a finely crystalline pyrite that became oxidized and left dark brown stains of limonite down the exterior surfaces of some of the buildings that were constructed with it. The United Methodist Church in Weeping Water (fig. 9), built in 1871, is an especially good example of this kind of stain (Barbour, 1903). The church was badly damaged by fire in December 2000 but was rebuilt by 2003. Many of the limestone beds quarried for construction contain abundant fusilinid foraminifera. These are one-celled marine organisms that resemble grains of wheat. They lived

during the Pennsylvanian and Permian periods, from about 323 to 248 million years ago, but became extinct at the end of the Permian. Fusilinid limestone from Johnson County was used for the courthouse in Tecumseh (Aughey, 1880).

The stone used for the exterior of Lincoln's old city hall (fig. 10), built in 1874 as a U.S. post office and courthouse on the north side of O Street between 9th and 10th streets, is a fusilinid limestone that came from the Gwyer Quarry along the north side of the Platte River near Plattsmouth (Brown, 1988). Though now heavily overgrown, some of the old quarries in the "DeKalb" limestone beds (South Bend Limestone of the Stanton Formation), from which this stone was taken, can still be found along the east side of the Dyson Hollow Road in Sarpy County, about 1½ miles west of La Platte. During the 1930s, a quarry in the Stoner Limestone was opened by the U.S. Public Works Administration a short distance east of the old Dyson Hollow quarries (Condra and Scherer, 1939). Some beds of this limestone are highly fossiliferous, nearly a coquina, composed almost wholly of fusilinid foraminifera (Barbour, 1903; Condra, 1930). The squared blocks were dressed with a rock-faced or pitched-faced finish, a technique rarely used today because it requires a large amount of expensive hand labor.

The lower part of the St. Paul Methodist Episcopal Church on the northwestern corner of 12th and M streets is the same limestone. The original church on that site, built entirely of limestone, was completed in 1885. It burned in 1899, but some of the stone was salvaged and reused in the present church, which was completed in 1902. Additions to the west end of the church, the last in 1999-2000, are faced with limestone from Indiana. Several blocks of this same fusilinid rock unit, perhaps salvaged from the burned

Fig. 6. House in Roca built of limestone from nearby quarries in the 1860s.

church, were used in the north wall of the building at the northeastern corner of 11th and O streets, which is a montage of this and at least one other limestone, as well as blocks of Dakota sandstone (fig. 11), all of which surely were reclaimed from earlier buildings that had been demolished.

A similar fusilinid limestone makes up the basal three courses of the Old Main Building, built in 1887 on the campus of Nebraska Wesleyan University. This same limestone was used for foundation blocks in many of the homes built in south Lincoln along 16th and 17th streets and some of the cross streets, such as A through D streets, before about 1900. Weathering by rainwater in the century since these buildings were erected has dissolved some of the fine-grained matrix, leaving the foraminifera standing out in relief. After about 1900, concrete blocks became the material of choice for most house foundations.

Many of the buildings in Lincoln's Haymarket area (7th to

Fig. 7. Schwarck Quarry north of Roca (about 1980). Equipment on the quarry floor is used to split blocks for retaining walls. Note heavy equipment in the center left for scale.

Fig. 8. Landscaping on the City Campus of the University of Nebraska-Lincoln, using Neva Limestone from Schwarck Quarry near Roca.

Fig. 9. The United Methodist Church in Weeping Water, showing the stains left from the decomposition of pyrite masses in the rock.

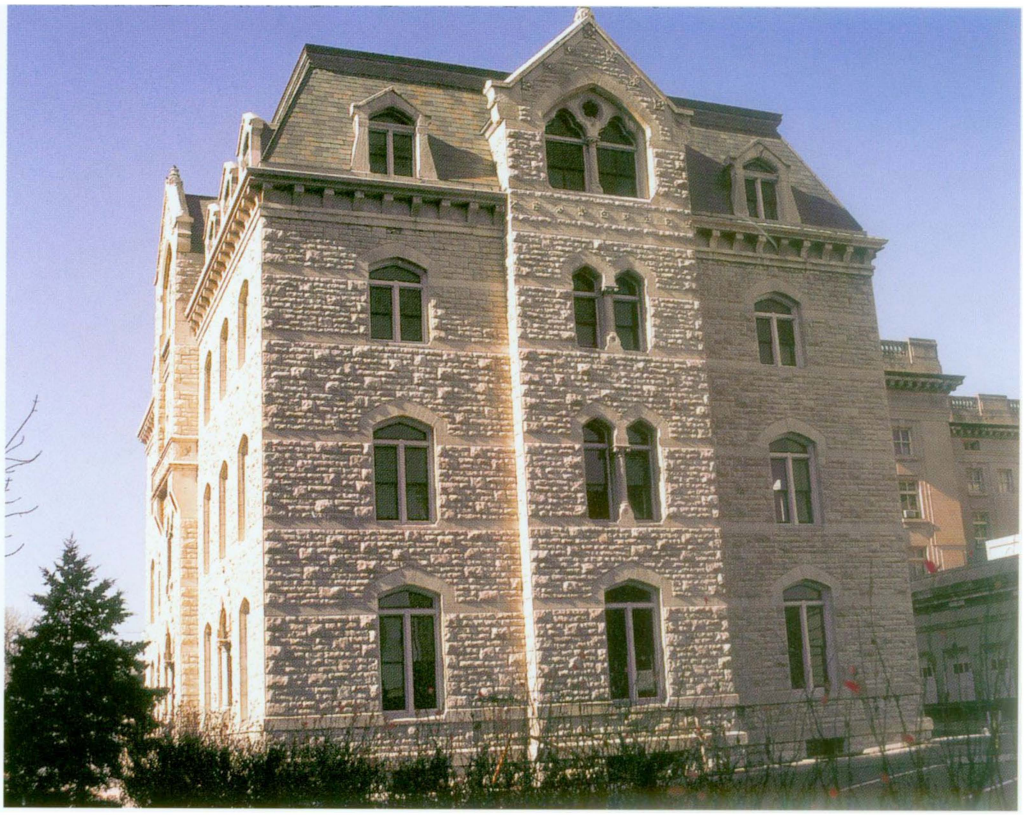

Fig. 10. Old city hall between 9th and 12th streets in Lincoln, built from fusilinid limestone quarried from Dyson Hollow north of Plattsmouth.

9th and N to R streets) have foundation courses of stone, although the upper parts of the buildings are of brick. Along the south side of the O Street overpass, the building of the Schwarz Paper Company (built in 1884) has a base course of local limestone that contains abundant fusilinid foraminifera similar to that on the old courthouse. The Raymond Brothers Building on the northeastern corner of 8th and O streets has a base course of rock-faced white limestone; the sill of a former opening on the west side is made of squared and dressed blocks of fusilinid limestone. These limestone blocks have been strongly affected by the weather, and the corners of some of them are crumbling. Only the stone used in the base of the Clark Building (also known as the "candy factory") at the northwestern corner of 8th and P streets shows little damage from weather. The stone at street level on this building is fine-grained gray sandstone.

The few limestone units in Nebraska that have the strength and durability to serve as dimension stone are thin and must be hand-worked; many of the limestone beds are too clayey to stand up to the climate when used in exterior construction. Except for the continuing use of small amounts of limestone from a quarry north of Roca in landscaping and retaining walls, no dimension stone in use today comes from Nebraska.

Imported Dimension Stone

After the Burlington and Missouri River Railroad had been extended through Lincoln, importation of dimension stone that had been quarried from more distant sources became possible (fig. 12). In 1886, the Cleveland Stone Company consolidated a large number of separate smaller companies that produced stone from the Berea Sandstone of Mississippian age in Lorain County, Ohio, near Cleveland (Bownocker, 1915). Soon afterward, the company began sending shipments of sandstone blocks as far as eastern Nebraska. About the same time, companies extracting the Salem Limestone of Mississippian age, known commercially as *Indiana limestone*, began to export to markets outside that state (Blatchley, 1908; Patton and Carr, 1982).

Sandstone

Sandstone is an important building stone in many regions, but it has been less used in Lincoln than most other building materials. Layers of sandstone from Colorado were set as curbing, with the bedding vertical, along many Lincoln streets in 1888-1889 (Nebraska State Journal, 1888c). Some of this curbing still can be seen on 14th Street north of Vine and R Street along the south side of the City Campus of UNL. It also remains on several other major streets, including 17th Street from J Street nearly to South Street, and 11th as far south as C Street, as well as some cross streets, such as J and F streets east of 17th Street. Wherever streets have been widened, of course, sandstone curbs have been replaced with concrete.

In addition to limonite-cemented beds of Dakota sandstone and the green Ogallala quartzite that were quarried locally, at least three kinds of sandstone were used in construction in the late 1800s and early 1900s. Several buildings erected in Lincoln prior to 1900 have foundations and trim of a light gray, fine-grained sandstone. Notable among these are the Clark Building (fig. 13; built in 1885) on the northwestern

Fig. 11. North wall of the building at the northeastern corner of 11th and O streets, Lincoln. It contains stone from at least four different rock units. Black granite was used for the base course when this building was remodeled.

corner of 8th and P streets and the Tyler House (built in 1890) at 8th and D streets (fig. 2). Similar stone was also used for the facing on the north (front) face of the Francine Apartments at 11th and H streets. Blocks of gray sandstone 28 inches by 9 inches by 6 inches deep make up the foundation of several houses in the area between 8th and 20th streets, south of the capitol, that were built about 1900. This stone probably is the Berea Sandstone, used extensively in many buildings in Ohio and Ontario and shipped at least as far west as eastern Nebraska (Cushing and others, 1931). The main part of the wall along the south side of the old city hall on O Street between 9th and 10th streets is light brown sandstone, probably built around 1885 with Dakota Formation stone from one of the old quarries north of Lincoln. The steps and cap are light gray sandstone that resembles that used in the curbstones. More than a century of exposure to the climate of Lincoln has modified the surface of the Dakota sandstone part of the old city hall wall into interestingly grotesque shapes, but the capping sandstone shows little alteration (fig. 14).

One of the most distinctive buildings in downtown Lincoln is the Burr Building, on the northeastern corner of 12th and O streets (fig. 15). Built by C.C. Burr in 1886 as a six-story tower, its exterior is rock-faced light brown sandstone brought from Berea, Ohio (Nebraska State Journal, 1888a). In 1916, the Security Mutual Life Company rebuilt and increased the height of the building to 10 stories, keeping the same brown sandstone facing. From 1959 until 1985, while it was known as the Anderson Building, at street level the front was faced with polished black fossiliferous limestone. In 1985, rehabilitated as the Centerstone building, at street level the facing was replaced with panels of Salem Limestone from Indiana.

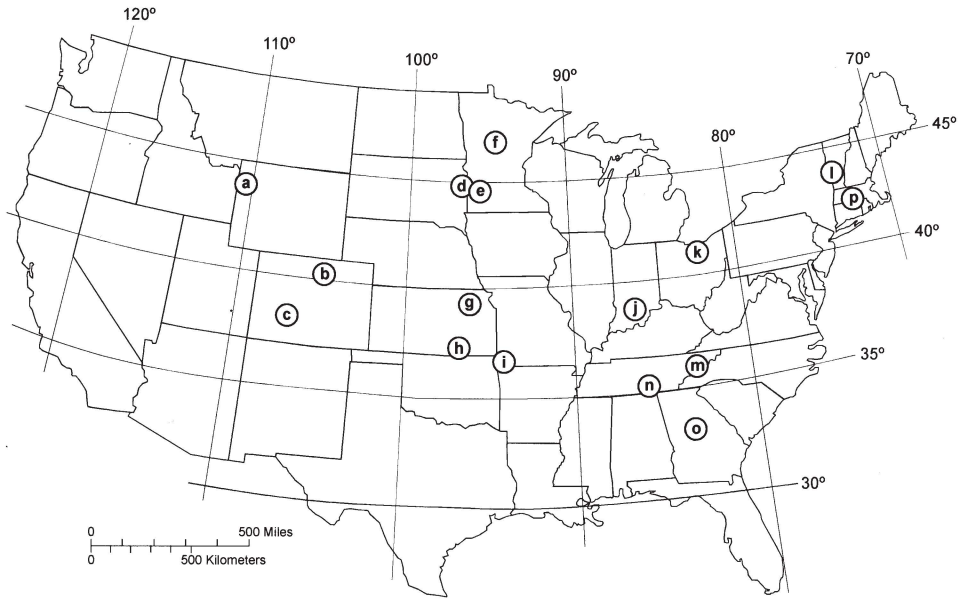

Fig. 12. Sources of dimension stone used in Lincoln outside Nebraska: a) Jackson, Wyoming; b) Ft. Collins, Colorado; c) Gunnison, Colorado; d) Milbank, South Dakota, and Ortonville, Minnesota; e) Morton, Minnesota; f) St. Cloud, Minnesota; g) Onaga, Kansas; h) Silverdale, Kansas; i) Carthage, Missouri; j) Bedford, Indiana; k) Berea, Ohio; l) Proctor, Vermont; m) Holston, Tennessee; n) Crab Orchard, Tennessee; o) Atlanta area, Georgia; p) Milford, Massachusetts.

Fig. 13. Clark Building ("candy factory"), 8th and P streets, the Lincoln Haymarket, Berea Sandstone.

The red Fountain Sandstone of Pennsylvanian age from Colorado also was used in the construction of several houses in Lincoln around the turn of the century (Hoyt, 1903). The Phillips Castle, 1845 D Street (fig. 16), was built in 1889 of this stone, as was the military academy that once stood northwest of 14th and Superior streets and the Clark-Leonard House at 20th and F streets (Zimmer, 1990). Still another building of this kind of sandstone is Maple Lodge at 20th and Euclid streets. This Colorado red sandstone was used for the sidewalk around the second capitol building in Lincoln, then was reused for flagstones in the patios at the entrances after the present capitol building was completed. The Fountain Sandstone and a lighter colored sandstone from Tennessee were chosen a few years ago for the flagstone walkways on the south side of First Plymouth Congregational Church at 20th and D streets.

Limestone

Perhaps the stone most extensively selected for the exteriors of buildings on the UNL City Campus and in downtown Lincoln is the Salem Limestone of Mississippian age (Indiana limestone). It is quarried from a small area in south-central Indiana (Patton and Carr, 1982). The exterior stone of the Nebraska State Capitol came from a single quarry of the Indiana Limestone Company of Bedford, Indiana (fig. 17), opened for that purpose. The officers of the Indiana Limestone Company no longer have records of the quarry dedicated to stone for the Nebraska State Capitol building, but they are reasonably sure that it came from their Empire Quarry, which was the source of stone for the Empire State Building in New York. Fowler (1981) and Luebke (1990) discuss the history, construction, and art of the capitol building (fig. 18), built between 1922 and 1932.

The outer part of the present building was built around the second capitol (fig. 18), which was then removed to construct the tower. The pillars, sills, and lintels of several of the buildings on the UNL City Campus (Morrill, Bessey,

Fig. 14. Sandstone wall along O Street on the south side of the old city hall.

Fig. 15. Burr Building, now Centerstone; Salem Limestone along street level, pitched-face sandstone from Berea, Ohio, as above.

Andrews, and Burnett halls, the Coliseum, and the College of Business Administration building) are made of this stone, which is a thick-bedded limestone composed almost entirely of tiny subspherical foraminifera and fragments of larger fossils. Although most of the buildings on the UNL East Campus were constructed of buff-colored brick, Indiana limestone can be seen as trim around the entrances and windows of nearly all the buildings that surround the East Campus mall, as well as several other buildings on that campus. At least 60 percent of the dimension limestone in use today in the United States is Indiana limestone, which can be removed in large blocks and worked readily by machinery. In Lincoln, it can be seen as ashlar (state capitol building, figs. 18 and 19), shot-sawed facing slabs (Stuart Building, 130 N. 13th Street), pillars and ornaments on many buildings, and carvings in relief (state capitol building and Assurity Life Insurance Company building (formerly Woodman Accident and Life), 1526 K Street, northeast of the state capitol building (fig. 20).

Indiana limestone is available in three textural classes: rustic, standard, and select (Indiana Limestone Institute of America, 1973). *Rustic* is the term given to a relatively coarse-grained, somewhat porous rock composed of small fossils and fossil hash. This type of stone is now used primarily as split-faced ashlar on homes, although blocks of rustic grade were mixed with standard on the older buildings on the UNL City Campus, such as Morrill and Bessey halls. *Standard* is the stone most frequently used; *select* is a uniformly fine-grained, dense, relatively non-porous stone that is often used in governmental buildings. It can be seen on the federal building at 100 Centennial Mall North in Lincoln (fig. 21).

Other popular dimension limestones used in Lincoln are the Fort Riley Limestone of Permian age, which has been quarried at Junction City, near Manhattan, Kansas, and in the southern part of that state, near Silverdale, and the Onaga Limestone from Pottawatomie County in northeastern Kansas (Grisafe, 1976). Both resemble the Indiana building

Fig. 16. Phillips "castle" (above), 19th and D streets, sandstone from quarries near Ft. Collins, Colorado.

Fig. 17. P. M. and B. Quarry of the Indiana Limestone Company (left), Bedford, Indiana. Salem Limestone for the state capitol building came from one of the quarries operated by this company.

Fig. 18. Nebraska State Capitol Building (right), about 1924, when the outer walls had been completed around the second state capitol building (photo from the files of E.C. Schramm).

stone, although they are more yellowish in color and some of it is somewhat coarser grained. Both limestone units are sold with cut surfaces for split-faced ashlar, and bedding-plane blocks of the Onaga are also used for facing. During the decade following World War II, many houses, apartment houses, and some commercial buildings throughout Lincoln were faced with this stone (fig. 22), although little of it has been used as veneer in the central business district of the city.

The limestone facing of many buildings in Lincoln has become coated with a dark gray stain (fig. 23). Some of this staining is dust, which accumulates where rainwash doesn't remove it, but the dark gray coating on more exposed areas is caused by the growth of bacteria and fungi and is particularly noticeable on the northern and eastern sides of buildings. Water alone, from precipitation and dew, dissolves limestone surfaces, but the corrosion rate is accelerated by the presence of these organic substances. Not all limestone facing seems to be affected by this surface stain, but more recently, other material that is less susceptible to its formation is often used. Dense (low-porosity) limestone seems to be less affected than limestone of greater porosity. In addition, limestone is especially affected by acid precipitation, often called *acid rain* (Patton, 1977; Winkler, 1978). Most of the limestone blocks used in construction in Lincoln in the 1870-1890 period show significant solution, and less soluble fusilinid foraminifera stand out in relief.

Marbles and crystalline limestones

Limestones that are crystalline and sufficiently dense to be polished are considered commercially as marble; true marble, however, is a crystalline rock produced by the metamorphism of limestone or dolomite under great heat and pressure. Much of the marble used as separation panels in restrooms in many older buildings, including Bessey Hall on the UNL City Campus, is a crystalline, pink, stylolitic, fossiliferous limestone from eastern Tennessee (the Holston "marble"). Some, including the wall paneling on the ground floor of the state capitol building, is a gray fossiliferous limestone from Carthage, Missouri (Robert Ripley, oral communication).

The Sheldon Art Gallery on the UNL City Campus, as well as a few other buildings in Lincoln (Sartor-Hamann Jewelry at 1150 O Street), are faced with travertine marble imported from Italy, north of Rome. It has also been used as interior paneling in the UNL (City Campus) Canfield Administration Building and the nave of First Plymouth Congregational Church at 20th and D streets. Similar stone used for facing on the new AAA (formerly American Automotive Association) building at 29th and O streets came from Jackson Hole, Wyoming.

Marble of metamorphic origin has been little used as exterior facing on buildings in Lincoln, although it can be seen as interior paneling in several downtown buildings, including the U.S. Bank building at 13th and L streets. The former Centel building (south side of N Street between

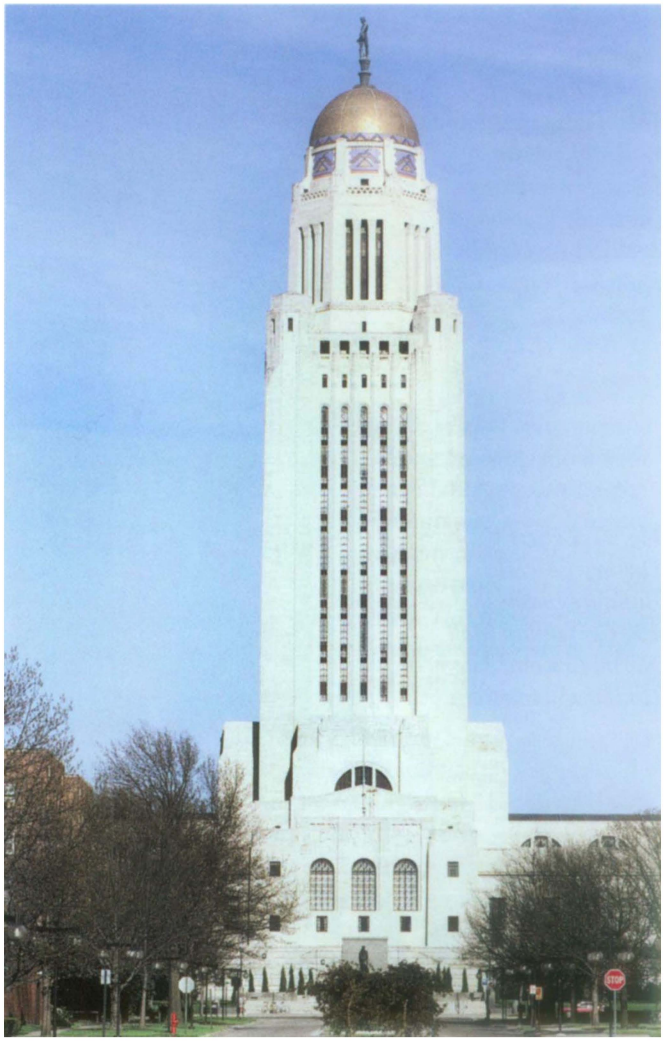

Fig. 19. Nebraska state capitol building, 14th to 16th, H to J streets, Salem (Indiana) Limestone.

11th and 12th), now part of the Tier One Bank complex, is cladded with white marble from Georgia. It has a swirling pattern made by small flakes of graphite and/or chlorite and may be the only structure in the city on which marble has been used for exterior facing (fig. 24).

Verde antique is the name used for a metamorphic rock composed of serpentine that has extensive white veining. Verde antique from Proctor, Vermont, was used to face the entrance to the Nebraska State Historical Society building at 15th and R streets, completed in 1953 (fig. 25), The remainder of the building is Indiana limestone. Verde antique faces the building at 14th and Q streets that is now the UNL Admissions office. The verde antique used as trim inside the old Miller and Paine Building, on the southwestern corner of 13th and O streets, came from Verona, Italy, as did that in the state capitol building. Verde antique is classed as "marble" commercially, although it is not a carbonate rock, as are all other marbles. The white veins that make it so distinctive may be calcite, quartz or chrysotile asbestos

Fig. 20. Carved panel in medium relief, Salem Limestone, south wall of the Assurity Insurance building (formerly Woodman Accident and Life), 1526 K Street.

Fig. 21. Robert V. Denney Federal Building (below), 100 Centennial Mall North, Lincoln. Salem (Indiana) Limestone.

Fig. 22. Commercial building at 2020 N Street, split-face ashlar from the Fort Riley Limestone, near Silverdale, Kansas.

Fig. 23. Wall of apartment building probably faced with Onaga Limestone, stained with dust and mold. There are many of these on O Street between 27th and 48th streets. This one is on the northwestern corner of 21st and O streets.

(which is a fibrous form of serpentine). The unusual grayish-green panels on the face of Keim Hall on the UNL East Campus are neither marble nor verde antique, but instead are a chlorite-biotite schist, a metamorphic rock.

Granites and related igneous rocks

Igneous rocks, called "granite" commercially, and encompassing not only true granite, but also gabbro and some of the intermediate rock types in the granite-gabbro series, have been set as facing in many commercial and governmental buildings in the city. In contrast to limestone, which is a relatively soft rock that is fairly easily worked, granite and its varieties are much harder. *Hardness* is defined by geologists as resistance to scratching and is rated on a scale of 1 to 10, soft to increasingly hard minerals. Limestones and marbles are composed of the mineral calcite (hardness 3), although some dolomite (hardness 4) has been used as building stone. Granites are mostly feldspar (hardness 6) with 5 to 30 percent quartz (hardness 7). Although some of the igneous rocks included commercially as granite do not contain quartz, all of them are much harder than calcite and dolomite. Granite's hardness makes it much more abrasion-resistant than limestone, so it is an excellent stone for use in steps, patios, and paving blocks.

Fig. 24. TierOne Bank, formerly Centel, building, 12th and N streets, with marble cladding.

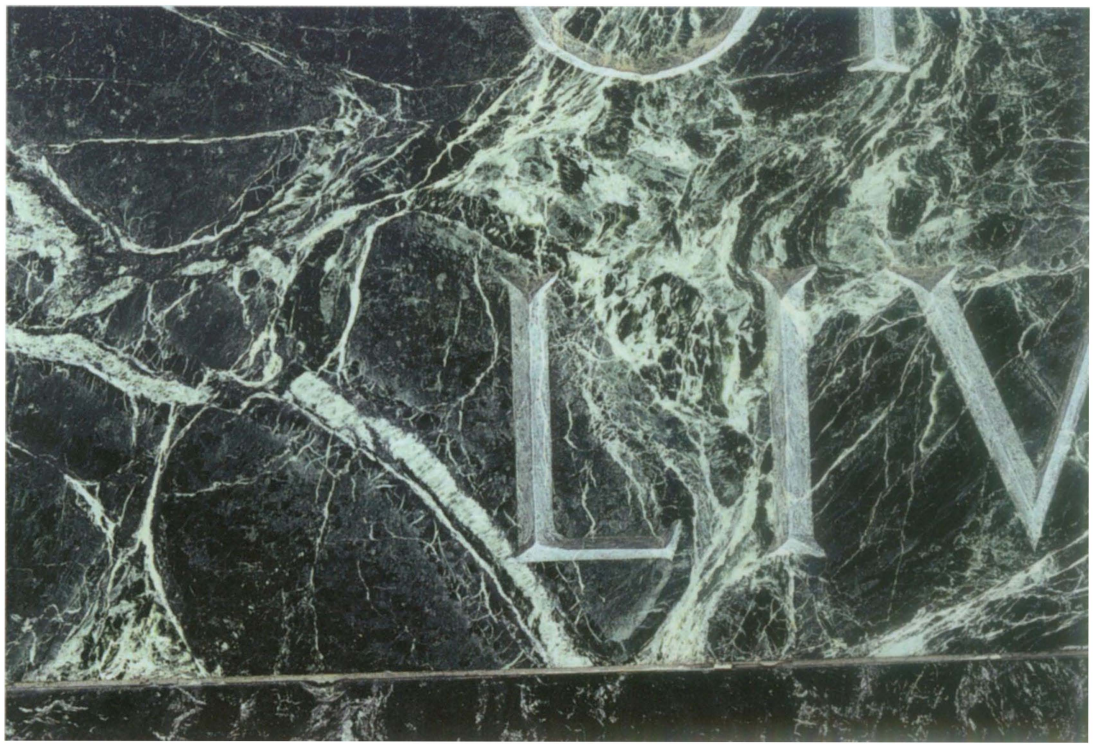

Fig. 25. Verde antique on the front of the Nebraska State Historical Society building, 15th and R streets, near the edge of the UNL City Campus.

Granite takes a high polish, and its surface is resistant to both abrasion and corrosion; therefore, it is often employed on both external and internal surfaces. The color of granite is determined by the feldspar, which makes up from 60 to 90 percent of the bulk of the rock. With true granites, the dominant feldspar is orthoclase or microcline (both potassium feldspars), and the rock may vary from nearly white (orthoclase) to salmon-colored to dark red (usually microcline). The common plagioclase feldspars are light gray to medium gray, although one, labradorite, an iridescent, dark blue feldspar, is the principal constituent of anorthosite (commercially called *black granite*). Gabbro, another "black granite," consists of augite, a pyroxene, and dark gray plagioclase feldspar.

The granites that are most commonly used in downtown Lincoln and on the UNL campus are a dark red (mahogany) granite from Wisconsin, Milbank, South Dakota, and Ortonville, Minnesota, along the Minnesota River valley (Bowles,1918; Thiel and Dutton,1935). These red granites can be seen on the east face of the UNL (Canfield) administration building, the remodeled former Penney's building on the northeastern corner of 13th and O streets (fig. 26), now the offices of the Nebraska Higher Education Loan Program, and the University Square parking and office building, completed in 1990, on 14th between O and P streets,. This same "mahogany granite," along with Indiana limestone, was chosen for the base for "Archie," the bronze statue of a mammoth that stands on the north side of Morrill Hall, the Nebraska State Museum building. Rough quarry blocks of the same granite were used in the design of the new fountain on the north side of the City (student) Union building on the City Campus of UNL.

Lincoln's milestone marker, which stands at the northwestern corner of 9th and O streets, is set in a monument of coarse-grained red granite. All vertical faces of the monument are randomly equigranular (all grains or crystals roughly the same size) with grains 3 to 15 millimeters across, but on the top surface of the monument, the feldspar crystals are aligned in a southeast-to-northwest direction, the way the stone was set. One of the ways in which this kind of alignment can develop in an igneous rock is for slight flowage to take place in the magma, just before complete solidification.

The base of the monument is the same kind of stone but has a rock-faced finish. Similar granite with aligned feldspar crystals can be seen on the east face of Ferguson Hall on the UNL City Campus. A very coarse-grained pink granite from the St. Cloud area in west-central Minnesota was used for the base course of stone in the state capitol building. The granite was used for the steps, and the terrace of the building came from Connecticut. It is also street-level facing on the building on the southwestern corner of 13th and Q streets, now occupied by the National Research Corporation, as well as the steps of the UNL administration building.

The Pillars, a colonnade of granite that stands between Memorial Stadium and the Coliseum, was quarried in 1893 from Granite Spur near Gunnison, Colorado (Hoyt, 1893). They were originally part of the Burlington Railroad depot in Omaha. When that building was remodeled in 1930, they were removed and added to the UNL City Campus (Kopiasz and Miller, 2004). Massachusetts was the source for the granite used for the architectural structure for the statue of Lincoln that stands at the west entrance to the state capitol building, dedicated on Labor Day 1912 (Nebraska State

Fig. 26. Dark red "mahogany" granite from Milbank, South Dakota, facing on the office building of Nebraska Higher Education Program, 13th and O streets.

Journal, 1912; Watkins, 1912). The granite in the structure resembles the granite from the Milford region in the south-central part of Massachusetts (Dale, 1923). Many different kinds of stones not discussed here were used in the interior of the state capitol building (Pabian, 1974). The capitol building interior is itself another treasure trove of building stone, but to examine it in detail would require virtually another paper. See Pabian (1974) for an extensive look at its building stone.

The distinctive dark iridescence of the rock anorthosite makes it desirable for many applications by architects. This "black granite" is the facing at the Stuart Building (southeastern corner of 13th and P streets) and the Walgreen's Drug Store (southeastern corner of 13th and O streets). It was also used for the trim on The Grand movie theater, which opened in 2004. Another kind of black granite was used for panels on the northern and southern faces of Pershing Auditorium, 15th between M and N streets. This has the composition of monzonite. It contains medium-gray plagioclase, which crystallized before the black mineral (biotite), and orthoclase, which filled in the spaces when it solidified. The biotite contains flakes of a red mineral, probably hematite.

The street level of the building at the northeastern corner of 11th and O streets is faced with panels of gabbro, also known commercially as "black granite," which probably came from quarries north of Duluth, Minnesota. The north (alley) wall of this building is the one constructed of blocks of stone from several local geologic units that probably were reclaimed from older buildings that had been demolished. An unusual variety of stone, imported from Norway, consists of medium-blue iridescent sodium and potassium feldspars. Called *laurvikite*, it was on the front of the former Commonwealth Savings and Loan Building (fig. 27) at the northeastern corner of 11th and P streets before it was demolished in 2003 to make space for The Grand theater.

Even though granite is one of the most durable of building stones, extreme exposure can damage its surfaces (Winkler, 1994). The second federal building in Lincoln, now Federal Place Apartments, erected before 1900 on P Street between 10th and 11th streets, is made of Indiana limestone above a base course of gray granite. The south-facing granite panels at the east entrance to the building show considerable exfoliation of a layer 3 to 4 millimeters thick (fig. 28). The damage to this surface probably resulted from moisture penetrating microscopic fractures in the rock, which was then subjected to enough repeated cycles of solar heating when the rest of the blocks were frozen, and/or wetting and drying and freezing and thawing, that its surface has begun to fail.

Metamorphic rocks employed as building stone in Lincoln, in addition to marble and verde antique, include granite gneiss, or migmatite, from the Minnesota River valley of southwestern Minnesota (Morton Gneiss, about 3.5 billion years old; fig. 29), which is on the street level of the Stuart Building. Commercially, granite gneisses are treated as granites.

Slate, a rock composed of metamorphosed shale, has been used for roofing on several of the buildings in Lincoln, including Architectural Hall and Love Library on the City Campus of UNL. Greenish-gray slate from Vermont was used to construct the retaining walls of the UNL Wick Alumni Center building, 16th and R streets (fig. 30).

Fig. 27. Laurvikite on front of the former Commonwealth Building, demolished in 2003.

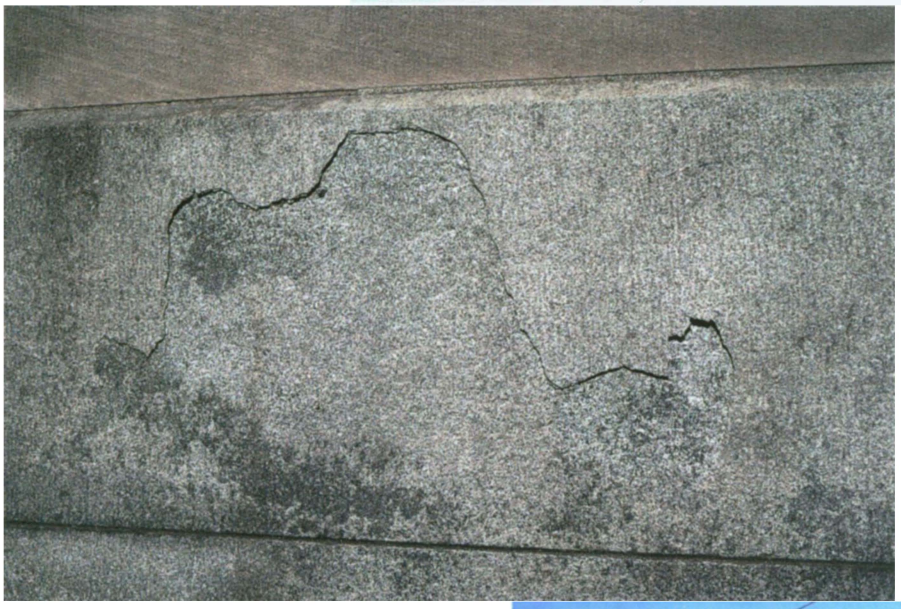

Fig. 28. Frost-damaged surface of granite foundation block at the east end of the Federal Place Apartments, the old federal building, 10th to 11th and P streets.

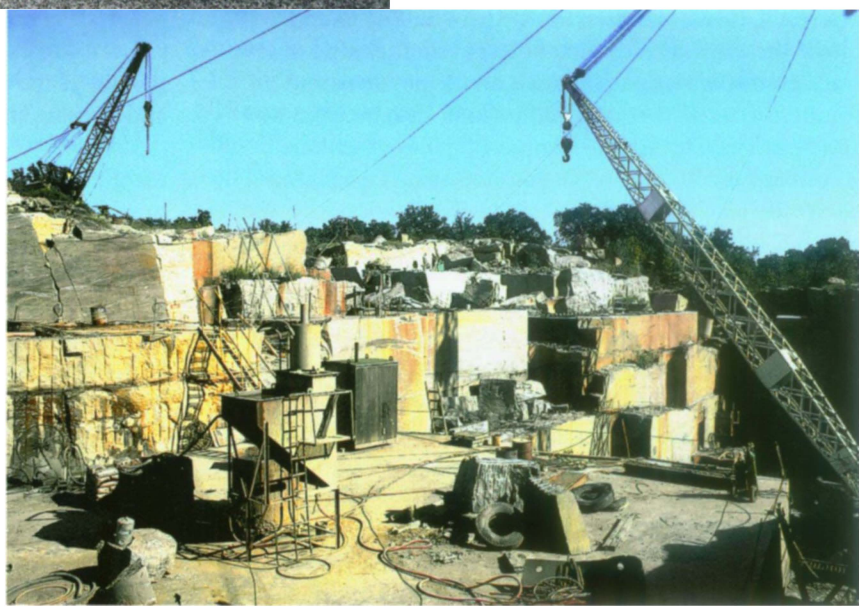

Fig. 29. Granite gneiss quarry at Morton, Minnesota. This quarry is no longer active (photo taken in 1981).

Fig. 30. Vermont slate retaining walls in the garden of the UNL Wick Alumni Center building, 16th and R streets, UNL City Campus.

Summary

Local sources of limestone and sandstone were used extensively in the construction of many public buildings and some private homes in the first quarter-century after the state capitol was established in Lincoln. Good quality limestone was found in many places in southeastern Nebraska, although most of the deposits are thin and back from the outcrop have a thick cover of glacial sediments. Completion of the railroad provided a means to import high quality and less expensive stones from farther away, so these limestones, sandstones and granites replaced the local stone. More exotic rock types, as well as more common ones, began to appear, especially after World War II. Today, in a walk through downtown Lincoln and the UNL City Campus, many kinds of dimension and architectural stones can be readily seen.

Walking Tour of Selected Building Stone on the UNL City Campus

1. Mueller Bell Tower between Morrill and Bessey halls is built of sawed, squared panels of Salem ("Indiana") Limestone. It is composed almost wholly of spheroidal foraminiferal tests (*Endothyra*) and uniformly sized fossil fragments.

2. The retaining walls around the bell tower are rough-squared blocks of limestone from the quarry at Roca, Nebraska (fig. 8), as are the natural-looking "outcrops" around Love Library. Only a few beds of this rock have properties that allow it to be used for building stone. Its nearness to Lincoln makes it a useful and relatively inexpensive material for landscaping.

3. Morrill Hall, College of Business Administration Building and the Coliseum. The pillars are made of Indiana limestone. These buildings were constructed in the 1920s, and several decades of exposure to weather has etched many of the fossil fragments into relief.

4. The Pillars. These columns of pink granite came from a quarry at Granite Spur, near Gunnison, Colorado, in 1890 for use in the Burlington Railroad Depot in Omaha. When that building was remodeled in 1930, the columns were removed and brought to the UNL City Campus, where they stand east of Memorial Stadium.

5. Sheldon Art Gallery. Travertine is a rock composed of calcium carbonate (a limestone) or silica that is deposited around springs. The travertine in this building, as well as in the Sartor-Hamann Jewelry store and the front of the sanctuary of First Plymouth Congregational Church at 20th and D streets, is calcareous and an architectural stone imported from Italy. Similar stone on the exterior of the AAA building at 2900 O Street came from Wyoming. Because it is dense enough to take a polish, it is listed architecturally as a "marble."

6. Canfield Administration Building, UNL, 14th and R streets. Entrance is polished red granite from Wausau, Wisconsin. The steps are unpolished pink porphyritic granite from Minnesota. The remainder of building exterior is limestone, probably Indiana limestone. The panels inside the front entrance are Italian travertine like that in Sheldon Art Gallery.

7. City (student) Union building. The steps leading to the south entrance along R Street are gray granite from Minnesota that is composed of orthoclase and plagioclase feldspars and quartz. Indiana limestone has been used to frame the entrance, and just inside is a polished limestone

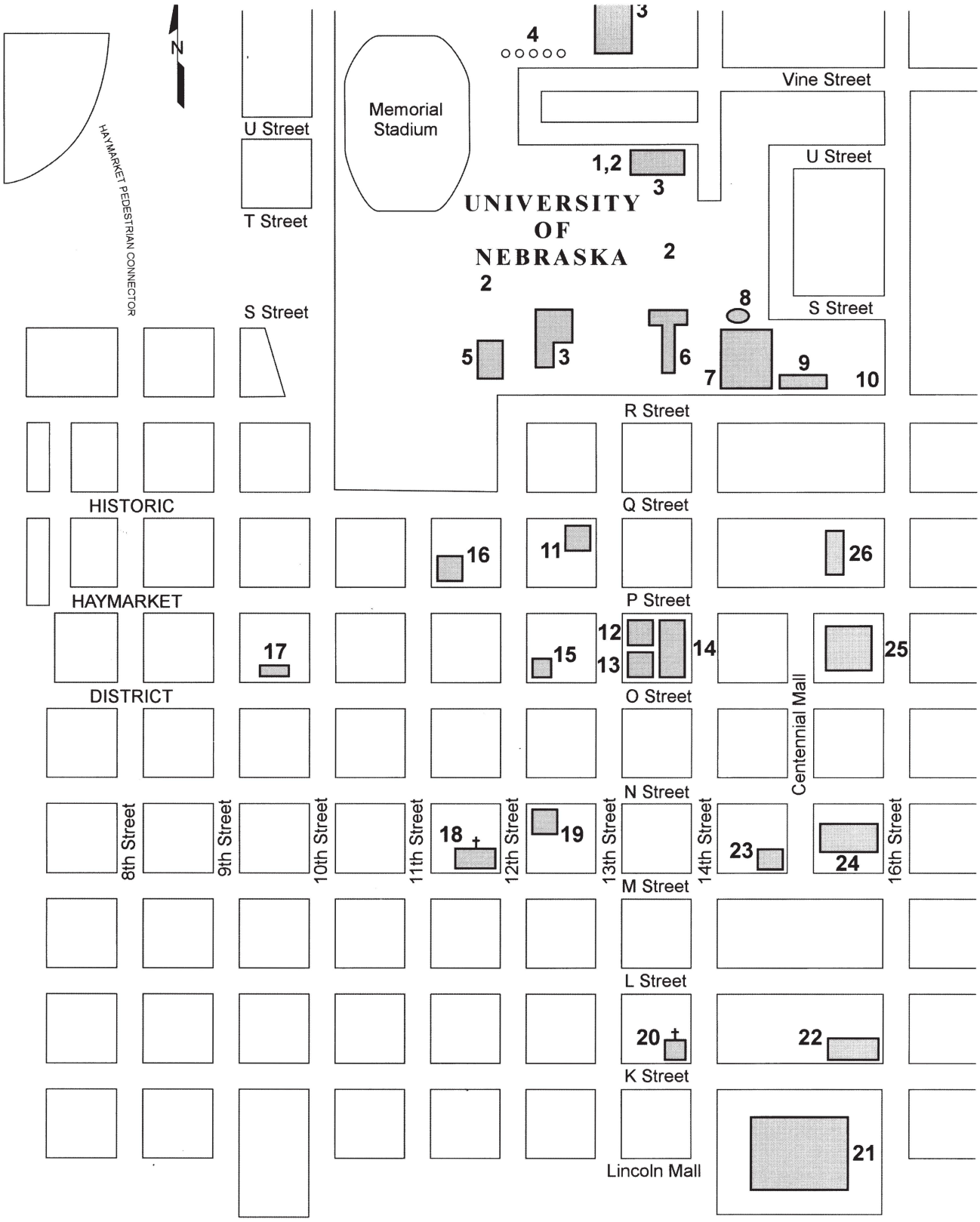

Fig. 31. Locations of building stone on UNL City Campus and in downtown Lincoln on walking tours.

that is composed of many individual corals in a limemud matrix. The north entrance is framed with Indiana limestone.

8. The fountain and pool of the courtyard on the north side of the City Union building contain blocks of red granite from the Minnesota River valley near Milbank, South Dakota.

9. The Nebraska State Historical Society library building (fig. 25) is faced with Indiana limestone. The panels around the entrance are verde antique, green serpentine cut by veins of chrysotile asbestos.

10. Wick Alumni Center, corner of 16th and R streets. Trim around the doorways and the walls in the garden east of the building are faced with greenish-gray slate from Vermont. Vertical faces are split slate, and the caps have been smoothed (fig. 30).

Walking Tour of Selected Building Stone Between the UNL City Campus and the Nebraska State Capitol Building

11. National Research Corporation Building, southwestern corner of 13th and Q streets. Trim on the pilasters is very coarse-grained, pale-salmon porphyritic granite. Some of the microcline phenocrysts are 15 x 30 millimeters. (The rock is 50-60 percent microcline, 25 percent plagioclase, 10 percent biotite, and 5 percent quartz.)

12. Stuart Building, southeastern corner of 13th and P streets. Ground-level facing is granite gneiss; it contains pink potassium feldspar (microcline and orthoclase) with some quartz; the black part is biotite. This is the Morton Gneiss from southwestern Minnesota, dated at 3.5 billion years old. The box office of the Rococo, formerly the Stuart, Theater is faced with polished anorthosite. Commercially called "black granite," it is composed almost entirely of labradorite, an iridescent calcium-rich plagioclase feldspar. The University Towers entrance beside the theater is chlorite schist with quartz veins. Above street level, the Stuart Building is faced with Indiana limestone, some of it carved. Several of the facing blocks are rust-stained. During the 1920s and 1930s, such staining had become an architectural fad and was accomplished by treating the surface of the cut stone with ferric chloride.

13. Nebraska Higher Education Loan Program (HELP) office building, northeastern corner of 13th and O streets (fig. 26). It is faced with coarse-grained red ("mahogany") granite from the Minnesota River region near Ortonville, Minnesota. It is about 70 percent red feldspar (microcline and orthoclase), 25 percent quartz, and 5 percent biotite. The interior floor is patterned polished and unpolished granite squares. Formerly occupied by J. C. Penney and Company, the building was remodeled in 1987-1988.

14. University Square Office and parking building, on 14th between O and P streets. Ground-level facing is red ("mahogany") granite from Milbank, South Dakota. The Commercial Federal Bank Building, between the Nebraska HELP building on 13th Street and University Square on 14th Street, has greenish-gray slate panels at ground level.

15. Centerstone, 12th and O streets. Originally the Burr Building, it was built in 1886 of rock-faced light brown sandstone from Berea, Ohio, with salmon-colored quoins on each floor (fig.15). Purchased in 1906 by the Security Mutual Life Insurance Company, the building was increased from six to 10 stories in 1916. Later, as the Anderson Building, the sandstone on the front was replaced with black fossiliferous limestone. In 1985, with new owners, the street-level facing was replaced with Indiana limestone.

16. First Commonwealth Savings Company, southeastern corner of 11th and P streets. Panels around the entrance are iridescent medium bluish-gray potassium and sodium feldspars with minor black biotite – an alkali syenite called *laurvikite* (fig. 27), imported from Norway. This building was demolished in 2003 to make way for The Grand theater complex. The black granite panels on The Grand are anorthosite.

17. Old city hall, north side of O Street between 9th and 10th streets (fig. 10). Limestone dimension blocks, rock-faced, came from the Gwyer Quarries along the north side of the Platte River near Plattsmouth. This limestone is almost a coquina of fusilinid foraminifera, which look like grains of wheat, and is Pennsylvanian in age. Constructed in 1875 as the courthouse and U.S. Post Office building, it was later taken over by the city and served as Lincoln's city hall until the new county-city building was completed in 1970. The interior was restored during the 1980s.

18. St. Paul Methodist Episcopal Church, northwestern corner, 12th and M streets. Street level is fusilinid limestone blocks, rock faced, from a quarry near Plattsmouth, perhaps the same one that provided the stone for the old city hall. These stone blocks were salvaged from the 1885 church after it burned in 1899 and reused in the new structure. The middle part of the church, west of the original part, is Indiana limestone and was added in 1953. The most recent addition, at the west end, is also Indiana limestone and was completed in 2000.

19. West part of the Tier One Bank complex, formerly the Centel Building, southeastern corner, 12th and N streets. Facing on both east and west sides is white marble that has a swirling pattern produced by small crystals that appear to be graphite and chlorite (fig. 24). The original sedimentary rock probably was nearly pure calcitic limestone with some clay along bedding planes. Diorite has been set as a base course along the sidewalk.

20. First Baptist Church, northwestern corner, 14th and

K streets. The exterior is Indiana limestone in sawed-block facing. The steeple corner of the building is built with curved blocks to make a circular tower.

21. Nebraska State Capitol building, between 14th and 16th and H and J streets (fig. 19). The exterior of the entire capitol building is so-called Indiana limestone supplied by the Indiana Limestone Company of Bedford, Indiana. It rests on a base course of granite from east-central Minnesota. The frieze around the outer wall near the top carries the names of all 93 counties in Nebraska. The steps and terrace are granite from Connecticut. Granite for the base course came from St. Cloud, Minnesota. The granite used for the structure for the Lincoln monument at the west entrance came from Milford, Massachusetts. Although it is not visible, the foundation of the building rests on Dakota sandstone. Excavation for the foundation began in April 1922, and by early 1925, offices were moved from the old capitol building to the completed part of the present one, which had been constructed around the old building (fig. 18). The old capitol building, constructed in 1886 of limestone from quarries along the Big Blue River and east of Ashland in eastern Nebraska, was then torn down to make way for the erection of the tower where it had been. The tower was completed by 1932. The interior of the capitol includes many kinds of architectural stone in panels, columns, floor tiles, and steps. Nearly 40 different kinds of stone have been used in construction of the building (Pabian, 1974; Robert Ripley, oral communication).

22. Assurity Insurance Company building, northwestern corner, K and 16th streets. Indiana limestone faces this building, which has a medium relief carving on the south side (fig. 20). Carvings such as this and the ones around the capitol building are done with power tools at the mill and finishing plant in Indiana. Strips of wood are used in place of mortar joints during the carving. The sculpture is then marked, dismantled, packed and shipped to the construction site, where the blocks are reset by stone masons according to the pattern prepared at the stone mill.

23. Alltel (formerly Lincoln Telephone and Telegraph, then Aliant) building, northwestern corner of 15th and M streets. Facing at street level is red granite, coarse grained, with phenocrysts of red potassium-feldspar (microcline) and some quartz making up nearly 50 percent of the rock. The matrix is about a 50-50 mixture of red feldspar and milky quartz. Above the street level, the building is faced with Indiana limestone in cut blocks, laid in coursed ashlar, with red granite in vertical panels between the windows.

24. Pershing Auditorium, east side of 15th between M and N streets. Red granite, uniformly coarse grained, about 90 percent red feldspar with minor quartz. Both composition and texture suggest that this probably is not a primary magmatic granite – rather, one formed through metamorphic processes from a shale or an arkose. On the north and south walls, the "black granite" is an unusual diorite that has diabasic texture, biotite with hematite stains rather than more typical augite or hornblende, and small xenolithic inclusions. Above the street level, the walls of the building are faced with cut blocks of Indiana limestone, some of which were shot sawed – note horizontal grooves across face of stone produced by mixing steel shot with the abrasive material on the gangsaws.

25. Robert V. Denney Federal Building and U.S. Court House, 100 Centennial Mall North, 15th to 16th streets between O and P streets (fig. 21). Completed in 1974, the federal building was constructed of cut stone panels of select-grade gray Indiana limestone. The sloping street-level facing is an artificially made "conglomerate."

26. Anderson Hall, UNL College of Journalism and Mass Communications building, formerly Security Mutual Life building, east side of Centennial Mall, between P and Q streets. Pillars and facing at sidewalk level are polished dark red granite with a few potassium-feldspar phenocrysts. Steps are cut blocks of very coarse-grained gray biotitic granite with pink feldspar crystals. Above sidewalk level, the facing is polished pinkish-gray granite. Indiana limestone was used for the window lintels and corner columns.

Bibliography

References Cited

Aughey, Samuel, 1880, Sketches of the physical geography and geology of Nebraska: Daily Republican Book and Job Office, Omaha, Nebraska, 326 p.

Barbour, E.H., 1903, Building stones, *in* Report of the State Geologist: Nebraska Geological Survey Report 1, p. 202-206.

-----, 1915, Nebraska green quartzite, an important future industry: Nebraska Geological Survey Report 4, pt. 19, 249-252.

Blatchley, R.S., 1908, The Indiana oolitic limestone industry in 1987: Indiana Department of Geology and Natural Resources, 32nd annual report, p. 299-459.

Bowles, Oliver, 1918, Structural and ornamental stones of Minnesota: U.S. Geological Survey Bulletin 663, 225 p.

-----, 1934, The stone industries: McGraw-Hill Book Co., Inc., New York, 519 p.

-----, 1960, 3rd ed., Dimension stone, in Jillson, J.L., ed., Industrial Rocks and Minerals: American Institute of Mining, Metallurgical, and Petroleum Engineers, Seely W. Mudd Series, p. 321-337.

Bownacker, J.A., 1915, Building stones of Ohio: Ohio Geological Survey, Bulletin 18, 160 p.

Brown, E.L., 1988, History and preservation of a national classic – Nebraska's first United States Post Office and courthouse: Nebraskaland Foundation, Lincoln, Nebraska, 289 p.

Condra, G.E., 1930, Correlation of the Pennsylvanian beds in the Platte and Jones Point sections in Nebraska: Nebraska Geological Survey Bulletin 3, 2nd series.

Condra, G.E., and Scherer, O.J., 1939, Upper Carboniferous formations in the lower Platte Valley: Nebraska Geological Survey Paper 16, 18 p.

Currier, L. W., 1960, Geological appraisal of dimension stone deposits: U.S. Geological Survey Bulletin 1109, 76 p.

Cushing, H. P., Leverett, Frank, van Horn, F. R., 1931, Geology and mineral resources of the Cleveland district, Ohio: U.S. Geological Survey Bulletin 818, 138 p.

Dale, T. N., 1923, The commercial granites of New England: U.S. Geological Survey Bulletin 738, 488 p.

Fenneman, N.M., 1938, Physiography of Eastern United States: McGraw-Hill Book Co., New York, 691 p.

-----, 1941, Physiography of Western United States: McGraw-Hill Book Co., New York, 534 p.

Fowler, C.F., 1981, Building a landmark – the capitol of Nebraska: Nebraska State Building Division, 101 p.

Graham, F.D. and Emery, T.J., 1951, Stone masonry, *in* Audel's Masons and Builders Guide: Theo. Audel and Co., New York, 1086 p., 4 volumes.

Grisafe, D.A., 1976, Kansas building limestone: Kansas Geological Survey Mineral Resources Series 4, 42 p.

Hannibal, J.T., and Park, L.E., 1992, A guide to selected sources of information on stone used for buildings, monuments, and works of art: Journal of Geological Education, v. 40, p. 12-24.

Hayes, A.B., and Cox, S.D., 1889, History of the City of Lincoln: State Journal Company, Lincoln, Nebraska, 379 p.

Hoyt, E.W., 1893, Colorado granite in Omaha: Stone – an Illustrated Magazine, v. 7, no. 6, p. 549.

-----, 1903, A Colorado red sandstone: Stone – an Illustrated Magazine, v. 26, no. 4, p. 331-336.

Indiana Limestone Institute of America, 1973, Indiana Limestone Handbook: Indiana Limestone Institute of America, Bedford, Indiana, 106 p.

Kopiasz, G., and Miller, E., 2004, Omaha's Burlington station – the past, present, and future: Heartland Railroad Historical Society, *http://www.rypn.org/hrrhs/bsp.htm,* accessed July 1, 2004.

Luebke, F. C., ed., 1990, A harmony of the arts – The Nebraska State Capitol: University of Nebraska Press, Lincoln, Nebraska, 122 p.

McKee, Jim, 1996, Banker got involved in community from the start: Lincoln Star, Journal Star Publishing Company, May 28, 1996.

Nebraska State Journal, 1888a, Permanent improvements in Lincoln for 1887 – the Burr Building: Nebraska State Journal, Lincoln, Nebraska, The Daily Journal Publishing, Jan. 1, 1888, p. 9.

-----, 1888b, The new building: plans and dimensions of the structure: Nebraska State Journal, Lincoln, Nebraska, The Daily Journal Publishing, Dec. 12, 1888, p. 9.

-----, 1888c, Paving and sewer: a year of unprecedented improvement: Nebraska State Journal, Lincoln, Nebraska, The Daily Journal Publishing, Dec. 12, 1888, p. 12.

-----, 1912, Ready for bronze figure – background of Lincoln monument is in place, Nebraska State Journal, Lincoln Nebraska, The State Journal Publishing, May 19, 1912, p. B3.

Pabian, R.K., 1974, The ornamental stones and mosaics of the Nebraska state capitol: Lapidary Journal, January, 1994, p. 1548-1556.

Patton, J.B., 1974, Glossary of building stone and masonry terms: Indiana Geological Survey Occasional Paper 6, 15 p.

-----, 1977, Durability, maintenance and restoration of stone masonry: Proceedings of Historic Preservation Conference, Ball State University, December 1977, p. 57-75.

Patton, J.B., and Carr, D.D., 1982, The Salem Limestone in the Indiana building stone district: Indiana Geological Survey Occasional Paper 38, 31 p.

Sawyer, A. J., 1916, Lincoln and Lancaster County, Nebraska: S. J. Clarke Publishing, Chicago, v. 1, 359 p.

Thiel, G.A., and Dutton, C.E., 1935, The architectural, structural, and monumental stones of Minnesota: Minnesota Geological Survey Bulletin 25, 160 p.

Watkins, Albert, 1912, Views of the Lincoln monument, which will be unveiled Sunday afternoon: Nebraska State Journal, Lincoln, Nebraska, The State Journal Publishing, Sept. 1, 1912, p. 1

Winkler, E.M., ed., 1978, Decay and preservation of stone: Geological Society of America, Engineering Geology Case Histories 11, Boulder, Colorado, 104 p.

-----, 1994, 3rd ed., Stone in architecture – properties, durability: Springer Verlag, New York-Wien.

Woodruff, E.G., 1906, The geology of Cass County, Nebraska: Nebraska Geological Survey, v. 2, pt. 2, p. 171-302.

Zimmer, Ed, 1990, The Near South walking tours, Mount Emerald and environs: Near South Neighborhood Association, Lincoln, Nebraska, v. 2, 98 p.

References Consulted But Not Cited

Aber, S.W., and Grisafe, D.A., 1982, Petrographic characteristics of Kansas building limestones: Kansas Geological Survey Bulletin 224, 37 p.

Berg, R.B., 1974, Building stone in Montana: Montana College of Mineral Science and Technology Bulletin 94, 41 p.

Bick, R.F., 1995, A visitor's guide to the North Dakota capitol grounds: State Historical Society of North Dakota, 55 p.

Buckley, E.R., 1898, Building and ornamental stones of Wisconsin: Wisconsin Geological and Natural History Survey Bulletin 4, 544 p.

Carr, D.D., and Hatfield, C.B., 1975, Dimension sandstone resources of Indiana: Indiana Geological Survey Bulletin 42-M, 28 p.

Condra, G.E., and Reed, E.C., 1959, The geological section of Nebraska: Nebraska Geological Survey Bulletin 14a, 82 p.

Doe, B.R., 1989, A different view of stone monuments, memorials and buildings of Washington, D. C.: American Geophysical Union Field Trip Guidebook T 235, 9 p.

Fouts, C.R., Freemen, E.B., Kemp, K.M., Marmont, C., and Minnes, D.J., 1991, Building stone and historic structures in downtown Toronto: Geological Association of Canada, Field Trip Guidebook A11/B11, 63 p.

Galán, E., Carretera, M.I., and Mayoral, E., 1999, A methodology for locating the original quarries used for constructing historical buildings – application to Málaga Cathedral, Spain: Engineering Geology, v. 54, p. 287-298.

Harris, R.E., 1991, Decorative stones of Wyoming: Geological Survey of Wyoming, Public Information Circular 31, 27 p.

Horanstein, S., 1989, Building stones of the New York area, *in* Baskerville, C.A., ed., Geology and engineering geology of the New York area: American Geophysical Union Field Trip Guidebook T361, 14 p.

Kemp, K.M., 1992, Walking tours of building stones for introductory geology courses: Journal of Geological Education, v. 40, p. 188-193.

Mirsksy, Arthur, 1989, 6th ed., Introductory geology field trip – using building materials in downtown Indianapolis: Department of Geology, Indiana University-Purdue University at Indianapolis, 65 p.

-----, 1999, 8th ed., Guidebook of building stones in downtown Indianapolis: Center for Earth and Environmental Science, Indiana University-Purdue University at Indianapolis, 72 p.

Meierding, T.C., 1993, Inscription legibility for estimating rock weathering rates: Geomorphology, v. 6, p. 273-286.

Patton, J.B., 1951, Industrial limestone in Indiana: Scientific Monthly, v. 72, no. 4, p. 259-265.

-----, 1987, The Indiana building limestone district, south-central Indiana: Geological Society of America, Centennial Field Guide, North-Central Section, p. 355-358.

Rooney, L.F., 1970, Dimension limestone resources of Indiana: Indiana Geological Survey Bulletin 42c, 29 p.

Shadmon, A., 1988, Stone technology – an old tradition with a new future: Episodes, v. 11, no. 4, p. 275-282.

Talbot, C.J., 1982, Building stones, *in* Clutterbuck, P.J., Ingles, O.J., and Talbot, C.J., eds., Rock as construction materials: Association of Geoscientists for International Development Course Notes, p. 69-78.

Watson, T. L., 1902, Granites and gneisses of Georgia: Geological Survey of Georgia Bulletin 9-A, 367 p.

Wayne, W.J., 1958, Let's look at some rocks: Indiana Geological Survey Circular 5, 36 p.

Winkler, E.M., 1966, Important aspects of weathering for building and monumental stone: Engineering Geology, v. 1, no. 5, p. 381-400.

-----, 1970, Corrosion rates of carbonate rocks for construction: Engineering Geology, v. 4, no. 1, p. 52-58.

-----, 1991, Building stone and stone decay in downtown Chicago: Association of Engineering Geologists Field Trip 4, Denver, Colorado, 14 p.

Withington, C.F., 1975, Building stones of our nation's capitol: U.S. Geological Survey INF-74-35, 44 p.

Zimmer, Ed, 1989, The Near South walking tours, Franklin Heights and environs: Near South Neighborhood Association, Lincoln, Nebraska, v. 1, 76 p.

Glossary

(For further discussion of terminology and tools of building stone, see Patton, 1974; and Graham and Emery, 1951)

anorthosite – a dark-colored plutonic (coarse-grained igneous) rock composed almost entirely of calcium-rich plagioclase feldspar.

ashlar – square or rectangular stone blocks; surfaces may be sawed, planed, or natural bedding planes.

augite – a black, calcium-iron-magnesium silicate, hardness 5-6; common in dark-colored plutonic rocks.

bed – 1) layer of rock between two bedding planes; 2) the layer of mortar on which a masonry unit is set.

bedding plane – the surface between two beds or layers of stratified rock.

biotite – black mica that contains iron and magnesium.

black granite – commercial term for dark-colored igneous rock used in building, commonly diorite, gabbro, anorthosite, or basalt.

building stone – stone selected for use in construction because of its durability, texture, appearance, freedom from impurities, and availability.

calcite – light-colored mineral composed of calcium carbonate; calcite is the principal mineral in limestone and marble.

carved work – hand-cut ornamental features for which a pattern could not be applied.

channeling – the process of making a cut to produce a quarry block.

chlorite – soft, micaceous mineral, generally green.

chrysotile – fibrous form of serpentine; white asbestos.

cladding – facing or sheathing overlaid on a structure for aesthetic reasons and/or weather protection.

coquina – limestone composed almost entirely of fossil shells, cemented by calcite.

course – horizontal layer of masonry units.
cut stone – building stone cut to a specific size and shape.

diabase – plutonic rock composed of plagioclase feldspar and pyroxene, with a distinctive texture in which the feldspar crystals are complete and in a pyroxene matrix.

dimension stone – any stone cut in a specific shape and size.

diorite – plutonic rock, generally dark gray, more than half plagioclase feldspar, with the remainder pyroxene.

dolomite – light-colored mineral composed of calcium and magnesium carbonate; also a rock that is primarily the mineral dolomite.

dressed stone – stone that has been worked into a desired shape.

exfoliation – peeling or scaling of stone surfaces, caused by weathering.

feldspar – a group of rock-forming silicate minerals; consists of two major groups, potassium feldspars and plagioclase feldspars.

fieldstone – loose, slabby stone found in fields or in soil, used without further shaping.

flagging – a group of flagstones.

flagstone – a flat stone, thin relative to its surface area, used for floor or terrace paving or for stepping stones.

forminifera – single-celled marine organisms with a hard exterior.

frieze – an ornamental band or strip in a wall.

fusilinid – a type of foraminifer (probably *Titicites*) that resembles a grain of wheat or rice; thrived during Pennsylvanian and Permian periods (325 to 225 million years ago).

gabbro – a dark-colored plutonic rock composed mostly of iron and magnesium-rich silicate minerals and plagioclase feldspar.

gangsaw – an assemblage of parallel, reciprocating steel bars using a slurry of water and a loose abrasive (sand or silicon carbide) to cut quarry blocks into slabs.

gneiss – a coarse-grained metamorphic rock, banded or foliated by alignment of platy or elongate minerals.

granite – a light-colored plutonic rock containing mostly potassium feldspar, some plagioclase feldspar and quartz; this term is used more broadly by architects to include any hard, crystalline rock used in building.

graphite – a soft black mineral composed of carbon; occurs in flakes in some metamorphic rocks.

hardness – the density of minerals as tested against a scale of relative hardness; each number indicates the hardness of a specific mineral, in order of increasing hardness: 1) talc; 2) gypsum; 3) calcite; 4) fluorite; 5) apatite; 6) orthoclase feldspar; 7) quartz; 8) topaz; 9) corundum; 10) diamond. (For comparison, a copper penny is about 3½; the blade of a pocketknife is about 5½.)

hornblende – a green-to-black, prismatic, calcium-iron-magnesium silicate mineral common in metamorphic rocks and some igneous rocks.

igneous – a rock that has crystallized from molten material, either deep beneath the Earth's surface (plutonic) or at or near the surface (volcanic).

laurvikite – an iridescent bluish-gray plutonic rock consisting of potassium feldspar and sodium-rich plagioclase feldspar (named after Laurvik, Norway).

limestone – a sedimentary rock composed mostly of calcite.

lintel – horizontal structure that bridges a window or door opening.

magma – molten rock beneath the Earth's surface.

marble – a crystalline rock formed by metamorphism of limestone or dolomite; architects use the term to refer to any carbonate rock that is dense enough to be polished.

metamorphism – the process of recrystallation of pre-existing rocks by heat, pressure, and/or chemical solutions.

microcline – a potassium feldspar, commonly reddish brown or white, but may be green; hardness 6.

migmatite – coarsely banded mixture of igneous and metamorphic rocks.

orthoclase – a potassium feldspar that may be white, flesh-colored, yellow, brown or colorless; hardness 6. It makes up most of the bulk of granite.

phenocryst – large mineral crystal in a groundmass of smaller crystals.

plagioclase – a group of feldspars that is a solid solution of sodium to calcium aluminum silicates, white to dark gray; hardness 6.

plutonic – igneous rocks that cooled and solidified deep within the Earth; plutonic rocks are coarsely crystalline.

pitched face – stone that has had each edge of the exposed face cut with a pitching chisel to produce a rough but slightly rounded surface; sometimes called "rock faced."

pyroxene – a group of calcium-iron-magnesium silicates common in plutonic and some metamorphic rocks.

quartz – the most common of minerals, found in all categories of rocks, may be crystallized or microcrystalline, clear to gray to violet; hardness 7. Crystalline quartz is common in granite, gneiss, sandstone and quartzite.

quartzite – hard, sugary-textured rock composed of quartz grains, either cemented with silica or fused together from heat and pressure.

quoin – one of a series of corner blocks that differs in material, size and/or finish from the rest of the wall.

sandstone – rock composed of cemented sand grains; most sand consists largely of quartz grains.

sedimentary – deposits or rocks composed of loose or solidified sediments deposited by wind or water.

serpentine – highly altered igneous rock consisting of iron and magnesium silicate minerals.

shale – hardened mud or clay.

shot-sawn (or -sawed) finish – randomly scored smooth surface produced by adding steel shot to the abrasive carried by gangsaw blades.

sill – flat stone set at the base of an opening in a wall.

slate – very fine-grained, hard, brittle, foliated rock, formed by metamorphism of shale; can be split into thin slices, commonly used for roofing.

split-faced finish – a rough face formed on building stone by splitting slabs with a split-faced machine into usable thicknesses for masonry.

star drill – steel rod with a hardened, sharpened tip formed in a cross; used with a mallet to drill holes by hand in stone.

travertine – a rock formed by precipitation of calcite, generally at hot springs; travertines commonly are full of small irregular holes.

verde antique – trade name for a green serpentine-rich rock used as building stone.

volcanic – microcrystalline igneous rocks that cooled quickly from lava extruded at the surface or injected very near the surface of the Earth.

wire saw – a helical wire on a loop, power-driven, ¼-inch in diameter, under tension, that is drawn across the rock surface carrying a slurry of water and carborundum grit or sand in order to cut a channel.

xenolith – a rock fragment embedded in intruding magma.

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