1999

# Geology of Rock Creek Station State Historical Park

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Education Circular No. 11a

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## Illustrations



Cover photo courtesy of Nebraska Game and Parks Commission

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## Acknowledgments

Wayne Brandt, Rock Creek Station State Historical Park superintendent, should receive a hearty thanks for encouraging the Conservation and Survey Division (CSD) to put together a field guide to the geology of the area, for his review of the first edition and for general help in matters relating to the park. CSD geologists James B. Swinehart and Duane Eversoll deserve a thank-you for their reviews of the earlier edition. Raymond R. Burchett, CSD geologist, supplied the information on the volcanic ash deposits included in the second edition. Charles A. Flowerday edited the copy and produced the publication. Melba Stemm typed the copy.

## Location and Facilities

Rock Creek Station State Historical Park in southeastern Jefferson County, Nebraska, is a property of the Nebraska Game and Parks Commission. The park can be reached (fig. 1) by following the well-marked road south from U.S. Highway 136 at Jansen for about 4.5 miles and then going east for about 1.2 miles. Another route is east from the town of Fairbury past the Fairbury Fairgrounds and Cemetery for about 4.5 miles, then south 1 mile, and then east about 1.2 miles. The park, located in parts of section 26, T. 2 N., R. 3 E. (fig. 2), includes about 400 acres of rolling land along Rock Creek that were acquired by the Nebraska Game and Parks Commission in the 1960s. Excellent camping and picnic facilities, hiking trails, and historical displays have been developed since 1984.

The land for the park includes sections of the Overland Trail (fig. 3 and 4a) and Pony Express routes, sites of the East and West Rock Creek Station Ranches, the place where a former toll bridge was built across the creek, and the site where James Butler "Wild Bill" Hickok killed his first man. Most of the ranch buildings have been reconstructed, and some are still being rebuilt. More than 70 species of plants and many kinds of birds and other animals can be observed in the park and surrounding area. More information on the park may be obtained for free from the Nebraska Game and Parks Commission, 2220 N. 33rd St., Lincoln, NE 68503.

## Geology of the Park

As you drive through the gates of the park, you will be traveling over grass-covered pasture underlain by remnants of glacial till, a very common deposit in easternmost Nebraska. The park is near the western margin of the former ice sheet that deposited the till when the ice flowed south over this country during the early part of the Pleistocene Epoch about 1.5 million years ago. In this part of Jefferson County, the till is thin or absent. Glacial till is a sedimentary deposit that contains much clay and other rock debris ranging in size from silt to very large boulders. These materials were picked up by the glacial ice at many places as it flowed south from Canada. Cobbles of fossiliferous limestone (fig. 4b) and yellowish-brown sandstone were eroded by the ice from areas nearby, but the large pink, very hard quartzites were eroded from areas near Sioux Falls, South Dakota. Granites and other durable rocks may have come from even farther north.

Directly beneath the soils and glacial till deposits on the uplands along the valley sides (fig. 4c) and beneath the valley floor of Rock Creek are interbedded sandstones and shales of the Dakota Group of Cretaceous age. Rivers that flowed over this area more than 100 million years ago during the age of dinosaurs deposited sands that filled stream channels and sandy muds and clays that covered flood plains. Later these sediments were cemented together and compacted to form rock. Fossil land plants and freshwater clams found in the same rock formations in other parts of eastern Nebraska (for example, Lancaster County) are evidence that the Dakota sediments were deposited by rivers. There are many natural and man-made exposures of the Dakota Group in the park

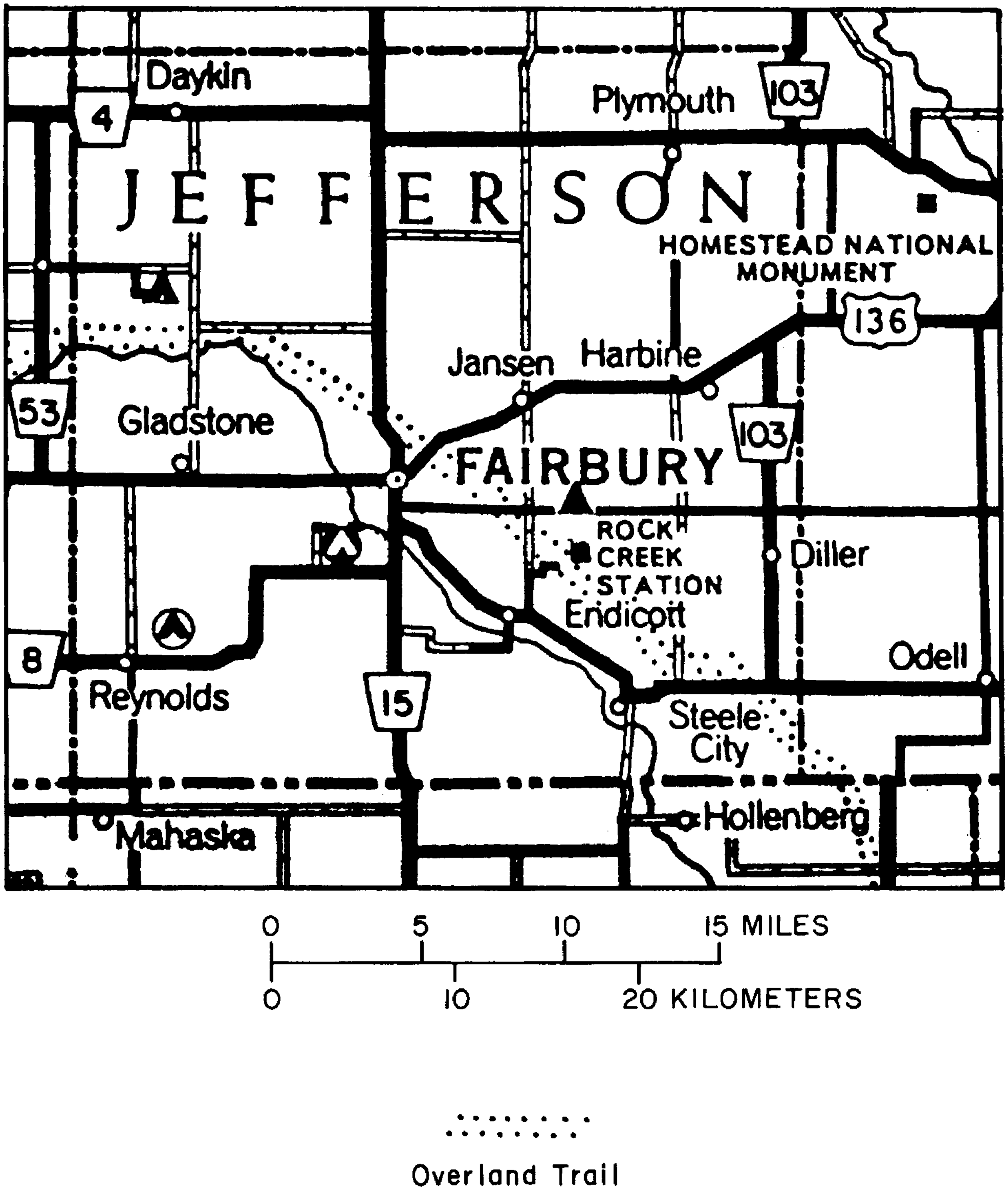



Fig. 1. Map of Jefferson County showing location of Rock Creek Station Historical Park.

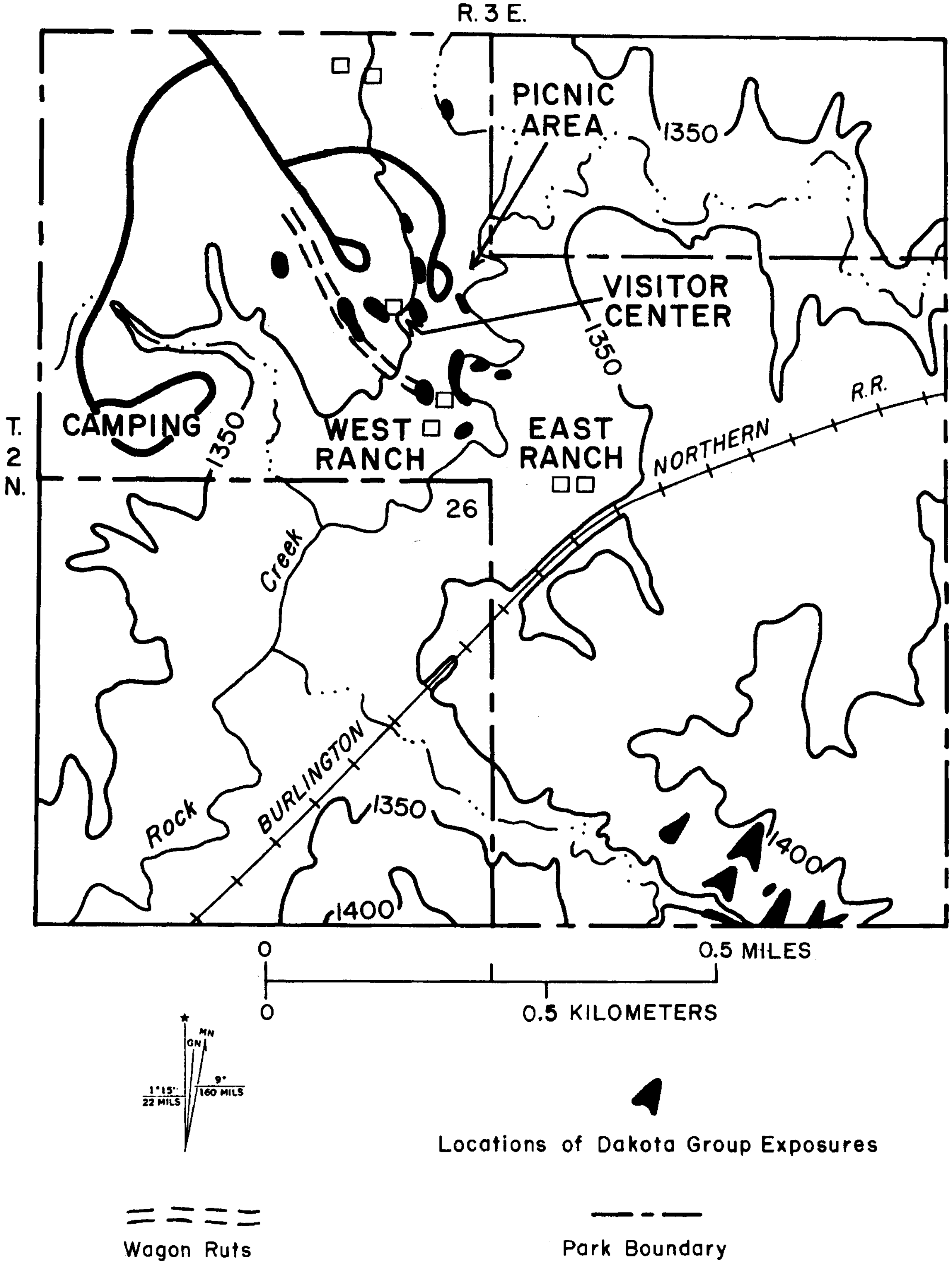



Fig. 2. Location of Dakota Group exposures.

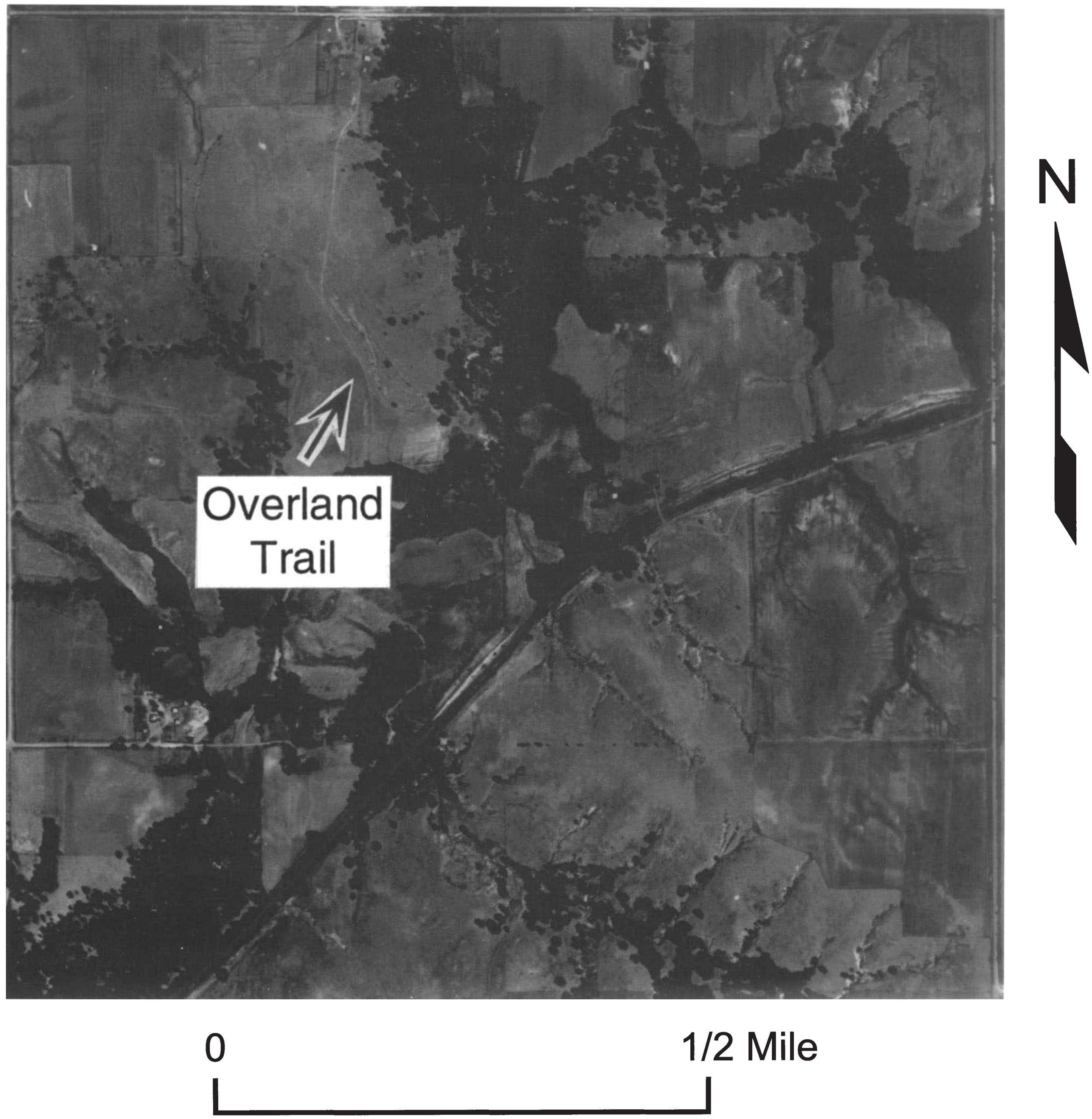
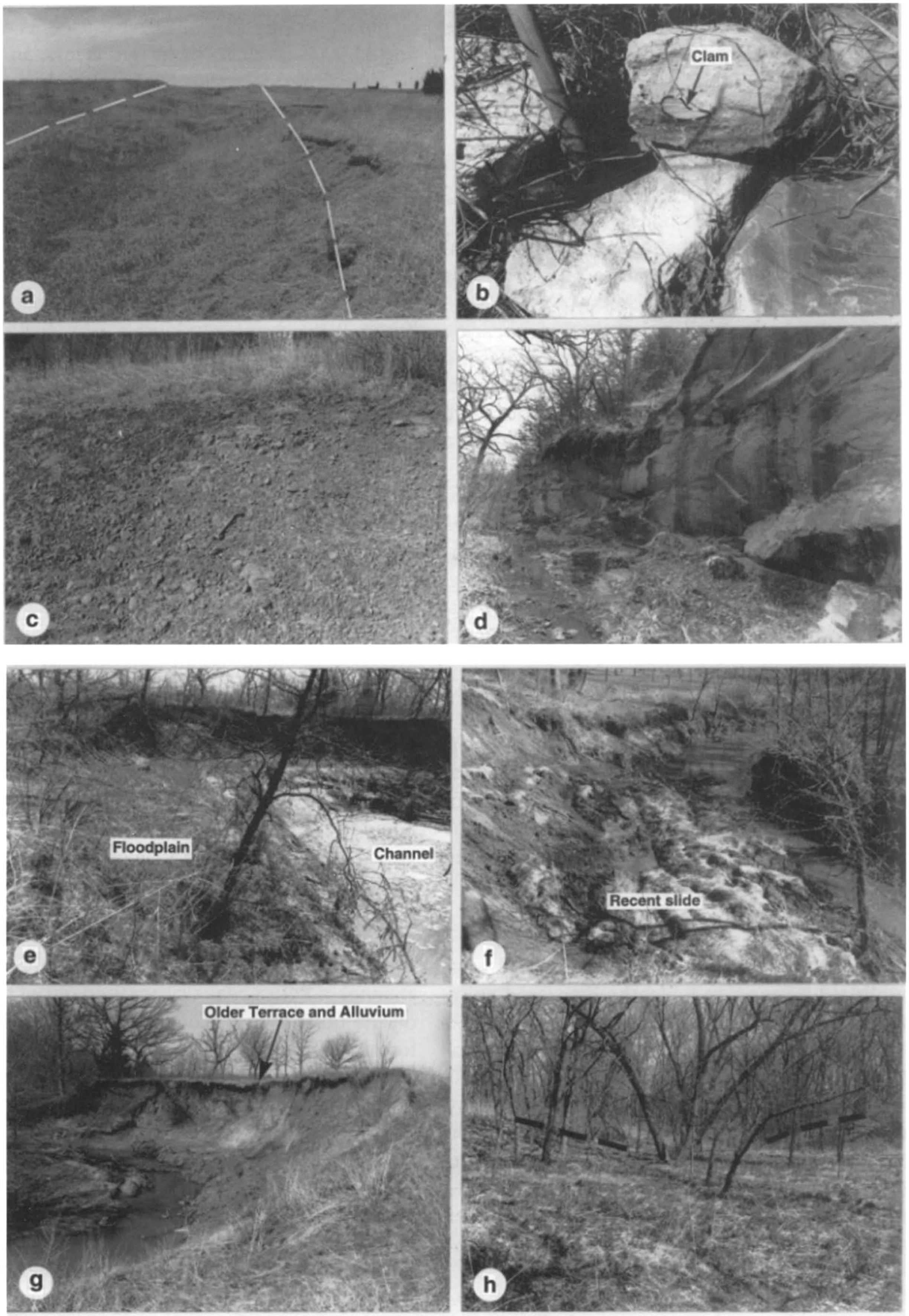



Fig. 3. Aerial photograph taken in 1956 of some of the present park site and surrounding area. Arrow points to ruts marking the position of the Overland Trail. The trail continues to the northwest; it does not include a well-worn road or path leading north of the arrow.

Fig. 4. Scenes at the park (on facing page): a) wagon ruts on Overland Trail; b) glacial cobbles including a piece of Cretaceous limestone with fossil clam shells; c) Dakota sandstone at the picnic area parking lot; d) Dakota sandstone at southeast part of park; e) Rock Creek channel and flood plain; f, g) downslope movement of fill and older alluvium on creek cutbank; h) hills of older alluvium (dashed lines) and position of old channel.


a
b
Clam
c
d
e
Floodplain
Channel
f
Recent slide
g
Older Terrace and Alluvium
h

(fig. 2 shows the locations of some of these). The best exposures are in the southeasternmost part of the park (fig. 4d) and can be viewed after a hike from the visitor center of about 0.5 mile.

The color of the Dakota rocks varies greatly. Much of the sandstone is stained yellowish brown by iron oxides. The sandstones also contain iron-oxide concretions, probably formed by decomposition of the mineral marcasite ($FeS_2$), which is made up of iron and sulfur. Some of the Dakota sandstone is white, indicating that iron-bearing minerals are not present in it. Dakota shales are gray, pink, red, purple, and other pastel shades. These colors indicate that the sediments were probably exposed to weathering after they were deposited.

There are no deposits known from the park area younger than the Dakota and older than the Pleistocene. All the remains of the passing of this period of nearly 100 million years is an erosional surface (unconformity) at the top of the Dakota.

Before the valley of Rock Creek formed, the rocks of the Dakota Group extended uninterrupted across the park area. Later much younger glacial deposits covered the eroded surface of the Dakota Group rocks. A layer of volcanic ash once underlay the glacial deposits in one part of the park (fig. 5), and some economic quantities of this ash were mined during the early part of the 20th century.

In 1916, E. H. Barbour, state geologist of Nebraska, published a report in which he discussed volcanic ash mines called the Endicott Mines (*Nebraska Pumicite*, Nebraska Geological Survey Historical Bulletin No. 42 [vol. 4, part 27, p. 376, 378]; out of print but available at CSD for study or copying). Volcanic ash was discovered during excavation of a cut for the tracks of the Chicago, Burlington and Quincy Railroad. The ash was deposited on top of the Dakota Group and was overlain by sand and glacial deposits.

This volcanic glass sand and silt (also called *dust* or *pumicite*) was up to 21 feet thick and was reported by Barbour to be in two layers, an upper cream-colored layer up to 16 feet thick and a lower white one 5 feet thick. Barbour also reports that "the Dawson brothers," whom he does not otherwise identify, operated strip mines on both sides of the railroad (fig. 5) until the deposits were removed. Little trace of the mines or the ash can be seen in the park area today, but we know from Barbour's report that the ash was sold to buyers from Omaha, Nebraska; Topeka, Kansas; Pittsburgh, Pennsylvania; and Jersey City, New Jersey. They used it to manufacture scouring compounds, as filler in cement, and for insulation. Individual ash particles contain bubble holes (fig. 6), which add to its value as an insulation material.

In relatively recent times, long after the glacial tills were deposited, the ancestral Little Blue River and its tributaries such as Rock Creek began to erode away the till, sandstones, and shales, forming the initial parts of the valleys in the area today. From time to time in the history of the valleys' development, conditions changed, and the river and creeks could not carry away all of the sediment eroded from the land (fig. 7). The streams deposited these sediments (alluvium) in their channels and on their valley floors.

Some of this sediment is preserved in the valley of Rock Creek. The sandy alluvium came largely from the decomposition of Dakota sandstones, while the clays could have come from erosion of tills and Dakota shales. The quartzite, granite, and other pebble- to boulder-sized rock debris in the channel of Rock Creek was washed out of the tills on the uplands and eroded from the sandstones forming the valley sides. These rocks were then transported by runoff and downslope movement to the valley floor.

## Valley Floor of Rock Creek

Presently, Rock Creek flows in a steep-sided sinuous (meandering) channel on the floor of the valley. Erosion by the water of the creek produced the channel. On either side of the creek is the

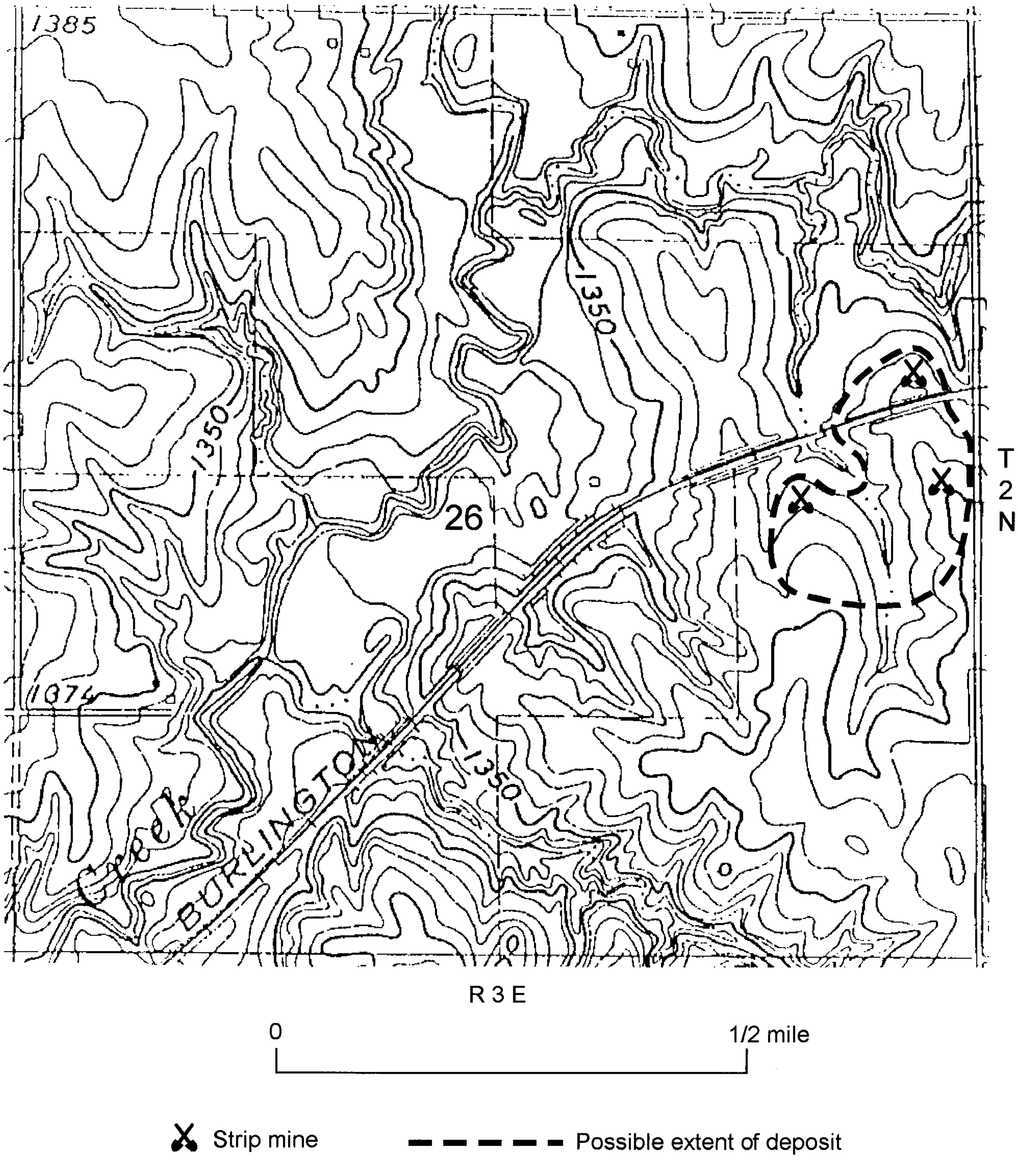



Figure 5. Locations of volcanic ash strip mines.

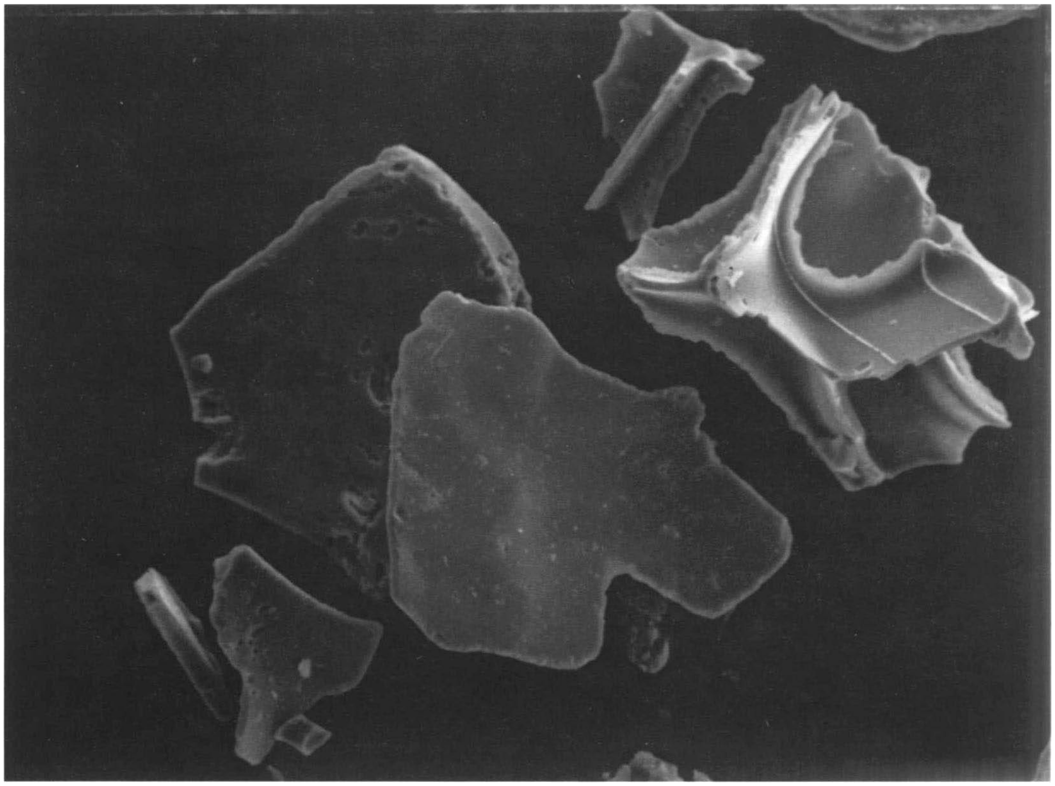
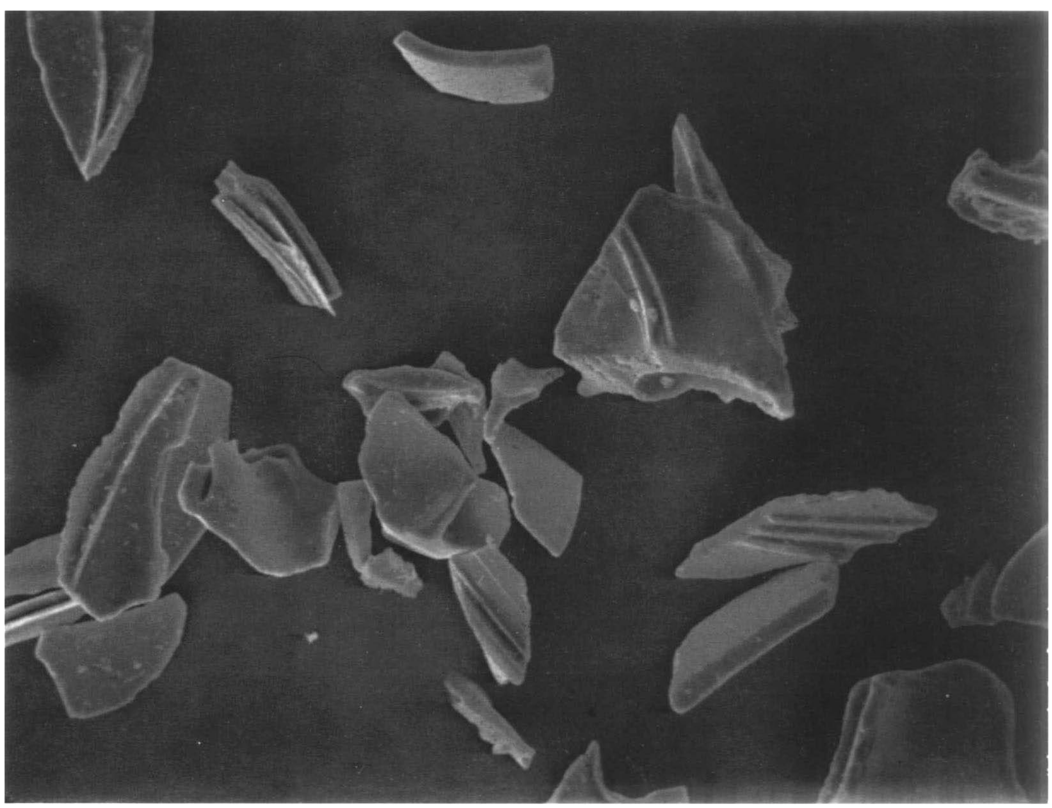


Fig. 6. Scanning electron microscope photographs of volcanic ash fragments or shards.



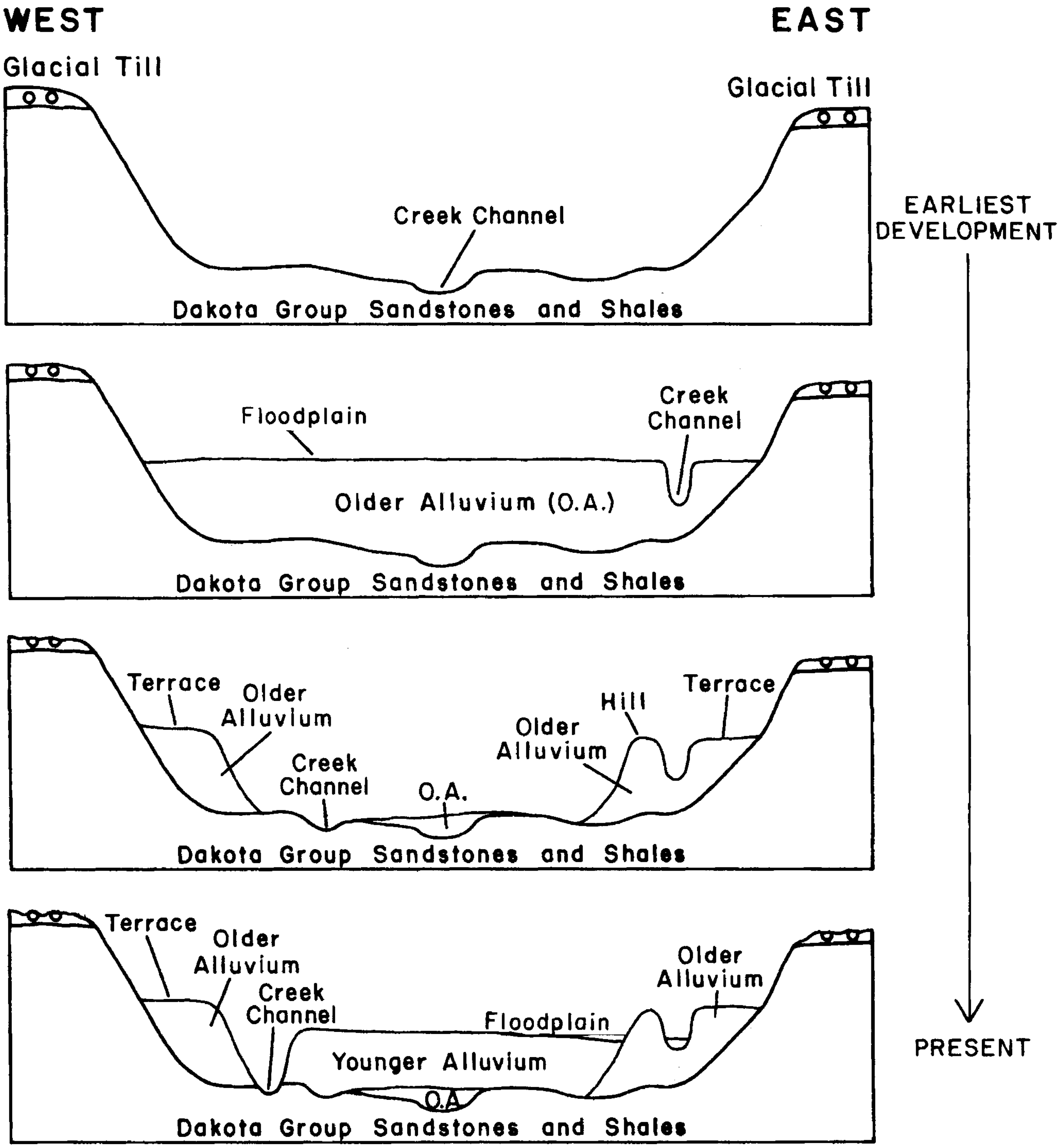



Fig. 7. Development of Rock Creek valley during the late Quaternary age (not to scale: vertical exaggeration).

nearly flat surface or terrace of the flood plain of the creek. This surface is 5 to 10 feet above the channel floor and is densely vegetated in most places (fig. 3e).

Higher along both sides of the Rock Creek valley are discontinuous remnants of the clay-rich deposits of an older flood plain and a nearly flat terrace that was the top of this former flood plain less than 10,000 years ago. The East and West Ranch buildings were constructed on this older flood plain, which is underlain by more clay-rich deposits than those beneath the present flood plain.

At the northern end of the park, the channel of Rock Creek is close to the east valley side, but about 0.25 mile south the channel is located close to the west side of the valley (fig. 8). Where the channel meanders west, the creek is eroding into the deposits beneath the older flood plain; these deposits rest upon Dakota sandstones and shales (fig. 7). On the outside (west side) of each of three meander bends, material is undermined during high stream flows and becomes unstable. Adding to this instability, some water from precipitation sinks into and downward through the older alluvium until it reaches the Dakota shales.

These shales do not allow water to pass through them readily. Instead, the groundwater saturates the bottom part of the older alluvium. The surface between the base of the older alluvium and the top of the Dakota shales becomes very slippery and unstable here. The combination of erosion on the outside or cutbank of Rock Creek and instability along the contact just described leads to downslope movement of debris into the channel of the creek (figs. 4f, g) either by slow slumping or by more rapid debris sliding. You may view these areas of downslope movement safely from the east bank of Rock Creek or from upstream or downstream of their locations (shown on fig. 8). DO NOT CLIMB ON THESE CUTBANKS! THEY ARE DANGEROUS PLACES.

The erosion on the cutbanks of the creek shows that Rock Creek is a changing stream. The creek is continuing to change the position of its channel, eroding and transporting materials from its banks downstream. Some evidence indicates that in the relatively recent past the channel of the creek from north of the picnic area to the southern boundary of the park was in a different position on the valley floor than it is today (fig. 8). In the wooded areas north of the picnic grounds and across the creek to the east are discontinuous, elongate, tree-covered hills 20-30 feet wide and 5-10 feet high (fig. 4h). The tops of these hills are at about the same altitude as the older terrace remnants along the valley sides. To the northeast of the picnic area, two hill remnants are separated by a low area about 60-80 feet wide that probably was the position of the former channel of Rock Creek. It seems clear that at an earlier time less than 10,000 years ago Rock Creek flowed in a channel on the east side of its valley just north of the sites of the ranches.

While you are studying the creek, watch the water flow down the channel. You can see sediment movement, the formation of ripple marks in the sediment, and other structures such as dunes, bars, pools, and riffles on the channel floor.

## While You Are In The Area

While you are in the park, inquire about other nearby scenic areas. The park personnel will be happy to direct you to other points of interest nearby.

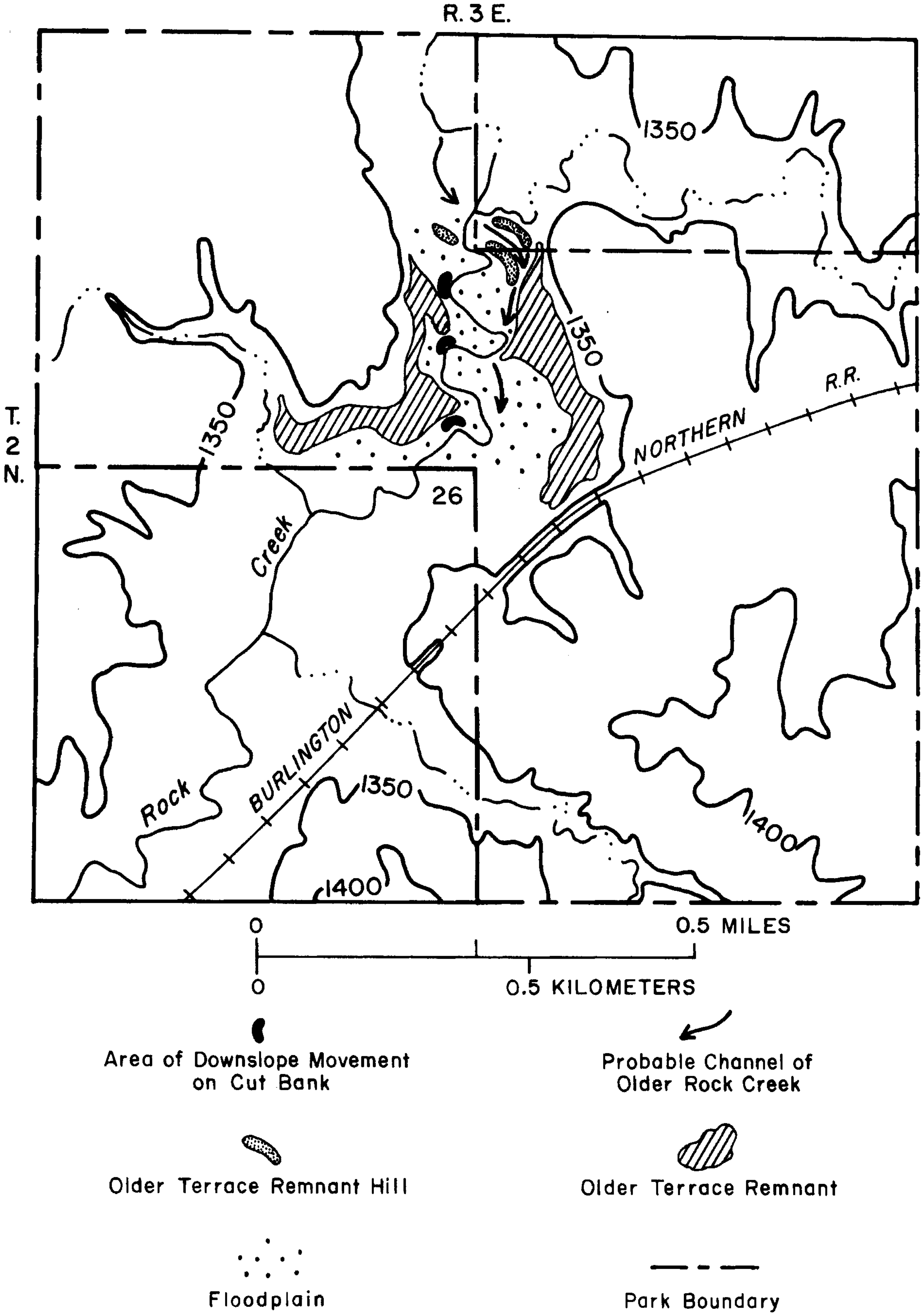



Figure 8. Rock Creek valley alluvial features.

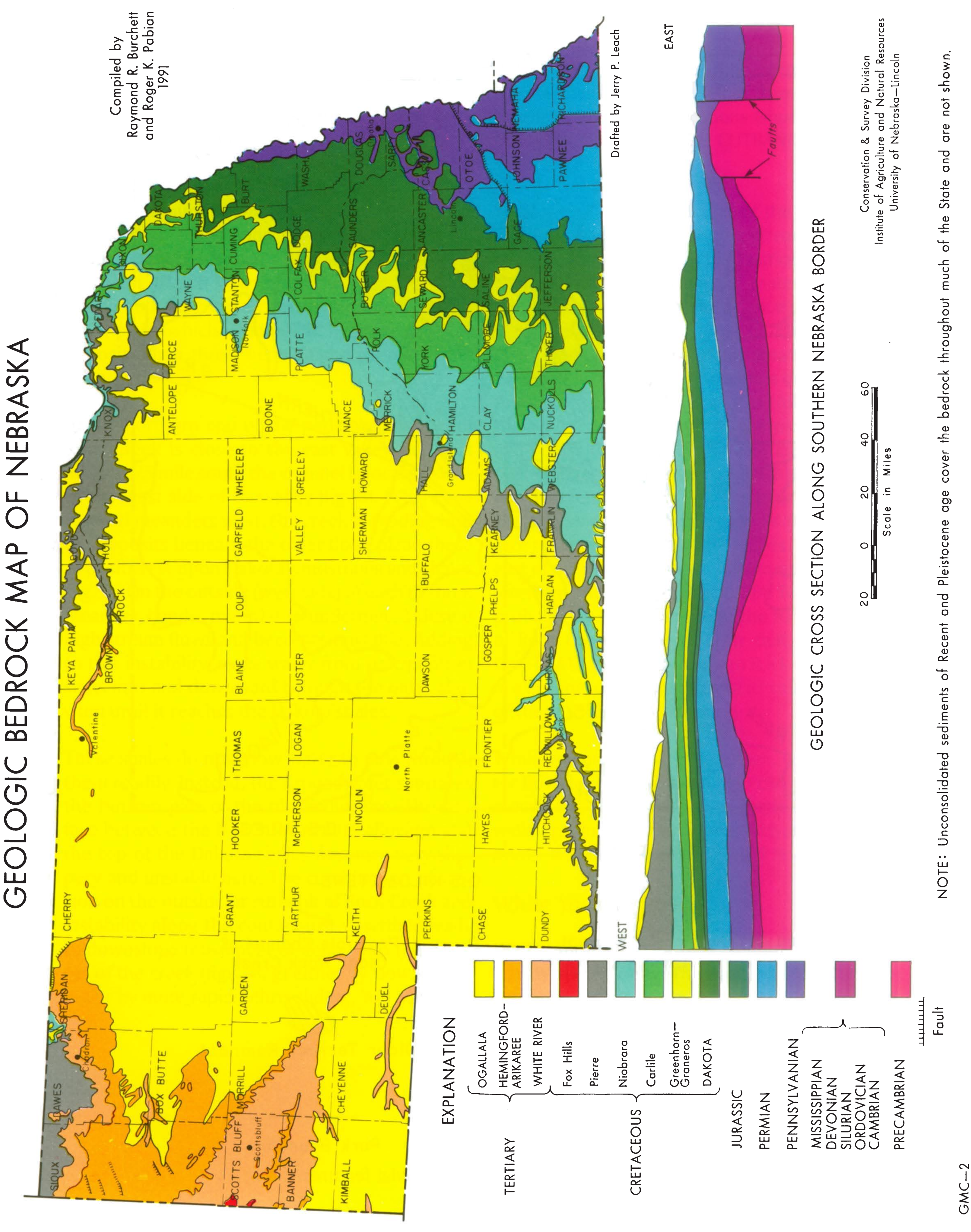
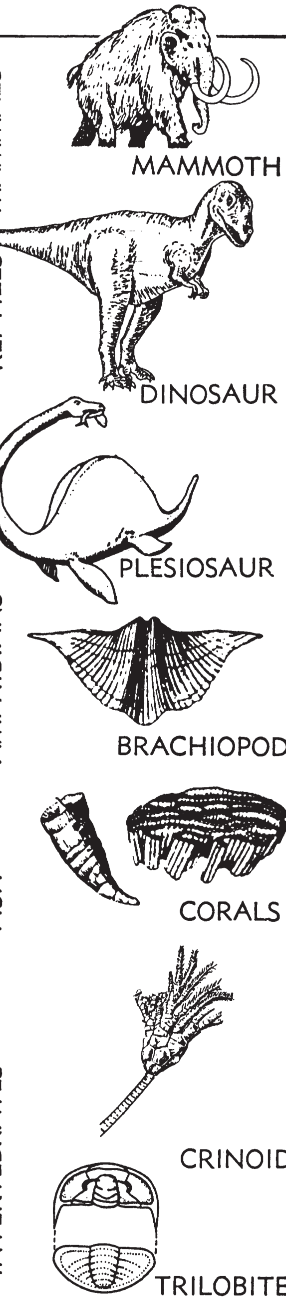
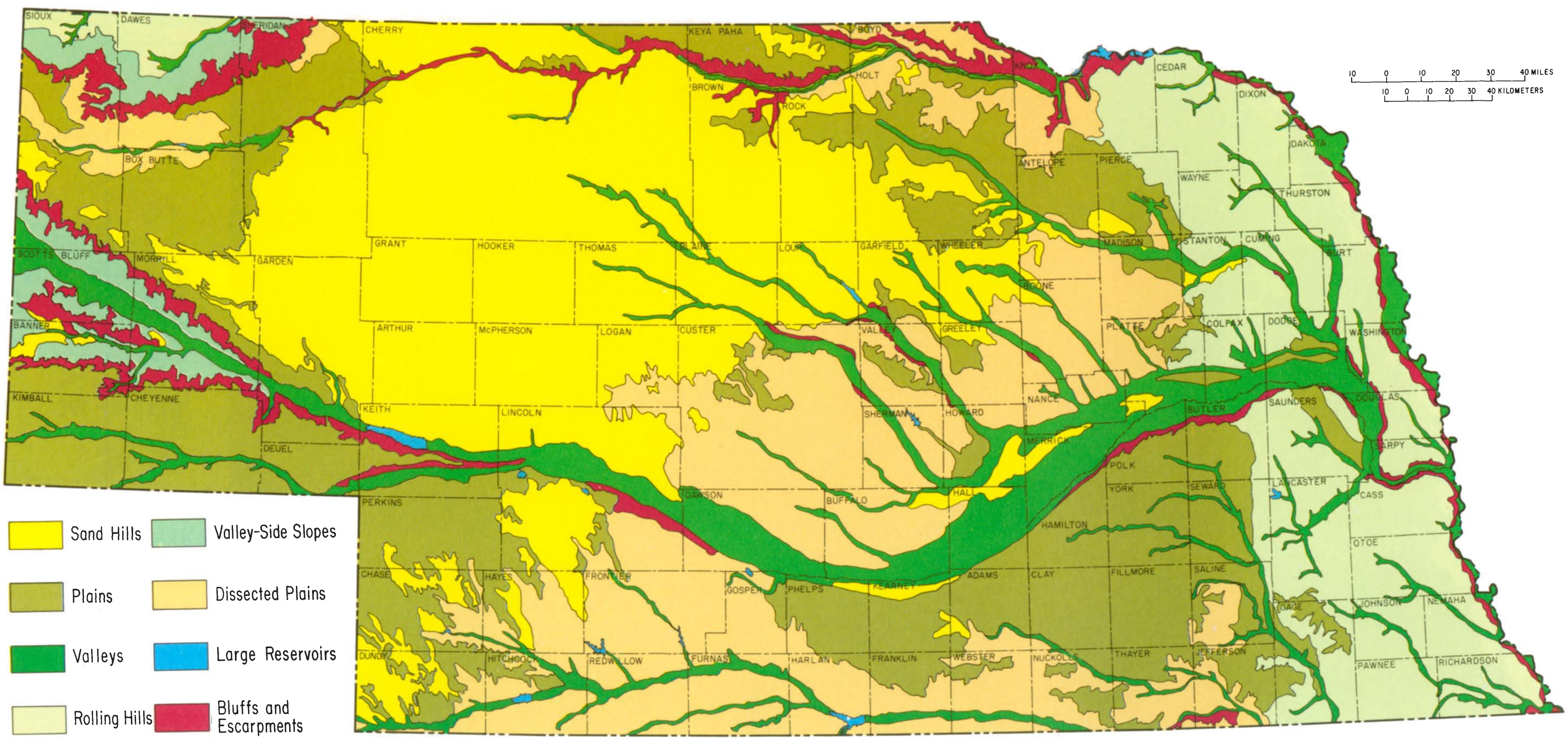



Fig. 9. Geologic bedrock map of Nebraska and time chart (facing page)

| AGE (MILLIONS OF YEARS AGO) | GEOLOGIC TIME UNITS | | ROCK TYPES | MINERAL RESOURCES AND PRODUCTS | TYPICAL FOSSILS |
|---|---|---|---|---|---|
| 1.6 | CENOZOIC (RECENT LIFE) | QUATERNARY (Recent and Pleistocene) | Glacial till, silt, clay, sand, gravel, volcanic ash. | Agricultural soil, water, sand & gravel, volcanic ash. | MAMMALS |
| 66 | | TERTIARY | Sandstone, siltstone, clay, gravel, marl, volcanic ash. | Agricultural soil, water, sand & gravel, volcanic ash, riprap & uranium. | |
| 138 | MESOZOIC (MIDDLE LIFE) | CRETACEOUS | Chalk, chalky shale, dark shale, varicolored clay, sandstone, conglomerate | Water, oil & gas, cement, brick, agricultural lime, & other construction materials. | REPTILES |
| 205 | | JURASSIC | Subsurface only. Sandstones and shales | | |
| 240 | | TRIASSIC | | | |
| 290 | PALEOZOIC (ANCIENT LIFE) | PERMIAN | Shale, limestone, dolomite, gypsum, anhydrite sandstone, siltstone, chert. | Water, agricultural lime, oil, road rock, riprap. | AMPHIBIANS |
| 330 | | PENNSYLVANIAN | Limestone, shale, sandstone, coal. | Oil, cement, brick, concrete aggregate, lightweight aggregate, road rock, agricultural lime, rip rap, water. | |
| 360 | | MISSISSIPPIAN | Subsurface only. Limestone, dolomite. | Oil, water. | FISH |
| 410 | | DEVONIAN | Subsurface only. Dolomite, gray shale. | | |
| 435 | | SILURIAN | Subsurface only. Dolomite. | | INVERTEBRATES |
| 500 | | ORDOVICIAN | Subsurface only. Dolomite, sandstone, shale. | | |
| 570 | | CAMBRIAN | Subsurface only. Dolomite, sandstone. | | |
| 5,000 ? | CRYPTOZOIC (HIDDEN LIFE) | PRECAMBRIAN | Subsurface only. Granite, other igneous rocks, and metamorphic rocks. | | ? |








**Valleys:** flat-lying land along the major streams. The materials of the valleys are stream-deposited silt, clay, sand and gravel. **Valley-side Slopes**: moderately sloping land that occurs between the escarpments and the major stream valleys in western Nebraska. These areas are mostly siltstone bedrock covered by a few feet to a few tens of feet of sand, gravel or silt. **Large Reservoirs**: constructed for purposes such as water storage for irrigation, generation of electricity, flood control or recreation. **Plains:** flat-lying land that lies above the valley. The materials of the Plains are sandstone or stream-deposited silt, clay, sand and gravel overlain by wind-deposited silt (called *loess*). **Dissected Plains**: hilly land with moderate to steep slopes, sharp ridge crests and remnants of the old, nearly level plain. These are old plains eroded by water and wind. **Sand Hills**: hilly land composed of low to high dunes of sand stabilized by a grass cover. The sand dunes mantle stream-deposited silt, sand and gravel and sandstone. **Rolling Hills:** hilly land with moderate to steep slopes and rounded ridge crests. In eastern Nebraska, the Rolling Hills are mostly glacial till that has been eroded and mantled by loess, while in northwestern Nebraska the hills were provided by the erosion of clay and clay-shale beds. **Bluffs and Escarpments**: rugged land with very steep and irregular slopes. Bedrock materials, such as sandstone, shale and limestone, are often exposed in these areas.

Figure 10. Topographic regions map of Nebraska

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