15 CENTS IF YOU TAKE THIS BOOKLET HOME

Self-guiding Auto Tour of

ARCHES

NATIONAL MONUMENT – UTAH

STRATIGRAPHIC COLUMN, ARCHES NATIONAL MONUMENT

Cretaceous Period, 60-125 million years ago.	**Mancos Shale.** This diversified shale is the youngest rock in the Monument. It was laid down in a marine environment, near the end of the Age of Reptiles, and contains numerous fossil sea shells. **Dakota Sandstone.** Cliffs and ridges near the Delicate Arch parking area are composed of this formation. The Dakota covers many western states and presumably was deposited at the edge of a slowly advancing sea.
Jurassic Period, 125-150 million years ago.	**Morrison Formation.** Named for exposures near Morrison, Colorado. Most carnotite deposits (uranium ore) of the Colorado Plateau occur in this formation. The Salt Wash member, sandstone and mudstone deposited along streams, contains petrified wood, dinosaur bones, and shellfish. **Summerville Formation.** A varied rock formation deposited in ancient mud flats and desert dunes. Chert nodules are common, but fossils are not. Type locality: Summerville Point, San Rafael Swell, Utah. **Entrada Sandstone.** This main arch-making sandstone apparently was laid down by wind and streams, presumably on a low, arid coastal plain. Named for Entrada Point in the San Rafael Swell, Utah. **Carmel Formation.** Named for the type locality near Mt. Carmel, Utah. Here consists of soft red mud and silt which accumulated in shallow basins along the edge of an inland sea. **Navajo Formation.** One of the greatest formations in the Colorado Plateau — superbly cross-bedded due to deposition of wind-blown sands. Rare fossils include dinosaur tracks. Forms bedrock under much of Arches National Monument. **Kayenta Formation.** Consists of beds of fine shale and sandstone (suggesting stream deposition) and includes dinosaur remains. Forms ledges above the sheer Wingate Sandstone. Named for outcrops near Kayenta, Arizona.
Triassic Period, 150-180 million years ago.	**Wingate Sandstone.** Named for cliffs north of Fort Wingate, New Mexico. Formed originally from wind-blown sands. Erodes today into imposing vertical cliffs. Contains fossilized wood and reptile remains. **Chinle Formation.** An extremely varied formation. One section of it, the Shinarump member, is an important uranium-bearing stratum. The Chinle, named originally near Chinle, Arizona, contains many fossils, chiefly petrified wood. **Moenkopi Formation.** Named after its type locality at mouth of Moenkopi Wash, Arizona. Silts and muds comprising it were deposited probably on ancient tidal flats. Fossils are uncommon.
Permian Period, 180 million years ago.	**Cutler-Rico Formation.** This varied rock layer is relatively thin in the Arches region. South of here it contains such areas of scenic interest as Natural Bridges and Canyon de Chelly National Monuments.
Pennsylvanian Period, 250 million years ago.	**Hermosa Formation.** This highly fossiliferous stone, deposited in an ancient sea which once covered the area, was named for outcrops along Hermosa Creek, in the San Juan Mountain Region. It is the oldest rock exposed in Arches National Monument.

Self-guiding Auto Tour of

ARCHES

NATIONAL MONUMENT

Introduction

On behalf of the National Park Service, Department of the Interior, welcome to Arches National Monument. We hope that your stay will be both enjoyable and educational.

Located at the edge of the Colorado Plateau and at the gateway to the canyonlands country of southeastern Utah, Arches Naional Monument, in its 53 square miles, contains natural arches, more stone arches than any other area of comparable size in the nation.

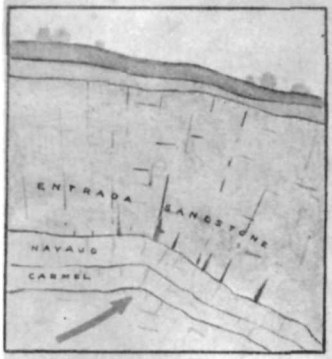
The best way to see Arches is at a leisurely pace, spending as much time as possible hiking the trails. You can get information on trails and hikes in the park leaflet and at the Visitor Center. The purpose of this booklet is to enable you to learn something about the many features of scenic and scientific interest that are visible from the roads.

Geology of Arches National Monument

The story of the arches begins in Jurassic time (approximately 150 million years ago) when muds and sands of the Navajo Sandstone, Carmel Formation, and Entrada Sandstone were deposited. These rocks were covered by several thousand feet of younger formations. Later, perhaps when folding was taking place in the Colorado Plateau area, a series of parallel, vertical joint cracks developed in the Entrada. Uplift and erosion have exposed the three Jurassic formations making up the most prominent features of the Monument.

In the final formation of the arches, water is the most important factor. Water from rain and snow melt tends to follow along the joint cracks. These breaks in the rock are gradually widened by dissolving action of the water and by its freezing in winter. Plants sometimes grow in the soil

HOW NATURE SCULPTURED THE GREAT ARCHES, FINS AND PINNACLES SEEN IN THE MONUMENT

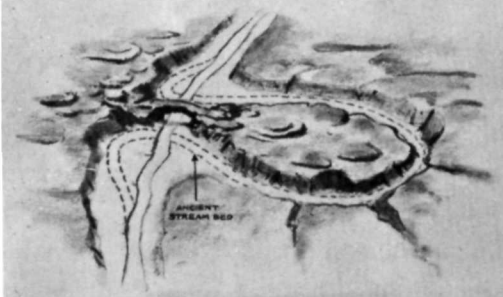


1 SHRINKAGE OF THE EARTH'S CRUST DEVELOPED A SYSTEM OF CRACKS IN THE MASSIVE LAYER OF THE ENTRADA SANDSTONE —

2 THROUGH MANY CENTURIES EROSION REMOVED OVERLYING LAYERS EXPOSING THE CRACKED ENTRADA SANDSTONE TO THE ELEMENTS —

3 CONTINUOUS WEATHERING ENLARGED THE CRACKS AND IS WEARING AWAY THE ROCK SURFACES THUS FORMING EVER THINNING SANDSTONE FINS.

NATURAL BRIDGE AND ARCH DIFFER IN FORMATION



SWIRLING GRAVEL-FILLED FLOOD WATERS GRADUALLY UNDERCUT A NECK OF THE STREAM'S MEANDER THEREBY STRAIGHTENING THE STREAM'S COURSE AND STARTING A NATURAL BRIDGE

GRAVITY CAUSES GREAT CHUNKS AND SLABS OF ROCK, LOOSENED FROM SIDES OF VERTICAL SANDSTONE FIN BY WEATHERING, TO FALL AWAY. THIS CONTINUED THINNING PROCESS EVENTUALLY PERFORATES THE FIN AND AN ARCH IS BORN

that collects in crevices and aid in widening the cracks by holding moist earth, thus removing sandstone cementing material through solution activity. As joint cracks are sufficiently widened, water continues to run through them, but at a continuingly lower level; eventually thin, vertical projections of sandstone, called fins, remain between the

cracks. Wearing away of the rock occurs more rapidly where the weak Carmel formation is exposed, and also along softer zones in the Entrada sandstone. Eventually a fin is perforated from one or both sides, usually at its base; further erosion enlarges the opening, and gravity and wind remove loose materials until an arch is formed.

In Arches National Monument, you see an astonishing variety of structures produced by water action along points of weakness in relatively soft, sedimentary rock. The geology of the area is much more complex than this brief outline indicates, and it is hoped that before long a detailed description of it will be written. Displays in the Visitor Center museum will help you understand what has taken place here.

Ecology of Arches National Monument

Elevations in the Monument range from 4,020 to 5,600 feet. In general this is an area of scanty rainfall, warm temperatures, and high evaporation. Temperature extremes are -24° and 113°. The climate is characterized by hot summers and cool winters. The average yearly precipitation is about 9.5 inches, mostly occurring as showers during the spring months and as thundershowers in late summer and early fall.

The Monument is in the Upper Sonoran Life-zone. Three types of habitat or life communities are found here: (1) desertscrub, covering a major portion of the Monument. (2) pinyon-juniper woodland or pygmy forest, restricted to rocky ridges and slopes, and adjacent ravines. (3)riparian woodland, which is found only along larger washes where water supply is sufficient to permit growth of cottonwoods and other streamside plants. An additional very restricted habitat occurs at springs or seepage areas, which are usually located along sandstone cliffs; here are found columbines, ferns, orchids, and other plants one would hardly expect in a desert environment. In years of good precipitation, spectacular wildflower displays may be seen; wildflowers are especially showy from late April to

mid-June and again in late summer. About 330 species of plants have been recorded in the Monument, and a list of these may be purchased at the Visitor Center.

Despite scarce water, four amphibians are found here, the commonest being the red-spotted toad. During warmer months lizards are the most frequently seen animals, seven species having been observed. Snakes are relatively scarce and seldom noted; most common is the gopher snake. Birds are few, because of scarcity of water and vegetation, but 117 species have been recorded. A list of birds and information on where to find them may be obtained at the Visitor Center. The whitetail antelope squirrel and the Colorado chipmunk are active during the day, but most other mammals such as the grey fox, ringtail, and various rats and mice, are nocturnal; one usually must be content with tracks or other evidence of their presence in the area. Mule deer may often be seen early in the morning and at dusk.

How to use this guide

The Self-guiding Auto Tour is a 13½-mile trip, extending from the Visitor Center to The Windows and returning to the junction with the main road. It is recommended that when you have finished the tour, you turn right at the junction and continue to the Devil's Garden area at the end of the Monument road. Evening campfire programs are given at Devil's Garden Campground during summer months, and trails lead from this locality to various arches and other points of interest. Comments concerning this Self-guiding Auto Tour and how it might be improved will be appreciated.

REMEMBER!

Drive slowly and carefully.
Don't stop your car on hills or curves.
If you plan to hike off the main trails, notify a Park Ranger for your own safety.
All rocks, plants, and various forms of wildlife are protected; leave them for others to enjoy.

Three formations seen from Visitor Center

Mileages given are distances between points of interest.

Visitor Center — The Formations: Before starting your drive, notice the three rock formations which comprise much of the scenic topography of Arches National Monument. They are the Navajo sandstone, Carmel formation, and Entrada sandstone. One can see these Jurassic age formations from the Visitor Center and from the road which climbs along the north wall of Moab Canyon.

The Navajo sweeps up from the canyon floor in a rounded, sloping mass of light-colored sandstone, easily recognized by the numerous juniper trees dotting its surface. In this part of Utah, it is a relatively weak formation, breaking down to form rolling lowlands. In Zion Canyon to the west, it is well known as a solid, cliff-forming sandstone.

The Carmel is exposed above the road in a comparatively

thin strip, recognizable by red color and thinly-bedded appearance. The bedding displays bands of wavy sediments. It is composed of poorly-consolidated sediments and wears away easily, leaving an uneven surface of rock cobbles and thin ledges.

The thick Entrada comprises the remainder of the wall, forming vertical cliffs which rise to the skyline. It is a massive, orange-red sandstone, originating as wind-deposited sand in an arid region, and as deposits in shallow water. The majority of the arches have been formed in this formation.

(.5 Mile)

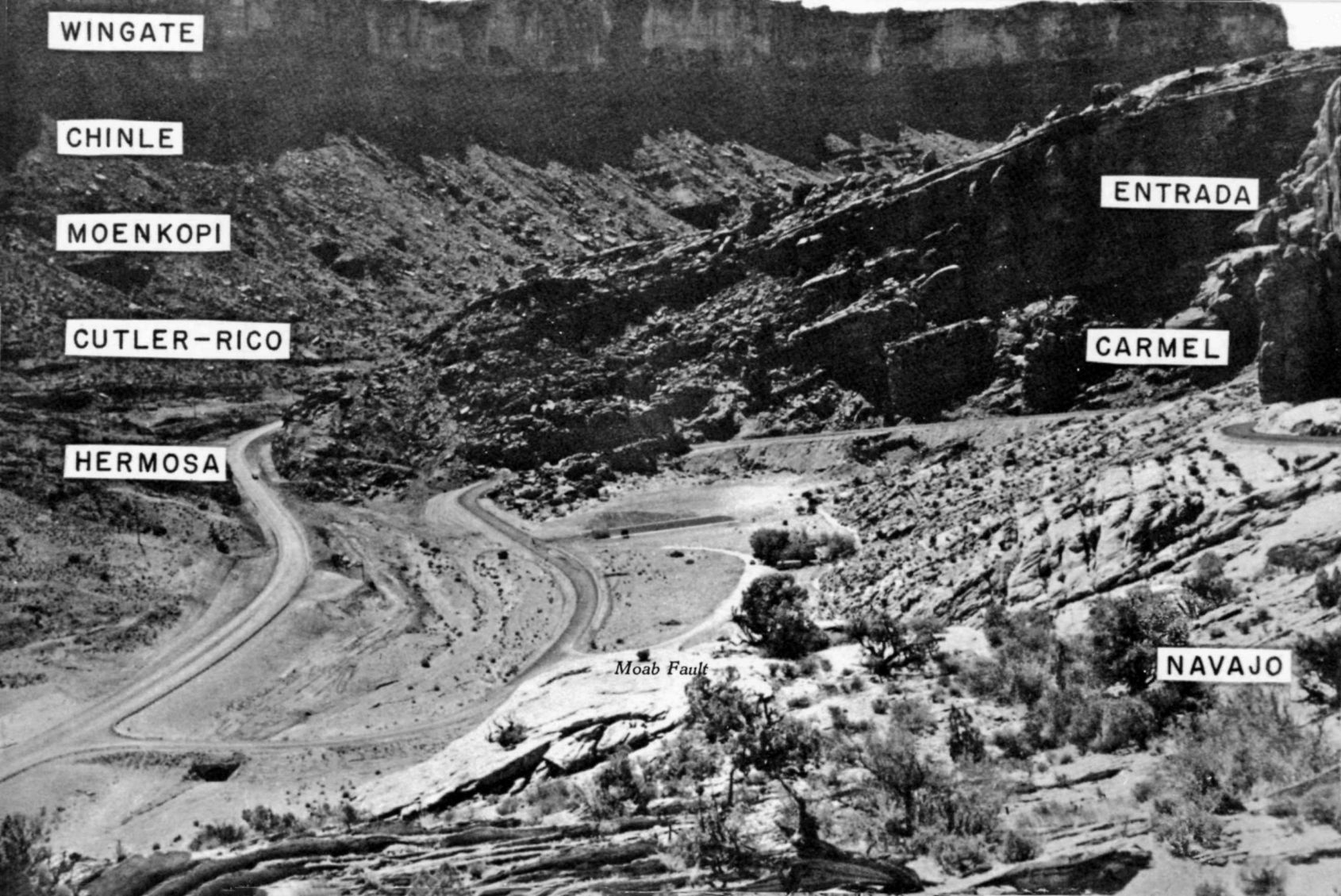
1. Spanish Valley: You are looking down Moab Canyon to the head of Spanish Valley and the town of Moab. The Spanish Trail which was used during the early part of the 19th century crossed the Colorado River where you now cross it on a highway bridge.

The first attempt to settle the valley took place in 1855 when the Mormon church sent a group of 41 men from Salt Lake City to establish the Elk Mountain Mission. Within a few months, these early settlers were driven off by Ute Indians, and three men were killed. No further attempt at settlement was made until 1878, when a few families moved into the valley to farm and raise cattle. Moab grew slowly and remained a small ranching community until the early 1950's, when a uranium boom brought thousands of people into the area. The pond that you see at the head of the valley is part of the Atlas Minerals development — a uranium processing plant.

Until recently, Arches National Monument was accessible only by rough roads and long hikes. The paved road from the Visitor Center to Devil's Garden was completed in October, 1963, making it possible for many more visitors to see the Monument; however, there are several interesting trails for those who wish to hike.

(.6 Mile)

2. The Moab Fault: If you think of the present highway (160) as a deep earth fracture dividing the canyon into two


WINGATE
CHINLE
MOENKOPI
CUTLER–RICO
HERMOSA
ENTRADA
CARMEL
NAVAJO
Moab Fault

separate blocks, you can begin to understand what happened along the Moab fault.

This fracture represents a weakness in the earth's crust, along which vertical movement took place approximately six million years ago. The side of the canyon where you stand slipped down like a large freight elevator, more than 2,600 feet! Note that the far canyon wall is higher than this side. You can also see the Entrada, just beyond the Visitor Center, dipping down and disappearing into the highway.

The sequence of rocks viewed in the far canyon wall is entirely different from those on your side. Although the cliff on the horizon looks much like the Entrada, it is not the same; it is a much older sandstone known as the Wingate.

How could one regain the original order of the rocks before the chaos of the Moab fault? Simply hoist your side of the canyon up and stack it on top of the Wingate where it belongs! In so doing, you will have created a complete stratigraphic section of the rocks in this area.

(.6 Mile)

3. *Desertscrub Community:* Along the right side of the road is a flat area covered with small shrubs, most of which are blackbrush (*Coleogyne ramosissima*), a member of the rose family. Large portions of the Monument are covered by stands of this plant. In some localities, the desertscrub community includes other shrubs such as sagebrush, saltbush, and greasewood. Arches National Monument lies within the Great Basin Desert, sometimes called a cold desert, although you may disagree if you visit the area in summer.

(.4 Mile)

4. *Park Avenue:* We suggest that you stop and take a short walk to the viewpoint. From there you will see the thin wall of sandstone dominating the right side of the canyon.Erosion has cut and widened former joints in the rock until all that remains is a resistant slab. This slab of rock is called a fin. It reminded early visitors of a big city skyline.

On the left of the canyon are some examples of balanced rocks. Fins and balanced rocks are common features of this landscape.

(.4 Mile)

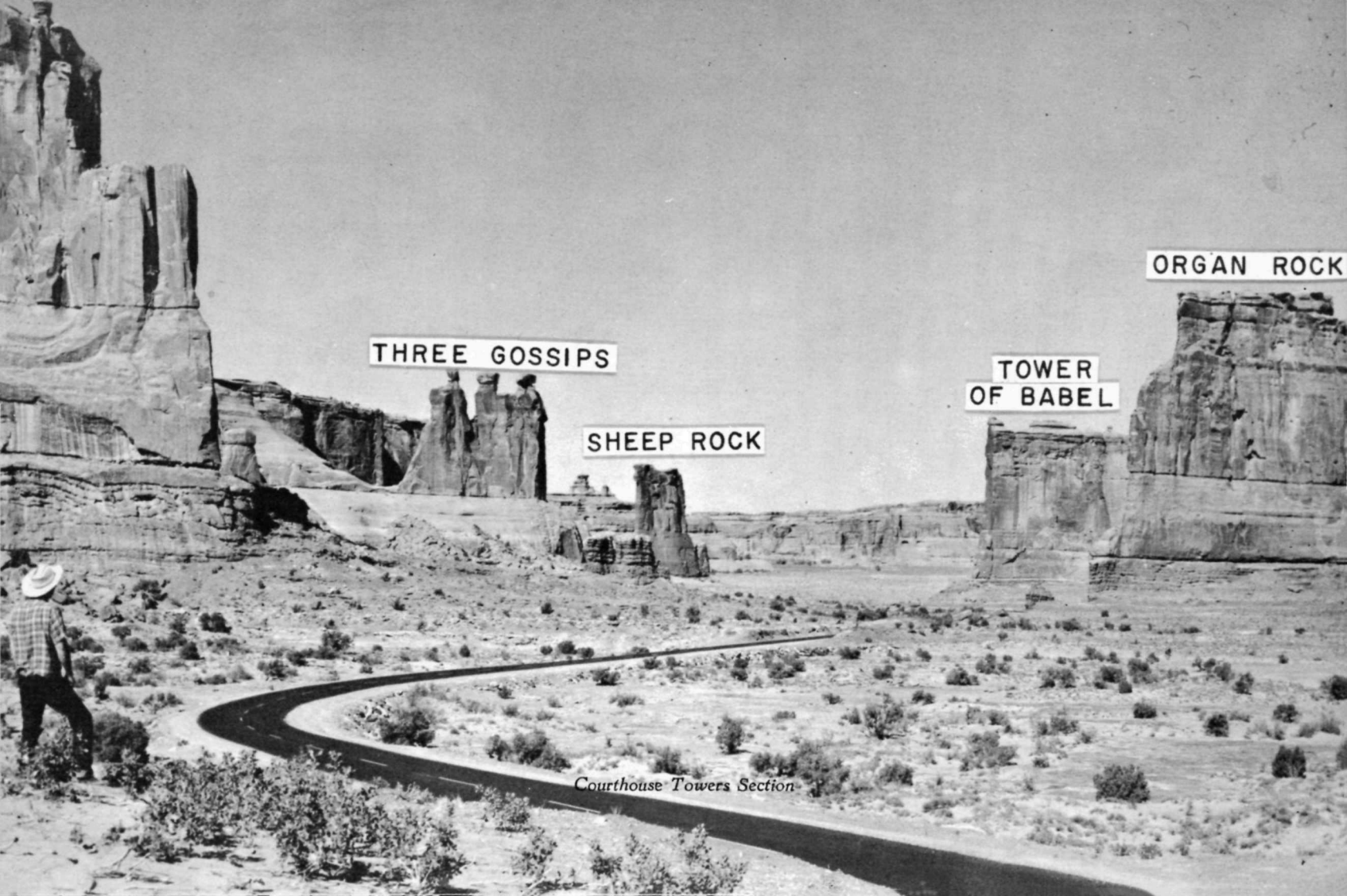
5. La Sal Mountain Viewpoint: An excellent view of the La Sal Mountains and surrounding country may be seen from the spur road parking area. The La Sals dominate the skyline, with some of the peaks attaining an elevation of almost 13,000 feet; this is the second-highest mountain range in Utah. The La Sals are an unusual type of mountain; they originated from molten rock whish cooled just below the earth's surface after pushing up many layers of sedimentary rock into a dome. During its active period, this ancient volcano just barely erupted. Its unused magma then cooled into crystalline rock, forming the general outline of the mountain. Subsequent erosion stripped off the overlying sedimentary rock, exposing the igneous core. Mountains of such origin are called laccolithic mountains. The nearby Abajo and Henry Mountains are other examples which had similar origins.

The La Sals are also of interest because of the great variety of plant and animal life occurring there, from desert types at the base to forests of aspen and spruce at higher elevations. By going from the base of the La Sals to the top ones moves through four different life zones.

(.5 Mile)

6. Courthouse Towers: The road now leads through the Courthouse Towers section, so named because of the erosional forms found here. As the canyons were cut back into the landscape, they eventually isolated resistant patches of rock. These large masses of rock are called monoliths, and can assume fantastic shapes. You could consider them as leftovers that have survived the first cycle of erosion.

You may want to stop and photograph the Three Gossips and other strange rocks. It might be fun to try naming some of them yourself. Each person sees them in a somewhat different manner.



Courthouse Towers Section

(.6 Mile)

7. Fallen Arch Viewpoint: No major arches are found in this section, but they may have once existed here. Sheep Rock is all that remains of a collapsed fin which possibly contained arches. The "sheep" lies looking back across the void which has stranded it. There is reason to believe two arches had formed in the ancient fin that once connected the sheep to its Entrada mainland. The face of the sheep displays a sharp cleavage, as though a rock span broke away from under the burden of its own weight. Similar scars appear elsewhere on the otherwise smooth surface.

Today we see a small arch forming at the base of the Entrada wall to the left of the broken fin. The bed of softer sediment has been pierced, and erosion will slowly expand the opening to grander proportions.

(.8 Mile)

8. Courthouse Wash: After crossing the bridge, you may park on the left side of the road and hike either up or down the wash. You should be prepared for some wading. You will probably encounter quicksand in a few places, but it is not dangerous here.

Courthouse Wash is a good example of a desert stream. During most of the year it contains only a trickle of water, but following a heavy rain it becomes a raging torrent, whish sharply erodes its channel. The riparian or streamside community is restricted to such areas where water is more readily available. Fremont cottonwood, tamarisk, willow, and other moisture-loving plants grow along the wash. Because of the more abundant supply of water and plant life, the washes are the best places to find birds in the Monument, especially during spring and fall, when several species migrate through the area.

(.3 Mile)

9. Along the Entrada Cliffs: Beyond Courthouse Wash the road follows the edge of the high Entrada cliffs. Because of the rock thickness and strength, erosion has made slow

progress in trying to slice deep canyons. Yet, on closer observation, its subtle work is apparent. Bowl-shaped amphitheaters, rounded drainage channels, solution cavities, and polished rock all testify to its slow decay. Piles of fallen rock remind us just how temporary landscape features can be. Sand-charged winds can pepper the rough surface of the rock, rounding off rough edges and corners. Sand particles drop, to accumulate as dune deposits along the cliff.

The dark stain seen coating the cliff surfaces in varying intensity is known as desert varnish. It is an oxide of iron and manganese which forms as a weathering effect in arid regions. It appears related to water dripping over the walls, but its exact origin is not known. In areas of such desert varnish the prehistoric Indians left their strange symbols known as petroglyphs. Excellent examples of this art may be seen along the Colorado River on the scenic road to Potash (Utah 279).

(.8 Mile)

10. Slickrock Slopes: The lower surfaces of the cliffs on your left, and the broad, gently-sloping rock surface on your right, are good examples of slickrock slopes. During brief, severe rain storms, the rain water does not have time to cut channels in the rock. It runs off in all directions in the form of a sheetflood, resulting in the smooth convex surfaces you see here.

(.3 Mile)

11. Petrified Dunes: The vast area of Navajo sandstone hummocks, stretching east toward the La Sal Mountains, is known as the petrified dunes. In Jurassic times (about 150 million years ago), this area was a sandy desert, somewhat like the Sahara. Large dunes drifted with the winds and accumulated into large masses of material. These dunes were eventually buried, compressed, and then cemented into the sandstone that we see today.

The groups of slanting lines often seen are really thin bedding planes from the original deposit. They are exposed now in cross-section as erosion cuts through the dune.

Sand dunes are again forming in this area from sand that is eroded away from the Navajo and other formations. Thus we see that erosion and deposition of materials is a never-ending process. Sand dunes of today may become the sandstone of future times.

(.3 Mile)

12. Utah Juniper: The Utah Juniper (*Juniperus osteosperma*), commonly miscalled cedar, is one of the most conspicuous plants in the Monument. The landscape is frequently dotted with these small trees which seem to be growing out of the rock, although they actually have their roots in pockets of soil that have accumulated in breaks in the rock surface.

Indians found uses for almost all the plants that grow in the area. They used the juniper and its berries in preparation of medicines. The shaggy bark provided them with fiber for making sandals, rope, and matting. Early settlers used it for fuel and for making fence posts.

In some parts of the Monument, such as at the Devil's Garden, you will find the juniper growing with the pinyon pine. These two conifers make up what is known as the pinyon-juniper community, or pygmy forest, which covers vast areas at intermediate elevations throughout the Southwest.

(.8 Mile)

13. The Pinnacles: The tall, slender stone minarets to the left of the road are called pinnacles. They are one of the last features to rule a landscape. Erosion has all but stripped away these stubborn rocks, and could well have done so had it not been for their protective helmets of hard sandstone. Pinnacles are prominent erosional features associated here with the Carmel formation. Although attacking processes are the same, the end result that we see is entirely dependent on the makeup of the parent material. Differences in rock types help explain the great variety of erosional features found throughout the Southwest.

(.7 Mile)

14. Windows Viewpoint From here a pair of arches dominate the skyline east of the road — North Window (left) and Turret Arch (right). The right side of the Spectacles (South Window) is hidden from view, but would otherwise appear between these two arches. You can hike to them from the end of the side road to The Windows (18). Again you see how rocks can take on new and bewildering shapes. Also, the position of the sun will lend new faces to many features as it and its shadows migrate across them.

(.9 Mile)

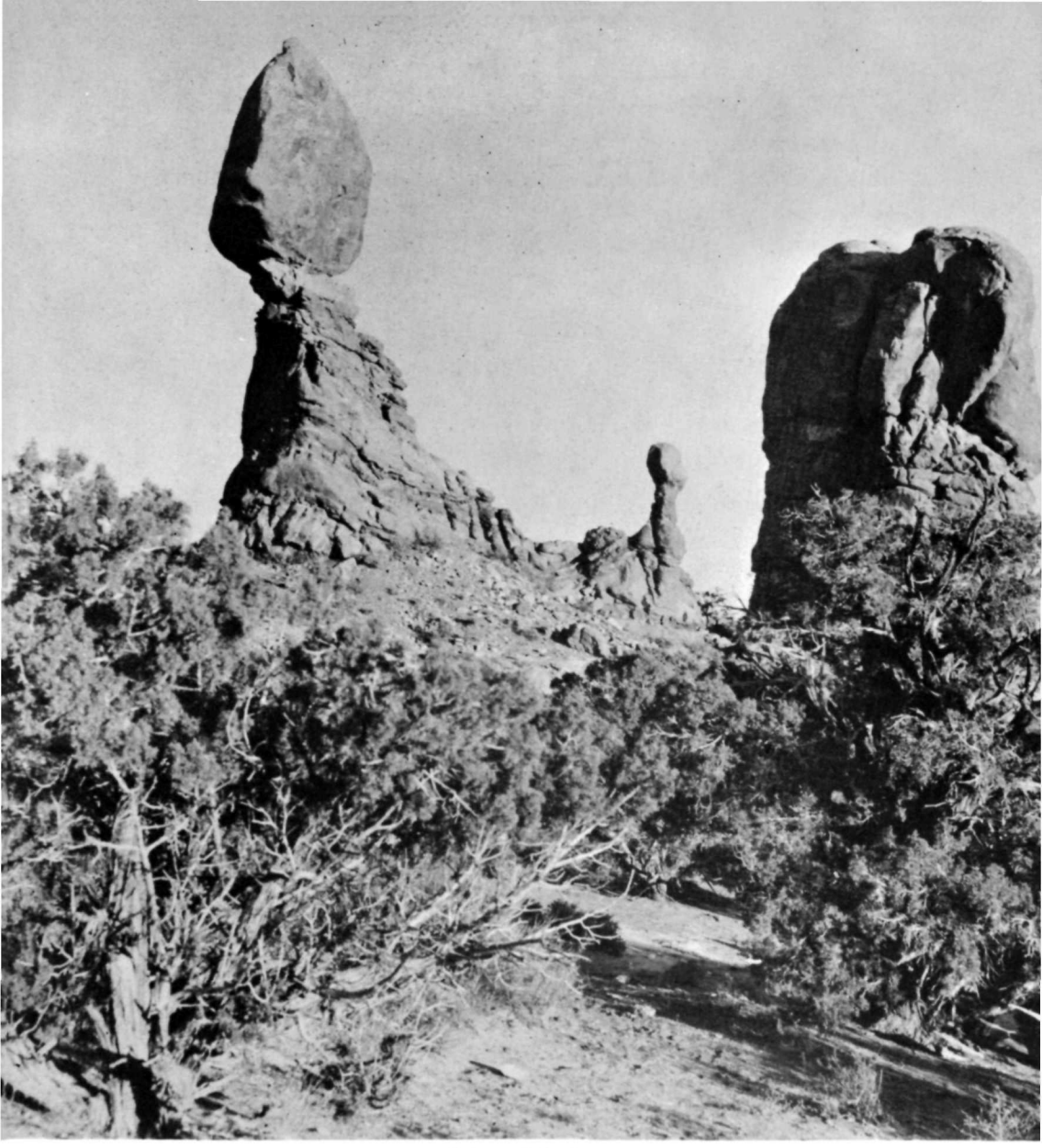
15. Balanced Rock: Standing in defiance of gravity, an Entrada boulder caps a puny pedestal of Carmel formation. This is the most famous balanced rock in the Monument. Its proportions are deceiving, and one tends to underestimate them. The total height of the rock is 128 feet. The large boulder balancing above is over 55 feet long and its weight has been estimated at approximately 3,577 TONS, equivalent to the weight of 1600 automobiles! A late afternoon picture is best, for then the low sun intensifies rock color and defines the mountains in the background.

The unimproved road across from the parking area leads a short distance to a dry picnic area. Tables are provided, but shade is hard to find.

After leaving the balanced rock, you will want to take a side trip to The Windows; the junction is just ahead. Don't miss this one, for you are about to see some of the Monument's most impressive natural stone arches.

(1.3 Miles)

16. Garden of Eden: You have an excellent view of Salt Valley and the area to the north, from the viewpoint at the end of the turnoff. Wih the aid of the view finder, you may be able to pick out Delicate Arch. Delicate Arch has become the symbol of Arches National Monument, and this motif is used on many of the area's signs, including those marking the auto tour. The best way to see Delicate Arch is to return to the main road, turn right and drive up this road for 2.5



Balanced Rock

miles, then turn to the right on an unimproved road that goes to Turnbow Cabin. It is a hike of 1½ miles to Delicate Arch from the cabin, and late afternoon is the best time for it. The road to Turnbow Cabin becomes very slick during wet weather and may be closed at such times.

To your left, across the valley, notice the concentration of red sandstone fins known as the Fiery Furnace. Conducted trips are taken through this fascinating area during the summer months. This involves a fairly strenuous hike of about 1½ miles, taking about 2 hours.

(1.0 Mile)

17 Alcoves: A short walk to the rise on the right of the parking area brings you to a viewpoint from which you can see North Window, Turret Arch, and a spectacular group of alcoves.

Many of the caves in which prehistoric Indians built their homes started as small alcoves such as you see on the cliff across the highway.

Erosion in this section has proceeded along the weak contact between the Carmel and the Entrada. The softer Carmel is sluffing away to form deep alcoves. These provide an ideal framework for arch formation. See if you can pick out Cove Arch among them.

(.3 Mile)

18. The Windows: In this area, you can see from the road a great concentration of natural stone arches. Foot trails leading to them allow closer observation and good photographic angles. You may view North and South Window together as the Spectacles if you hike to Turret Arch. A favorite morning shot is to frame Turret Arch with the North Window.

(.2 Mile)

19. Double Arch Area: A short hike down the trail from the parking area brings you to a group of striking geologic features. Most renowned of these is the Double Arch, which displays twin bows resulting from the collapse of its middle section. It is a combination of two types of arch formation — the perforated fin and the pothole. The largest opening is 163 by 157 feet.

Looking back from the trail's end, one sees the Parade of Elephants, whimsical stone statuary resembling a circus

pachyderm parade. With tail in trunk, the elephants rumble toward you along a sandstone roadway.

(.6 Mile)

20. Recent Rock Fall: Do balanced rocks and pinnacles ever fall? Undoubtedly many do every year; however, owing to their small size and concealed locations, most examples go undetected. The cliff to your right bears evidence of one of the largest and most recent known rock falls in the Monument. Notice the fresh scar along the cliff (on the left) from where the rock tumbled on October 7, 1962. Erosion working in the joints and cracks loosens large sections of rock, causing them to fall. This action is known as spalling. Erosion in the soft sandstone of this region is a relatively rapid process, although it may seem slow to us.

(.3 Mile)

21. Ham Rock: A prominent landmark which may be seen for many miles is Ham Rock. Located high to the left on a skyline of Entrada, to some people this rock closely resembles a ham. It is simply another balanced rock, but one carved entirely of Entrada sandstone.

Notice the prominent fold in the Carmel formation at the base of the cliff. This apparent folding is probably due to the fact that sediments making up this formation were deposited on a slope, as in a delta. The soft sediments may have folded as they slid down the slope, before being transformed into rock by time and pressure.

(.8 Mile)

22. Salt Valley Viewpoint: Salt Valley is a long depression marking the site of a salt dome. At some time in the past, movement of salt deposits upward domed the overlying sedimentary rocks, forming an anticline. When the salt eventually dissolved away, the broken material above it collapsed and was slowly removed by erosion, leaving the trough that you see today. Rocks making up the Fiery Furnace and other areas at the edge of the valley show the great amount of fracturing that took place at the time

of uplift. Rocks found in the Salt Valley area include younger formations not found elsewhere in the Monument; these are the Summerville, the Morrison, the Dakota, and the Mancos.

At the end of the ridge on the right is a dark sandstone spire known as the Dark Angel; you will see it again as you approach Devil's Garden on the main road. The rock formation jutting into the sky on the left side of the valley is known as Klondike Bluffs. An unimproved road leads to the bluffs, but you should inquire about its condition before attempting it.

For Geology of Salt Valley, see 2-page spread starting on Page 20.

(.5 Mile)

Road Junction: From this point you may either turn left and return to the Visitor Center, or turn right and continue another nine miles to the campground and picnic area at Devil's Garden. There are many things to see on the way, and you may wish to take the side trip to Delicate Arch. We invite you to stay and see more of the interesting features of your National Monument.

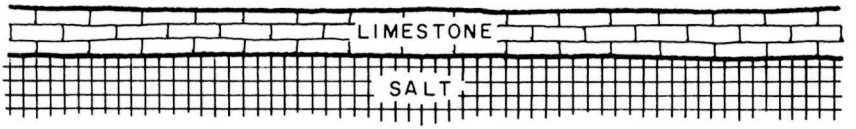
We hope this booklet has made your drive more meaningful and enjoyable. If you have further questions about the Monument and its features, please ask any of the Park Rangers to help you.

COME AGAIN!

4th Edition—20M—8-66

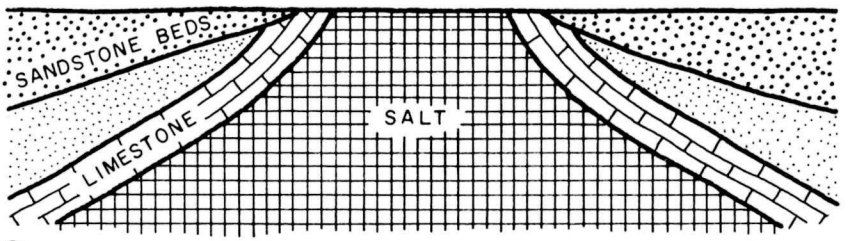
Looking up Salt Valley

CHART ON GEOLOGY OF SALT VALLEY

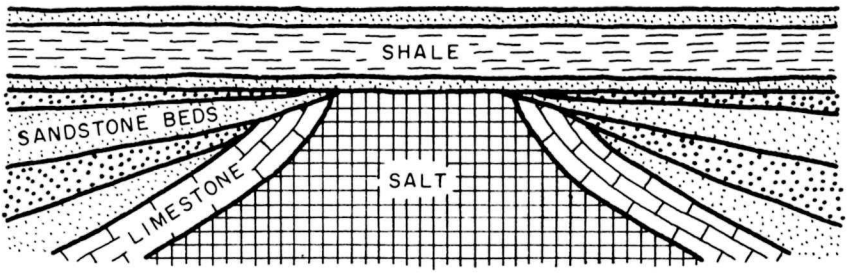


A. AROUND 250 MILLION YEARS AGO, THICK SALT BEDS (+8000 FEET) WERE DEPOSITED IN A LARGE LAND-LOCKED SEA; FOLLOWED BY AN INVASION OF MARINE WATERS WHICH DEPOSITED THE LIMESTONE.

B. FIFTY MILLION YEARS LATER, REGIONAL COMPRESSIONAL FORCES RESULTED IN SEVERAL VERTICAL RISES OF WALLS OF SALT (SUCH AS HERE IN "SALT VALLEY"); FORCING THE LIMESTONE ABOVE THE WATER LEVEL AND EXPOSING IT TO EROSION.

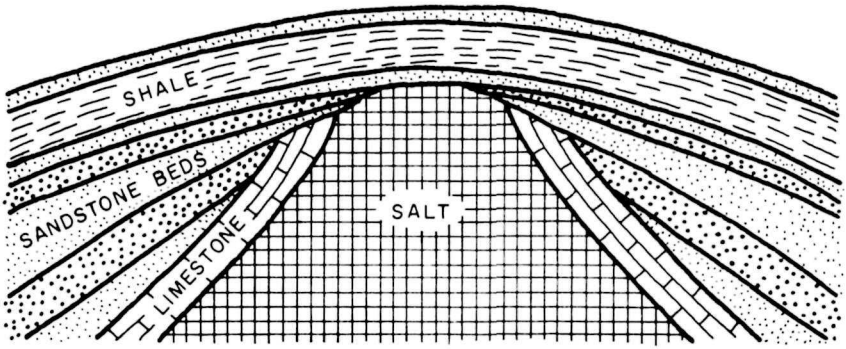


C. SOON AFTERWARD, MARINE AND FRESH WATERS FLANKED THE OVAL SHAPED ISLAND, DEPOSITING MOSTLY SANDSTONE BEDS. CONTINUED EROSION FINALLY REMOVED THE ISLAND; RESULTING IN A NEAR FEATURELESS FLOOR BELOW EXTREMELY SHALLOW BODIES OF WATER.

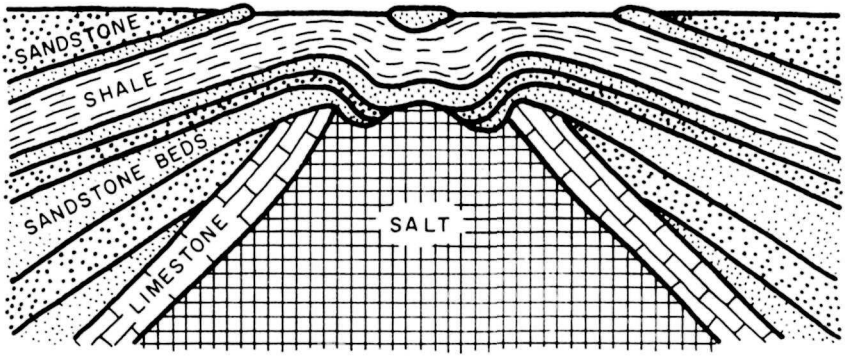


D. AROUND 150 MILLION YEARS AGO, THE ENTIRE REGION WAS AGAIN FLOODED BY BOTH FRESH AND SALT WATERS, RESULTING IN THE DEPOSITION OF SANDSTONE AND SHALE BEDS.

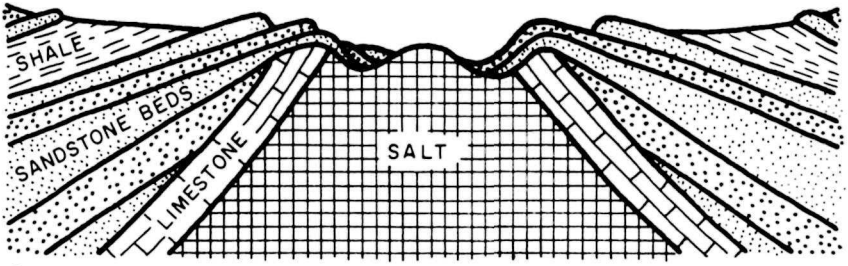
CHART ON GEOLOGY OF SALT VALLEY



E. ABOUT 60 MILLION YEARS AGO, THE AREA WAS AGAIN SUBJECTED TO COMPRESSIONAL FORCES. THE SALT PLUG WAS FORCED UPWARD, AND THE ENTIRE SECTION OF ROCK ABOVE THE PLUG WAS BULGED UP INTO A DOME SHAPED STRUCTURE.



F. WITHIN THE LAST SEVERAL MILLION YEARS, DEEPLY PENETRATING GROUND WATER DISSOLVED THE UPPER PART OF THE SALT DOME AND CARRIED IT AWAY, RESULTING IN A HUGE CAVITY INTO WHICH THE UNSUPPORTED OVERLYING ROCK COLLAPSED.



G. OVER THE PAST MILLION YEARS, THE VALLEY AS SEEN TODAY, HAS SEEN LITTLE CHANGE. THE EROSION FOLLOWING COLLAPSE HAS REMOVED THE SHATTERED ROCK FROM THE CENTER OF THE VALLEY, AND IS AGAIN IN THE PROCESS OF REDUCING THE AREA TO A LEVEL PLAIN.

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