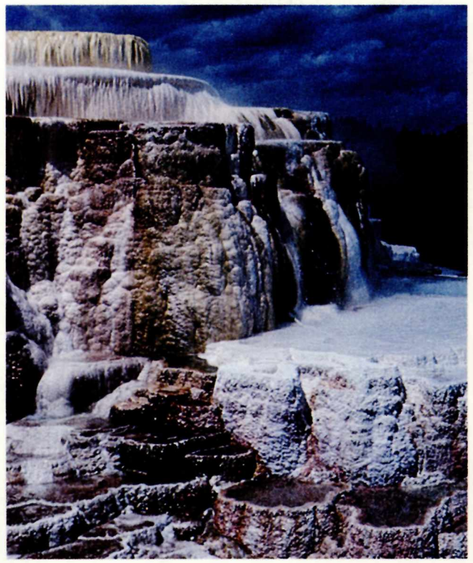
MAMMOTH HOT SPRINGS AREA

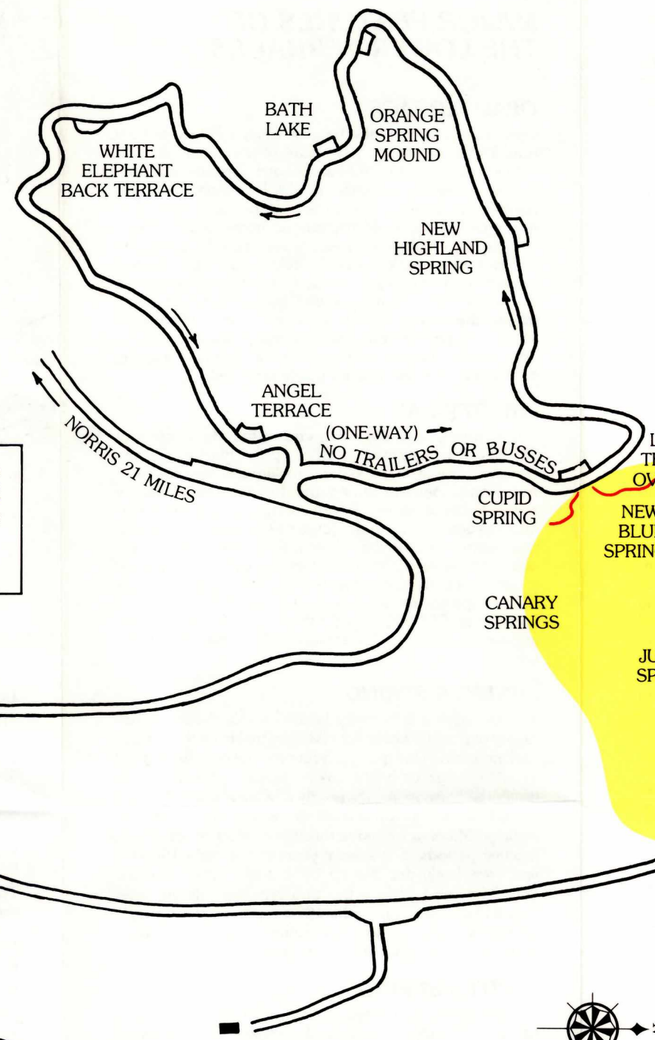
YELLOWSTONE NATIONAL PARK

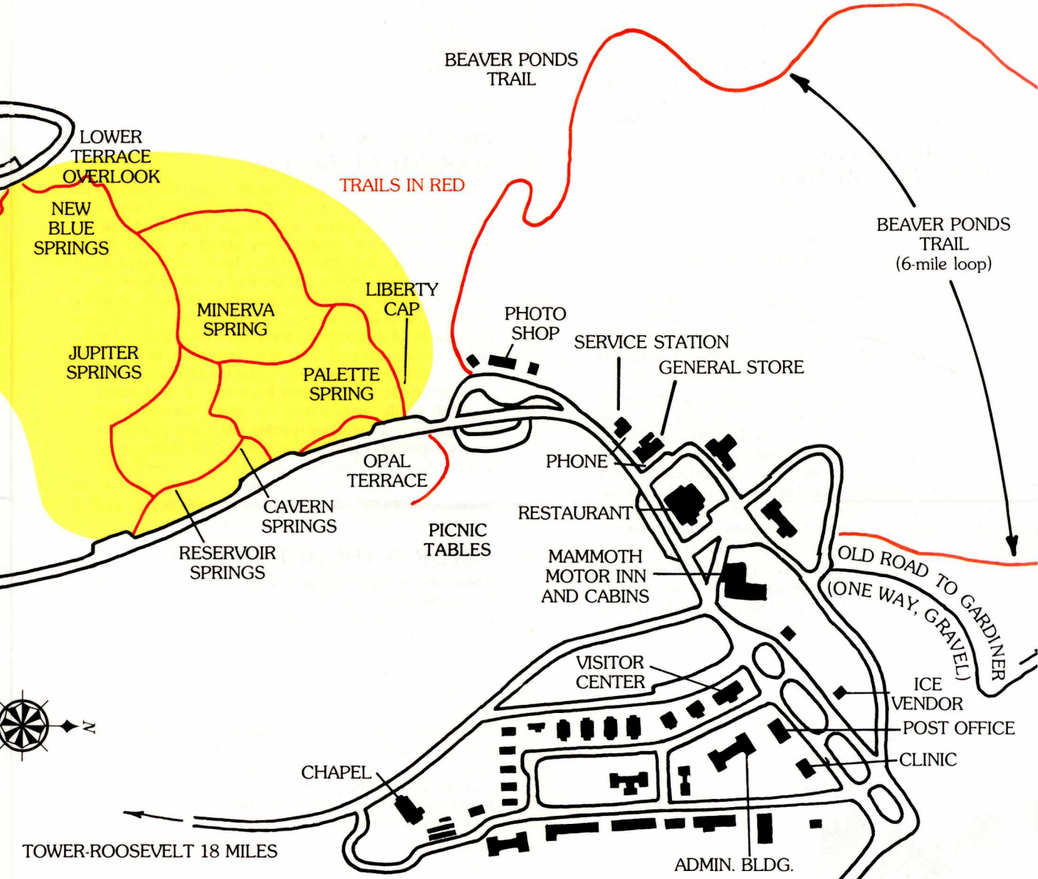


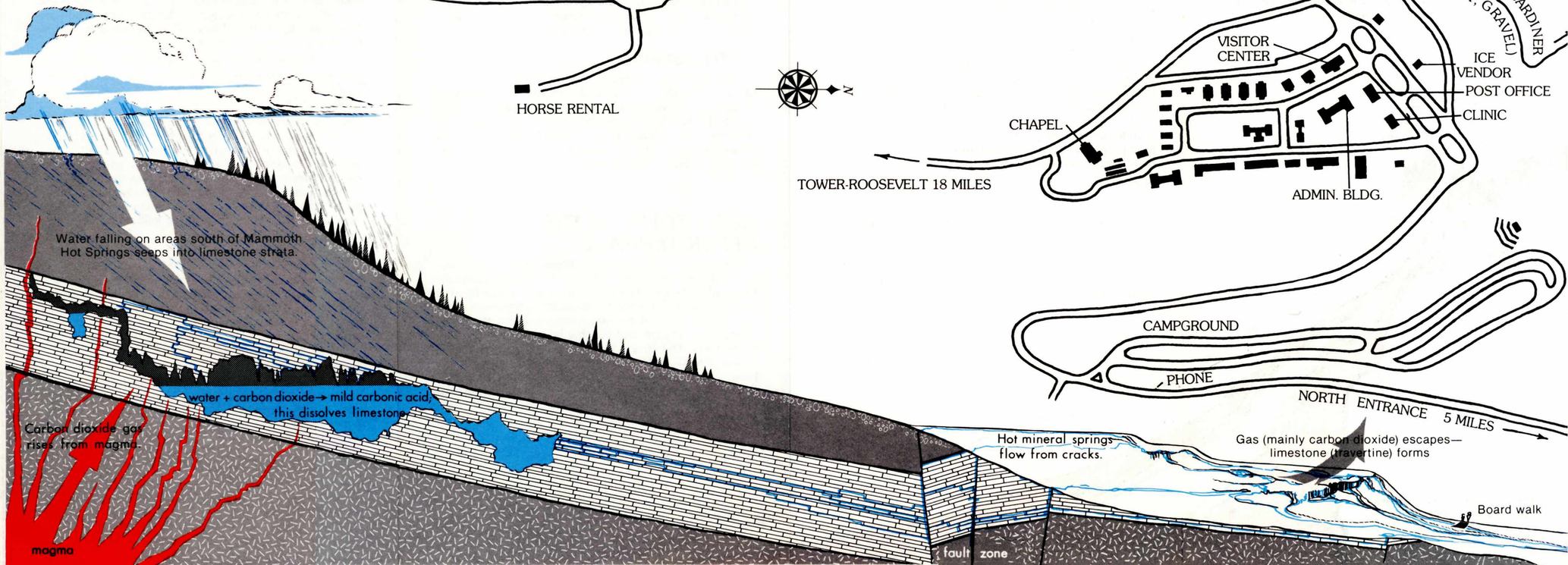
Scale of Miles 1" 2" — .1m .2m — .1609k .3218k

For your safety and the protection of the fragile features, PLEASE STAY ON THE TRAILS. Pets are not permitted on the trails, for their protection and yours.

EMERGENCY PHONE 344-7381







WELCOME *to the Mammoth Hot Spring Terraces, one of Yellowstone's fascinating natural features! There are several ways to enjoy the terraces—hike the boardwalks or drive the Upper Terrace Loop road, for example. You may wish to drive to the Upper Terrace Loop, drop off members of your party, let them hike down the boardwalk and pick them up at the lower parking area. The maps in this pamphlet will help you decide how you might best enjoy the terraces.*

The Mammoth Terraces and Hot Springs were officially discovered by a U.S. Geological Survey party led by Dr. Ferdinand Hayden in 1871. However, some local knowledge of the Hot Spring Terraces and their activity had existed previous to that time.

The Mammoth Hot Springs have interested people since the establishment of Yellowstone National Park, not only for their striking beauty but also their changeability. These remarkable springs are noted for their rapid deposition, unpredictable shifts, and random rejuvenation. Here the active forces of geology often make measurable changes from one day to the next, and it is possible that significant changes have occurred since thie booklet was printed.

INGREDIENTS FOR HOT SPRINGS ACTIVITY

Hot water is the life of the terraces. Without it terrace growth ceases; the formations weather gray and black, and begin to crumble. Typically the many hot springs gush forth at random, flow a short way, then disappear into a crack or fissure farther down slope.

In searching around the Mammoth area old dormant terrace mounds can be found in several places. Although a frequent shifting seems to take place, the records over the past several years indicate that the total flow of water has remained fairly constant at some 500 gallons per minute.

Ground water is the source of the outflow at Mammoth Hot Springs. It is mostly seepage fed by rain and snow falling high on the slopes of Terrace Mountain and areas as far south as Norris Geyser Basin. This cold ground water is heated before it emerges to the surface by rising heat from the magma chamber which once fueled the violent volcanos of Yellowstone's past. See the diagram on the reverse of this leaflet. The water temperature in these springs reaches the vicinity of 170 F (73 C.)

Yet still another ingredient is needed for growth of the terraces — that is, a basic building material. The raw material here is calcium carbonate. It is abundant beneath Terrace Mountain as thick layers of sedimentary limestone. Related layers of limestone are visible as outcrops on the face of Mt. Everts across the narrow valley to the east.

As the ground water seeps slowly downward into the limestone it comes in contact with hot gases rising from the magma chamber which are heavily charged with carbon dioxide. Some of the carbon dioxide is readily absorbed to form a carbonic acid solution. Ordinarily water can only slowly dissolve limestone, but the hot, acidic solution rapidly dissolves great quantities of it. Saturated with lime, the carbonated water continues to seep along the rock layers until it gushes forth as the Mammoth Hot Springs.

Once exposed to the open air some of the carbon dioxide escapes from the solution, thus reducing the acidic level. As this happens, the lime, no longer able to remain in solution, is deposited as travertine in the shape and form of a terrace.

Looking at the terraces you can visualize the amount of limestone excavated. Geologists estimate that the Mammoth Hot Springs water carries more than two tons of dissolved limestone to the ground surface each day.

CHANGE ON THE MAMMOTH TERRACE

The Mammoth Terraces are continuously changing. Had you visited the area in the 1930's, you would have found Blue Spring, Cleopatra, and Angel Terraces to be the feature attractions. Today they stand as gray, lifeless ruins, and newly named springs have succeeded them. Throughout the 1970's Jupiter and Minerva Springs and parts of Highland Terrace have flowed freely, building delicate and colorful terraces. These clear pools, rimmed by scallops of algae-tinted travertine, have created spectacles known around the world for their beauty. The tiered pools form as a result of the peculiar way in which the carbon dioxide escapes from the cooling water. In tranquil pools evaporation is slow. Where water is agitated the gas escapes quickly. At these points travertine is deposited rapidly. The rim of deposition grows upward to form a higher dam, which further accents the two zones. The travertine rim continues to grow until water pressure bursts the dam. Then the process begins again at a prominent riffle in the new channel.

COLOR IN THE HOT SPRINGS

Travertine is deposited as a white mineral, yet whenever hot water glistens on its surface the formation is brilliant with color. The oranges, yellows, greens and browns are from a great number of tiny living bacteria and algae. Approximately sixty-five species of thermal algae live in the waters of Mammoth Hot Springs and reflect varying conditions of such environmental factors as temperature, acidity, sunlight and carbon dioxide concentrations. White and bright yellow thermal bacteria predominate in the hottest section of the runoff channels near the springs. Farther along where the water has cooled a bit, the orange, brown and green algaes are most abundant. Different combinations of temperature and carbon dioxide paint mosaics of algal color across the terraces.

Most of the color comes from the group known as the blue-green algae, which display more colors than their name suggests. These thermal algae are extremely primitive and have probably changed little from those growing in hot springs at the very dawn of life on earth. Amid any Yellowstone thermal basin on a steamy day it is easy to imagine a volcanic region on a primitive earth where hot spring waters bubbled up through colored strands of these same types of algae and bacteria.

Different temperature zones in the water channels paint ribbons of algal color.

MAJOR FEATURES OF THE LOWER TERRACES

OPAL TERRACE

Opal Spring flows at the base of Capitol Hill across the road from Liberty Cap. After years of dormancy, this spring became active in 1926 and began depositing up to a foot of travertine per year. In 1947 a tennis court was removed to allow natural expansion of the terrace. Further growth threatened the historic home next to Opal. Designed by Robert C. Reamer and built in 1908, the house is an example of Prairie Style architecture. Among Reamer's other designs are the Old Faithful Inn and the Roosevelt Arch. Sandbags and an earthen wall today protect the house. It is the mission of the National Park Service to protect both historical and natural resources, which come in conflict at Opal Terrace. Should the spring be restrained or the historic house removed?

LIBERTY CAP

This feature marks the north end of the Mammoth Hot Springs. It was named in 1871 by the Hayden Survey party because of its marked resemblance to the caps worn by colonial patriots during the Revolutionary War. It stands today as an extinct hot spring cone. Its outer surface has been cool and dry for many years and supports a plant community much different from that found at the active hot springs. Near the top are patches of orange lichen which are the pioneers at work breaking the rock into soil, paving the way for other plants to follow at some future time. PLEASE STAY ON THE TRAIL as weathering has loosened rock fragments which may fall at any time.

MINERVA SPRING

Minerva Spring is centrally located within the lower terrace group and is easily accessible by trail from the various parking areas. This spring is a favorite not only because of its wide range of bright colors, but also for its ornate travertine formations. Since the 1890's when the first records were kept on the activity of the Mammoth Hot Springs, Minerva has gone through a series of active and inactive periods. For several years in the early 1900's it was completely dry, but by 1951 it was again reported that "Minerva is very active and certainly it is the most beautiful spring." During the 1970's spring activity has increased in some of the other features regenerating algae mats which now rival those found at Minerva.

JUPITER SPRING

Jupiter Spring is situated just south of Minerva. It was named in the 1880's because of its imposing and towering formation. Jupiter was a Roman god of the elements; the thunderbot was his sign and the rainbow his messenger. If you listen quietly you may hear the hot water thundering down the terraces of this feature. The rainbow of algae covering its terraces is obvious.

AUTO TOUR OF THE UPPER TERRACE

The entrance to the Mammoth Terrace Drive is one and one-half miles south of the Mammoth Visitor Center on the road to Norris. This scenic auto tour winds for one and one-half miles among several active thermal springs and has convenient parking pull-outs along the route where you can stop and become better acquainted with the features. The drive is a one-way loop road and due to several sharp turns it is necessary to exclude towing units, buses and motor homes in excess of 25 feet in length. Remember that thin crust and very hot water make caution especially important when you are near thermal features.

MAMMOTH HOT SPRINGS AREA

Lower Terraces

LOWER TERRACE OVERLOOK

This viewpoint offers an excellent overview of the springs and pools of the Lower Terraces. The large blue pool ahead and to the right is Canary Spring. The pools visible to the left are the New Blue Springs complex. The names of these features suggest colors which are inconsistent with what we see today. The color of both features has changed from when they were originally named. Changes in environmental conditions may account for this; perhaps a change in water temperature.

The trail to the left goes around New Blue Spring and on down over the terraces to Minerva Spring. Near that point the trail branches to the right to Jupiter Spring and past Minerva itself, or left to Liberty Cap. Both routes lead to parking areas along the lower road.

Beyond the terraces the red-roofed buildings on the right are those of historic Fort Yellowstone, built and occupied by the U.S. Cavalry during their tour of duty here from 1886 to 1918.

The ecological community in this section of the upper terraces is worth noting. The high content of decayed travertine produces a porous soil which dries out quickly. Consequently, vegetation is sparse and is limited to those species which are tolerant of such conditions. Several variations may be seen in the plant communities at other points along the tour road. What environmental conditions can you detect that might be influencing these differences?

NEW HIGHLAND SPRING

Activity began at New Highland Spring in 1952. The continuous heavy flow of mineral laden water has caused a very rapid development of this beautiful terrace. Prior to that time a luxuriant growth of trees, shrubs and flowers covered this hillside. The tree skeletons being engulfed by travertine stand as monuments to the former conditions.

To the right of New Highland still stands a portion of dense vegetative cover growing on a north facing slope. Most noticeable upon close inspection is the amount of undergrowth, which includes a heavy growth of mosses. What soil and moisture conditions are reflected here? Why would this area be so different?

ORANGE MOUND SPRING

The bright orange of this formation is a clue to the temperature of its water. Also, the rate of flow and the rate of deposition are very slow. It could follow then that since we have no record of this spring ever being very active, this small mound could be considerably older than those that are much larger.

BATH LAKE

Just ahead of you is a short but very steep hill. At the bottom of this hill on the right is Bath Lake, named by some of the local residents in the 1880's. Being a quiet pool, deposition of travertine is at a slow rate and the water remains highly mineralized with limestone. According to the old records Bath Lake was entirely dry in 1926 and remained that way until the 1959 earthquake. Although the name of this feature derives from the soldiers' habit of swimming in it, we now know that this activity damages the bacteria and algae which are part of what the park exists to preserve. Bathing in thermal features is also unsafe and unlawful.

WHITE ELEPHANT BACK TERRACE

This long white ridge is unusual for a hot spring terrace and adds a touch of fantasy to the area. Someone has said that it resembles a string of circus elephants marching over the Mammoth Terraces. Take the time to view it from different angles to see what you think!

The final section of the Upper Terrace Drive goes through a wooded area. Mule deer are frequently seen here, especially during the late afternoon and evening.

Forest vegetation along this section is dense even though it a south-facing slope. The thermal features in this vicinity are old and have been inactive for many years. This has allowed for a more complete decomposition of the travertine and an accumulation of a heavier, richer soil. Its moisture-holding properties far exceed those of the soil found at the Lower Terrace Overlook.

ANGEL TERRACE

At the bottom of the hill on the left are the ruins of Angel Terrace. Visitors during the 1920's and 30's saw it as a beautiful algae-tinted feature. Today it is beginning to crumble and young pioneer plants are taking root in the thin soil over its surface.

Alteration and change are constantly occurring in the thermal basins and add to the mystery of this fascinating land. They bring not destruction and loss, but rather new birth and gain. Who knows what interesting ornate new features may develop by next year, or in five years. You are encouraged to return again and again to enjoy this ever-changing scene.