Department of the Interior
National Park Service
Yellowstone National Park

Yellowstone Park, Wyoming — June 1, 1929

Roger W. Toll
Superintendent

Dorr G. Yeager
Park Naturalist

RANGER NATURALISTS MANUAL of YELLOWSTONE NATIONAL PARK

Volume III

PROPERTY OF

YELLOWSTONE MUSEUMS

Please return this copy to the Park Naturalist
at the close of the season.

No. 95

TO

RAY LYMAN WILBUR

Secretary of the Interior

This Manual, issued in behalf of
the Educational Work of the
National Park Service,
is dedicated

P R E F A C E

RANGER NATURALISTS MANUAL
o f
YELLOWSTONE NATIONAL PARK

This is a collection of scientific and popular articles on the many features, present and historical, of Yellowstone National Park. The articles were prepared under the direction of the Educational Division by scientists and friends of the park. To these men we are deeply indebted for the splendid articles and great amount of research and work incurred in their preparation.

The Ranger Naturalists Manuals are source books of information concerning Yellowstone Park. The articles are a condensation of material scattered through many books. It is hoped that each year a Manual will be prepared bringing together the results of the scientific and historical research carried on by the Educational Division.

Your cooperation is solicited in the preparation of articles on the geology, biology and history of the region for future volumes. It is hoped that the Manual of 1929 will be a value and inspiration for the guides and lecturers of this and future seasons, and that from these publications information will be obtained which will set the standard of the Ranger Naturalist Service on a still higher plane.

Roger W. Toll
Superintendent.

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QUESTIONS AND ANSWERS

"These Questions and Answers are a continuation of the Questions and Answers started with the 1928 Ranger Naturalists Manual and are compiled to help inform members of the educational division and other employees regarding answers to common or typical questions." - Dorr G. Yeager, Park Naturalist.

The Questions and Answers in the 1928 Manual were divided into six sections, as follows, and the same section numbers will be used in this Manual, although Questions and Answers on all of the subjects do not appear in this issue:

SECTION	I	History, Administration, Geography
SECTION	II	Geology
SECTION	III	Botany
SECTION	IV	Fishes
SECTION	V	Birds
SECTION	VI	Animals

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SECTION II

Geology (Part 1.)

Prepared by:

Dr. C. N. Fenner, Geologist, Geophysical Laboratory of the Carnegie Institution of Washington, D. C. The questions were asked by Mr. J. E. Haynes, former Acting Director of the Yellowstone Park Museum and the answers were supplied by Dr. Fenner. (NOTE: Dr. Fenner has visited the Park before but in 1928 spent three months and a week studying the Yellowstone Park. He has had access to all of the literature on the Park, including the original manuscript by Dr. Arnold Hague, which was unpublished, but which covered many phases which never came into print.)

Q. - What do you consider the most outstanding geological feature in Yellowstone National Park?

A. - From the strictly geological standpoint I would say that the volcanic history of the Park is the most interesting feature.

Q. - What is the outstanding thing about the volcanic history that impresses you?

A. - The variety and enormous amount of volcanic activity displayed through several geological periods, which make this region comparable with the principal volcanic regions of the world.

Q. - Do you consider the geysers, terraces and hot pools among the most important geological manifestations we have here?
A. - By all means. The geysers, terraces, and hot springs are of great interest as geological features, occurring in only a few other parts of the world, notably New Zealand and Iceland.

Q. - How do these geysers and hot spring terraces compare with others?
A. - According to descriptions in the literature, the ones in Yellowstone Park greatly exceed those in Iceland and New Zealand, both in number and in magnitude.

Q. - How about the hot springs and geysers, if any, in California?
A. - There are no geysers in California, and the hot springs are of much less importance and magnitude. Their interest is in the attempted development of them in the last five years as sources of power.

Q. - How is the power obtained from these hot springs, in California?
A. - By putting down driven wells which tap the steam supplies under considerable pressure.

Q. - Do you consider that such development will ever be made in Yellowstone National Park, or in any National Park?
A. - That will depend on the attitude of the officials of the National Park Service and the question of whether they are near enough to manufacturing centers to make such development of importance in utilization. It is a very nice question whether this would be economical or practicable.

Q. - Have you observed in your study of the geysers and hot springs here any seasonal fluctuation due to the abundance or diminution of surface waters?
A. - That is a matter I have not gone into myself but I understand that Dr. Allen has some data on that and thinks that there is.

Q. - What is the so-called Sherman Volcano?
A. - There porbably was not a single volcano but rather an area in which there were a number of volcanic orifices - active volcanoes.

Q. - Where were these situated?
A. - Their exact position can hardly be specified, but probably in a rather small area in the immediate vicinity of Mount Washburn there were several vents. The fact that there were vents in that vicinity is indicated by the great accumulation of fragmental volcanic material, built up in enormous quantities.

Q. - Is Mount Sheridan the site of any of these volcanic orifices?
A. - This is so far removed from the area that I have in mind that it represents a separate vent.

Q. - Are there other places in the Park where volcanic orifices were active in the past?
A. - Doubtless there were orifices in other places; probably a number in the Absaroka Range. In addition there were vents which were not of the nature of central volcanoes, that is, single orifices, but rather fissures which opened and from which melted lava was poured out.

Q. - If you were to estimate what the longest fissure is from which the lava flowed what would you give as its length?
A. - The fact of these fissures is rather inferred. Their exact position cannot be specified, except that some were situated in the rhyolitic plateau and probably others in the Absaroka Range, and since their position cannot be exactly determined it would not be possible to say what their length might be. Probably they were of very considerable length, but that is only a general statement.

Q. - Where we have the pentagonal columns in the basaltic formation near the lower part of the Grand Canyon in the vicinity of Tower Falls, and in the Gardiner Canyon, back of Bunsen Peak extending clear up to the seven mile bridge, what accounts for the pentagonal shape of the columns?
A. - Simply contraction in the mass of molten lava which cooled slowly and regularly. That is a feature which is often found in lava flows which cool under such conditions.

Q. - Is it true that the rock masses in cooling tend to take on the crystal form of the principal mineral ingredient?
A. - No.

Q. - Is it true that these columns are frequently hexagonal?
A. - They may be pentagonal, hexagonal, or quadri-lateral.

Q. - In the Park, from your observation would you say that most of them are pentagonal?
A. - I would say that most of them are pentagonal or hexagonal.

Q. - Is the Obsidian Cliff a volcanic plug or fissure flow or what is it?
A. - It is very doubtful if it is a volcanic plug, but probably represents a flow spread over a considerable area, which happened to take the glassy condition at that point.

Q. - It has been stated frequently that the reason this lava is vitreous is that it cooled rapidly and did not have time to crystallize. Is that correct?
A. - Not wholly correct; in fact quite far from being the whole explanation. Lavas, when they come up to the surface, contain a large amount of gaseous matter, and if that is able to escape quickly the lava becomes viscous and is likely to congeal in a vitreous condition. That is, it gradually becomes more and more stiff, and finally consolidates as a glass.

Q. - This then accounts for the fact that in many places the vitreous lava occurs under the stony, does it not?

A. - That relation may occur under two conditions. First, that the glassy portion may sometimes be formed as a bottom layer of a given flow, or secondly, a single flow may consolidate in this glassy condition, and if a stony layer is found above it that will represent a second flow. On the whole, lavas high in silica are much more likely to take the glassy form.

Q. - What lava form predominates on the surface in the Yellowstone.

A. - The rhyolitic lava is most commonly seen. For example, it occurs in the greatest areal development in the region of the geyser basins - the central plateau of the Park. I had better qualify that statement a little in this way. It relates to the part of the Park most visited by tourists. In the Absarōka range to the east, fragmental lavas of andesitic and basaltic compositions are found in very great development. I don't know that I could say which would exceed the other in magnitude. As related to the part visited by the tourists the rhyolitic lava predominates very greatly. The outstanding features passed on the main highway are tabulated below with the explanation of the kind of rock of which they are composed:

The Hoodoos - hot spring deposits of travertine or calcium carbonate.

Golden Gate - rhyolite.

Bunsen Peak - an intrusion of dacite (porphyritic dacite).

Obsidian Cliff - obsidian. Chemically this obsidian has the same composition as rhyolite, but from its physical characteristics it is called obsidian.

Gibbon Canyon - rhyolite, chiefly.

National Park Mountain - rhyolite and obsidian.

Cliffs surrounding Upper Geyser Basin - rhyolite and obsidian.

The Area by Kepler Cascade - rhyolite.

The Yellowstone Canyon - the Yellowstone Canyon is predominantly rhyolite which has been intensely acted upon and decomposed by thermal waters, so that its original characteristics have been pretty well lost.

Mount Washburn - almost entirely fragmental volcanic material of predominantly andesitic composition, with some basalt, and penetrated by minor intrusions of andesite and basalt. This means that this material was thrown out from the volcano in explosive eruptions as fragments of various sizes measuring from several feet in diameter down to fine dust, and lava flows were of minor importance.

The Yellowstone Canyon at Tower Falls - at the bottom of the canyon is the same sort of fragmental volcanic material that is found at Mount Washburn, which may have come from the volcanoes of that same region; that is, the area of the Sherman Volcano. Above that is a much later flow of columnar basalt, which is overlain by a fairly thick deposit of rounded gravel representing stream wash, and then by a second flow of basalt, and over that, surface material, perhaps of glacial origin.

Mount Everts - The face of Mount Everts that we see is composed almost wholly of sedimentary strata of Cretaceous age - sandstone, shale and some limestone, which were deposited at the bottom or near the shores of a large arm of the ocean. The cap of Mount Everts, at the southern end, is a flow of rhyolite. At the northern end of Mount Everts are two or three intrusions, of sill-like form, of andesite. Underneath the strata of Mount Everts which are exposed, are earlier strata of Jurassic age, in which there is a greater predominance of limestone. These same limey strata occur beneath the terraces at Mammoth and almost certainly furnish the limestone which is brought up in solution by the water and deposited to form the terraces, including the cap on Terrace Mountain, the Hoodoos, and the whole surface layer of travertine at Mammoth Hot Springs, including that which underlies the parade ground and extends clear down to the Gardiner River.

Q. - How extensive are the glacial deposits in the Yellowstone National Park?

A. - They are visible in considerable magnitude in many parts of the Park that the tourist ordinarily visits. They are found in many places around Yellowstone Lake, and, from the tourist standpoint, are seen principally in the vicinity of Mammoth Hot Springs, Hayden Valley, and at Yellowstone Lake.

Q. - Were there several invasions of the glaciers or one great invasion?

A. - Presumably there were several invasions in this region as elsewhere, but evidence of the earlier ones is obscure. In my opinion, the glacial deposits we see here, with one or two possible exceptions, represent one great invasion, with minor fluctuations. By that I mean that there were probably advances and recessions, all included in this one glacial cycle.

Q. - Dr. Ralph Chaney, associate with the Carnegie Institution, states that in the region of the petrifactions in the northeastern corner of the Park there are evidences of trees which are not common to an elevation of more than three thousand feet. How is this explained?

A. - The probable explanation is that at the time these trees grew the region stood at only a very moderate elevation. In addition there may have been a condition of general warm climate, such as occurred at certain geological periods, and is believed to have characterized the miocene period in which these trees lived.

Q. - Would you say that the uplifting of the Rocky Mountain Range had any bearing on this?

A. - The uplift probably took place largely after these trees grew. In this place we find not only elms, chestnuts, oaks, and beeches but magnolias, laurels, and figs, the evidence of which points to a considerably warmer climate. Less elevation and probably a condition of wide-spread warmer climate account for this.

Q. - I understand you have been to the top of Electric Peak yourself this summer. Will you give us an explanation of the geological structure of that mountain?

A. - Electric Peak and Sepulcher Mountain probably formed a portion of a single volcanic mass. They are now separated by a fault and displacement of several thousand feet, and along this fault a valley of erosion has been formed. The area to the west of the fault, in which Electric Peak is situated, represents the uplifted side. Although Electric Peak is now topographically higher than Sepulcher Mountain, this relation has been brought about by displacement along the fault, and the rocks of Electric Peak represent material which, in its original position, formed the lower part of the volcanic edifice or structure, and the rocks of Sepulcher Mountain are largely the fragmental material which was thrown out from the volcanic vent. That fragmental material has been eroded away from Electric Peak, so that now what we see at Electric Peak represents, as it were, the roots of the volcano. The strata of Electric Peak are the sedimentary beds through which the volcanic conduit or neck was formed. These sedimentary strata of Electric Peak are penetrated by a great number of dikes of volcanic rock which was forced in along cracks in molten condition, and these now stand out as prominent ridges or walls. There is also found here a large mass of igneous rock which represents a molten plug that finally consolidated in the volcanic neck at the end of eruptive activity.

Q. - It has been stated that the reason that at the head of Yellowstone Canyon there are two waterfalls is that each is supported by a dike. Is this a fact?

A. - I have not been able to find anything in the nature of a true dike at either place, but at each place there is a vertical band of rhyolite which has been silicified and thereby rendered much harder; and these seem to represent the conditions which have produced the falls. The falls are, geologically, of a temporary nature, and as these harder bands are worn away the falls will retreat upstream.

Q. - How were these bands to which you refer silicified?

A. - By the circulation of waters which deposited silica in the pores of the rock and probably also partially replaced the original material.

Q. - I understand that there are travertine deposits combined with siliceous deposits in the region of National Park Mountain, in the Terrace Springs, and at Lower Geyser Basin near the Steady Geyser, and at Old Faithful in what is known as the Hillside Springs to the west of the basin. Does this indicate that limestone strata underlie the region as far south as Old Faithful? (By Old Faithful I mean the Old Faithful Geyser Basin, not Old Faithful Geyser, as a whole, extending from the Riverside Geyser up to the Old Faithful Geyser).

A. - That would be indicated rather strongly, but it is only an inference, and a positive statement cannot be made. The universal presence of calcium in volcanic rock would hardly account for these travertine deposits south of Mammoth Hot Springs, at the special localities mentioned.

Q. - Have you observed any statements by our Ranger Naturalists this summer that might lead to an erroneous conclusion or impression on the part of the tourists?

A. - In accounting for the solution and deposition of calcium carbonate at Mammoth Hot Springs hardly sufficient importance was given to the effect of carbonic acid gas in the waters of the springs. Probably the presence of carbonic acid gas is the chief factor in causing the solution of calcium carbonate in the underground circulation, and the escape of carbonic acid gas causes the deposition at the surface. There probably are other factors concerned, but the effect of carbonic acid gas is the chief one. In explaining the geological history of the region around Mammoth probably too much importance has been attached to glacial erosion in forming the valley in which Mammoth Hot Springs is situated. Glacial erosion was undoubtedly of considerable importance, but the more normal erosion by streams acting upon rocks disintegrated by frost action and other weathering processes, continued through great periods of time, was the principal factor in carving out the valley in which Mammoth Hot Springs is situated. A greater amount of limestone was indicated among the visible strata of Mount Everts than is actually present. The limestone strata of chief importance as a factor in the formation of the terraces lie at a lower level in Mount Everts.

Q. - It has been stated that there was a fault in front of Mount Everts and that the strata as visible in Mount Everts represented the underlying strata at Mammoth Hot Springs, which I understand is incorrect. Is this so?

A. - I would not want to exclude the possibility of the presence of minor faults at the base of Mount Everts, but if such are present they are probably of very little importance in causing displacement, and I have not seen or heard of any evidence indicating the presence of a fault of large magnitude.

Q. - You have observed the peculiar markings on the east face of the wall of National Park Mountain in the new Firehole Canyon driveway. It has been stated that this is a cross section of a hot spring or geyser basin. Is this a fact?

A. - I think it is very doubtful. Specimens of rock immediately adjacent to these markings were sent to the Geophysical Laboratory last spring and appear to be simply rhyolite and obsidian, and no sinter was found such as might be expected to occur adjacent to a geyser tube. Also, in the vicinity of these markings the rock in general does not appear to have undergone the sort of decomposition that thermal waters would produce. The rock

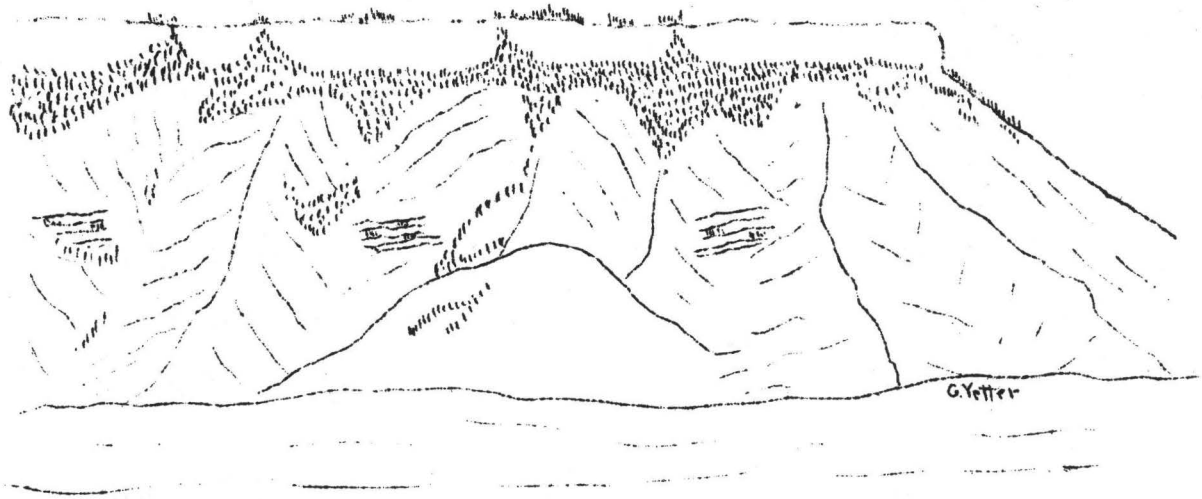
materials in these cliff walls are of heterogeneous physical makeup, due to conditions at the original consolidation of the molten material. My supposition would be that this heterogeneous condition has led to a peculiar or unusual breaking-down or spalling-off of the rock wall. This statement should hardly be regarded as a final conclusion, as I should want to make a more careful examination before reaching a definite decision.

Q. - It is understood that the elevation of the surface of Yellowstone Lake was at one time considerably higher, and that the waters flowed to the south into Snake River rather than north as they now flow. How do you account for the lowering of the level of Yellowstone Lake?

A. - It is probably due to what is called "stream piracy". That is, that a minor valley was eroded along the present course of the Yellowstone Canyon and gradually worked up headward until it tapped the waters of Yellowstone Lake, and when this occurred a large volume of water from the drainage of an area of considerable magnitude was diverted along this valley. The erosion of this stream acted upon rocks which had been in many places decomposed and softened by thermal action, and under these conditions the Canyon was worn down with great rapidity.

Q. - I understand that in the Monument Geyser Basin region there is a gelatinous silica known as "pealite" and I have been asked how silica could occur in a gelatinous form.

A. - Gelatinous or pasty silica has been found at a number of places in the Park as a hot-spring deposit. In the laboratory it is not at all difficult to prepare silica in this form; in fact, it is easier to prepare it in this form than in the hard and dense condition. Gelatinous silica contains a large amount of water, and probably rapid deposition is the most important factor favoring its formation.



SECTION II

Geology (Part 2.)

Prepared by:

Dr. Eugene T. Allen, Chemist of the Geophysical Laboratory of the Carnegie Institution of Washington, D. C. The questions were asked by Mr. J. E. Haynes, former Acting Director of the Yellowstone Park Museum and the answers were supplied by Dr. Allen. (NOTE: Dr. Allen has been actively engaged in the study of the thermal features and processes in Yellowstone National Park ever since the beginning of the season of 1925.)

Q. - Where does the heat that is in the hot springs and geysers in Yellowstone National Park come from?

A. - The heat is assumed to be the internal heat of the earth, which is brought up to the surface through deep cracks mostly in the form of steam. The principal amount of the heat comes from the condensation of this steam, rather than cooling it from one temperature to another. This steam condenses when it comes in contact with the surface waters. Diligent observation on my part has never been able to get any evidence for chemical energy. Investigation made on radio action indicate also that that has nothing to do with it.

Q. - Where does the water come from that flows out of these hot springs?

A. - Up to the present time the evidence indicates that the water is chiefly derived from rain and snow, and to this is added the condensed steam, so that a little of it is derived from great depths.

Q. - About how much water is discharged by the Boiling River at Mammoth into the Gardiner River, as compared to the total amount discharged by all of the hot springs at Mammoth Hot Springs?

A. - In the midsummer of 1928 the discharge of the Boiling River was about eight times that of the total discharge of the Mammoth Hot Springs, all taken together.

Q. - How is this explained?

A. - The Boiling River represents the ground water derived from a larger area.

Q. - Where does the travertine (calcium carbonate) come from that is deposited by this water?

A. - From the limestone which outcrops around the hot area of Mammoth Hot Springs. Solution of the limestone doubtless takes place below the ground; how far down no one knows. The waters of the Mammoth Hot Springs in all probability produce a solution of the limestone below ground, by water charged with volcanic gases.

Q. - What is the most important factor responsible for the deposition of travertine (calcium carbonate) at Mammoth Hot Springs?
A. - The escape of carbon dioxide from the hot spring waters.

Q. - Where does the water get the carbon dioxide gas?
A. - From the rising volcanic gases.

Q. - Does the water get any carbon dioxide gas from the decaying vegetation through which the meteoric water passes on the surface of the earth before going down into the ground?
A. - The probabilities are that no considerable part of it comes from this source.

Q. - What makes the carbon dioxide gas escape from the water when the water reaches the surface?
A. - The difference in pressure of the carbon dioxide gas in the water and in the atmosphere. The total atmospheric pressure, of course hinders the rapid escape of the carbon dioxide gas from the water, but in the end diffusion enables it to escape, until the pressure is equalized.

Q. - What effect does the fact that the water is hot and the atmosphere cold have on this change?
A. - The hotter the water the less gas would be dissolved in it at the same pressure. The amount of gas dissolved in any liquid depends upon the pressure on the gas over the liquid. The temperature of the water and the pressure on the gas determine the amount of gas that can be dissolved in the water. When the water gets to the surface the pressure is released and therefore the carbon dioxide gas escapes from the water. It must be understood, of course, that water at the surface is under the pressure of one atmosphere, but the partial pressure of the carbon dioxide in the atmosphere will eventually determine that in the water. This means that the two would eventually become equal if the water came to equilibrium. As a matter of fact the supply of CO_2 is in many places continually renewed, while much of the water escapes down the slope long before an equilibrium is established.

Q. - Is cooling a factor in the deposition of travertine?
A. - We have proved in the laboratory that spring water left to cool after sealing, deposits no carbonate of calcium, so cooling is not a factor in deposition.

Q. - Do algae use carbon dioxide from the water and therefore tend to rid the water of its total carbon dioxide content and thus speed up the deposition of the calcium carbonate?
A. - Yes.

Q. - Does it reach a geological importance?
A. - I am inclined to think from my own personal observation that there are places where this factor is negligible and in other places I am in doubt.

Q. - Is all of the calcium carbonate deposited from the water when all the carbon dioxide gas has been removed from it?
A. - The solubility of calcium carbonate in water alone is negligible, geologically speaking.

Q. - What amounts of calcium carbonate are dissolved in these waters?
A. - They vary from 0.560 to 0.775 grams in a liter of spring water or 560-775 parts in a million parts of water.

Q. - When the carbon dioxide gas, then, is removed from the water, does all of the calcium carbonate precipitate?
A. - All except the negligible quantity which is dissolved by the water. We found by actual experimentation that cooling alone precipitates no calcium carbonate. If you would be exact the salts in the water have an influence on the solubility, but as they reach only a very small percentage the result is negligible.

Q. - Is there any evidence that calcium carbonate is deposited from the water by freezing?
A. - No. Possibly this may occur but if it were a factor of any importance it probably would have been observed.

Q. - What influence does evaporation have on this deposition of the calcium carbonate?
A. - This would affect only the negligible quantity which water alone dissolves.

Q. - What would you say the maximum rate of deposition of the travertine is, in the Park?
A. - It varies all the way from little or nothing to more than one foot per year. If the rate is uniform at the foot of Jupiter Terrace it would amount to about twenty two inches a year. This work was done with the aid of Mrs. M. L. Arnold.

Q. - Are the Hoodoos and the rock on top of Terrace Mountain of the same origin as the present terraces at Mammoth Hot Springs?
A. - Dr. Arnold Hague says they are.

Q. - Have we any data on the age of these hot springs deposits?
A. - Hague states that there is glacial drift on the top of Terrace Mountain, which shows conclusively that they ante-date the glacial age (that is, the deposits ante-date the glacial age.)

Q. - About how long ago was the glacial age?
A. - I would look it up in a good text book and see what estimates are made there.

Q. - Why are there no geysers at Mammoth?
A. - Because the water is never hot enough. Even if it were hot enough it is possible that none would occur. Another essential condition for geyser action is a column of water reaching down from the surface, so long and narrow that convection currents are incapable of heating the water thoroughly and so equalizing the temperature. The heat supply which comes in from somewhere below

the surface of the water must bring a portion of it to boiling before the surface layer reaches that temperature. The Mammoth Springs may or may not fulfill this condition.

Q. - We have understood previously that the travertine terraces are at Mammoth Hot Springs, and that all the other deposits in the Park are of the nature of silicious sinter. What springs in the Lower or Upper Basin deposit travertine instead of sinter, if any?

A. - A number of springs deposit both travertine and silica. Sometimes these occur together and sometimes separately. The Hillside springs at Old Faithful, the Firehole Lake at Lower Geyser Basin, the Steady Geyser, Young Hopeful and the Terrace Springs, the latter near Madison Junction, all deposit both silica and travertine. It has been said that the precipitate at Mammoth Hot Springs is soft and porous, because it is deposited from hot water. This is a mistake. The deposit from the Hillside Springs comes from hotter water, yet it is very dense. It seems to depend on the rate of deposition and the rate is conditioned, apparently by the concentration of calcium or calcium carbonate, in the water.

Q. - Why do some springs deposit silicious sinter instead of travertine?

A. - The spring waters of the springs which deposit silica only, do not come through limestone strata.

Q. - Does the presence of carbon dioxide gas in the water have anything to do with the depositing of the silicious sinter, such as that at Upper Basin?

A. - So far as is known it does not.

Q. - Then the evolution of the carbon dioxide gas does not cause the precipitation of the silicious sinter.

A. - No.

Q. - What is the principal factor then that does cause the deposition of the silicious sinter from the hot springs in Yellowstone Park?

A. - Only two factors are known. First, the evaporation of the water, and secondly, the separation of the water by freezing, in very cold weather. Ranger Charles Phillips, Ranger Marguerite Lindsley Arnold and Ranger R. M. Baker, have all observed the deposition of silica by freezing. This, however, was known before and was described by Dr. Arnold Hague.

Q. - What is the maximum rate of the deposition of silica, as you have observed it in the Park?

A. - At Norris Basin, on the Porcelain Terrace, $1\frac{1}{4}$ inches in about ten months.

Q. - What would you say, in answering the questions of the tourists, the average rate of deposition of the silica would be?

A. - We cant answer that until we examine deposits and look over deposits on sinter blocks, which we have already gotten and will study later. In the Upper Basin it is a very small fraction of an inch.

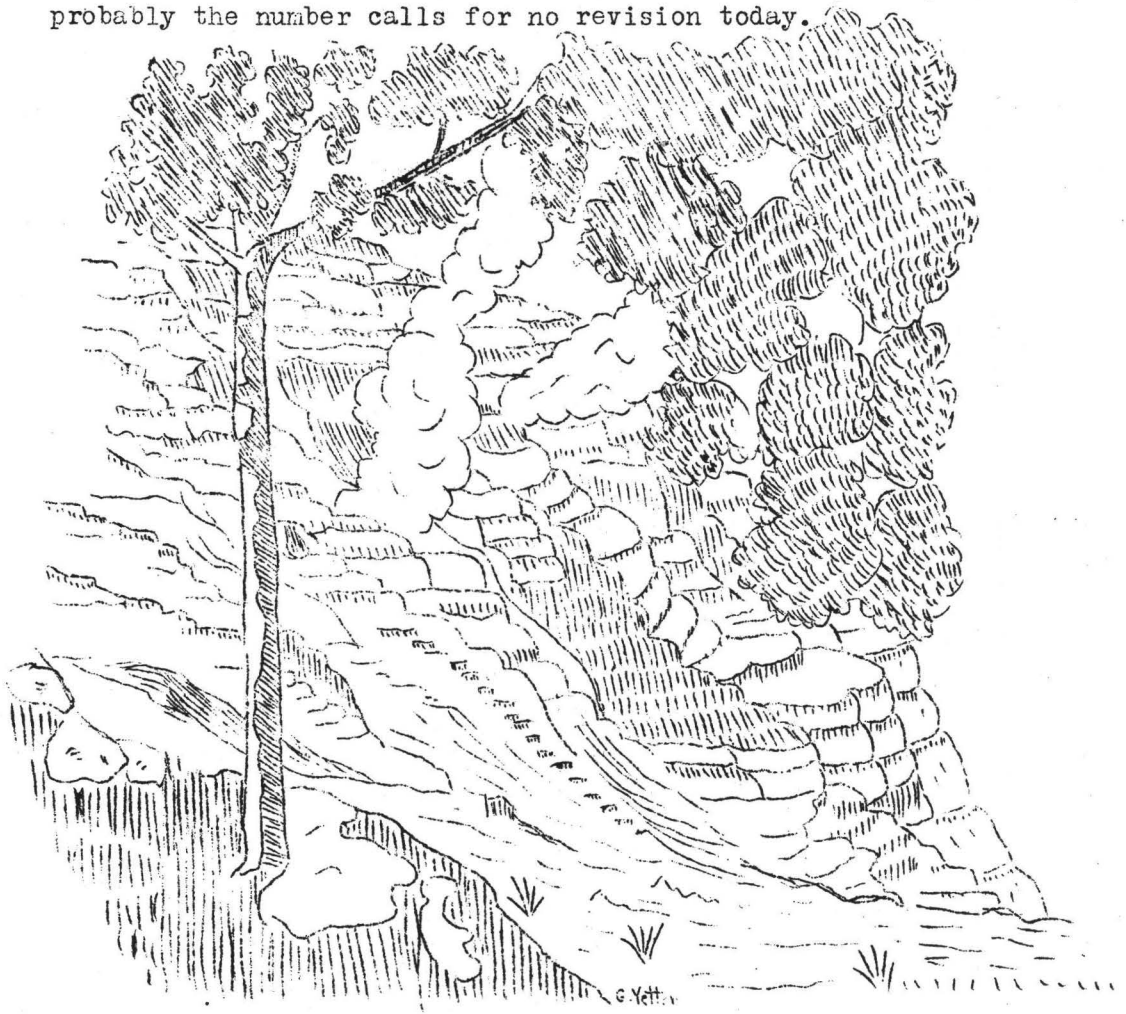
Q. - Is it a fact that the sources of the water, the gases and the heat, are the same in the springs and geysers depositing siliceous sinter as in those depositing calcium carbonate?
A. - The evidence all indicates that they are.

Q. - You have sounded many of the hot springs and geysers in the Park. Which ones did you find to be the deepest?
A. - The deepest is the new geyser, which was found to be about 75 feet below low water level, which would be at least 80 feet below high water level. Of course, it is possible that the sounding line was not strictly perpendicular.

Q. - What is the next deepest one that you found?
A. - The Lion and Giantess were both 72 feet. There are a great many in the Upper Basin that are 15 to 30 feet in depth.

Q. - What is a fumarole?
A. - A fumarole is a vent for natural steam?

Q. - How many hot springs are there in Yellowstone National Park?
A. - Peale actually counted 2195 springs in the Park, and estimates the total number at not less than 3000. Counting every orifice, probably the number calls for no revision today.



Botany

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Q. - What is the plant which looks like maiden-hair fern?
A. - Meadow-rue, a close relative to the buttercups and the columbine; the leaves are finer than those of the columbine but not as fine as those of the maiden-hair fern.

Q. - What is the color of the columbine found in the Park?
A. - Light yellow; often some of the older blossoms are tinted with pink.

Q. - Do you find the blue columbine which is the state flower of Colorado?
A. - No; the only columbine found in the Park should be yellow.

Q. - Are baneberries poisonous?
A. - Yes, somewhat. Neither animals nor birds will touch them. They are not deadly poison.

Q. - Is there poison oak, poison ivy or sumac found in the Park?
A. - So far as we know there are no plants found here which are poisonous to the touch. Of course, there are a few plants such as nettles and dogbane which are poisonous to some persons.

Q. - Will the Rocky Mountain fringed gentian grow in other sections of the country?
A. - Of course this is its natural habitat, but there is no reason why it would not grow in other localities if the soil and moisture conditions could be made the same, and the seeds gathered when they are ripe. Seeds should be planted in the fall as they live out of doors in a very rigorous climate.

Q. - Is it possible to transplant the Rocky Mountain fringed gentian?
A. - No, it is an annual and therefore not transplantable.

Q. - Why is the Rocky Mountain fringed gentian in blossom in June? Is it not a fall flower?
A. - In alpine regions, such as Yellowstone Park, we do not have distinct seasons. It seems that all plants vie with one another in attaining their maturity and as a result we find the spring, summer and fall flowers not only following each other in rapid succession, but often in blossom at the same time. The gentian first blooms on the Geyser Basin in June. Here it is warm and moist, but as the season advances and we find less water on the basin, the gentian retreats to the more moist sections of the Park, until in August, which is really our fall, you will find them where you naturally expect to find them.

Q. - Is the bottle or blind gentian found here?
A. - Although it extends to the northwest, it has not been reported from this region.

Q. - Is the gentian the state flower of any state?
A. - Not now. At one time it was so considered by the State of Wyoming, but in 1917 they chose the Indian paintbrush. However, it is the flower of the Park, being so designated in 1926.

Q. - Is the gentian found here used in medicine?
A. - The medicinal one is the yellow gentian of Europe and is a perennial, the rhizome yielding the drug.

Q. - Is this plant the same as the ginseng which is also used in medicine?
A. - No. They belong to entirely different families, the gentian belonging to the Gentianaceae and the ginseng to the Araliaceae.

Q. - Are all of the arnicas of medicinal value?
A. - No. It is Arnica montana of Europe which is used. Some of the arnicas are poisonous.

Q. - Do you find the medicinal arnica in the park?
A. - No.

Q. - Are all of the lupines poisonous?
A. - No. Many are used as a source of food by the Indians.

Q. - Are the larkspurs poisonous?
A. - Not all of them. The tall larkspur is very poisonous and causes a great loss to cattlemen throughout the Rockies. The seeds are particularly poisonous.

Q. - Are all parts of the monkshood poisonous?
A. - Many of the species have the poison in the flower as well as in the root.

Q. - Is the pear-leaved wintergreen the plant which bears the wintergreen berries?
A. - No. It is not even a member of the same family. It is called a wintergreen because of the leaves which remain green throughout the year.

Q. - Is pearly everlasting the same as the Edelweis of the Alps?
A. - No. It is a member of a closely related genus. The closest relative found on this continent is the Arctic everlasting, Antennaria lanata.

Q. - Will it make winter bouquets?
A. - All members of these related genera will if they are gathered at the right time.

Q. - What is Queen's lace?
A. - Many of the various members of the carrot family are called Queen's lace but the real Queen's lace is the wild carrot, Daucus. It is not poisonous, and does not grow in the Park. The Queen's lace of the Park is Carum gairdneri.

Q. - Is cow parsnip poisonous?
A. - No, many animals, especially the groundhog, eat the leaves and many birds are fond of the seeds.

Q. - How can you tell the poisonous members of this family?
A. - The most poisonous one, wild parsnip or water hemlock, will reveal a series of chambers or cavities in the root when it is cut longitudinally. These chambers run crosswise of the section and are present whether the root resembles a rhizome or a mass of tubers.

Q. - Does the pink yarrow grow in the park?
A. - No. Only the white one is found here.

Q. - What are the brown bunches, resembling nests, which one sees in the spruce trees?
A. - Golden or yellow witch's broom, the result of the growth of a fungus.

Q. - Does it attack other trees?
A. - Yes. Both Western yellow pine and the lodgepole pine.

Q. - Will it kill the tree?
A. - Probably not, but the injury may open the way for some other fungus to enter or for insects, and thus be an indirect cause of the death of the tree.

Q. - Is little elephant or elephant's head an orchid?
A. - No. It belongs to an entirely different class of plants, although at first glance it might seem to resemble an orchid. It is often found growing in great areas of swamp land together with the wild orchid.

Q. - Are the wild onions of the park edible?
A. - Yes. They often served as a source of food, not only for the Indians but for the early explorers and trappers of the west.

Q. - Are any flowers peculiar to geyser formations?
A. - Yes, a few of them seem to be, namely, the geyser daisy and the formation everlasting.



SECTION V

Birds

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FORWARD: The questions about birds asked by tourists are legion. In this set offered, I am trying to give answers typical and fitting to questions not only asked by the individual but also suggested by the appearance of a bird on a nature walk or the mention of a bird during the course of a lecture. How can one answer that question in an inspiring and educational fashion? One question naturally leads to countless other questions, each of which in turn is auto-suggestive. The good nature guide must out-think his hearers; many questions will be born in their minds long after he has departed, and these, if worth while, should have been anticipated and answered by him. A trail question usually concerns an isolated subject, such as the name of a bird or flower. With this answer as an opening wedge, related facts are brought forth until a generalization may be enunciated. Ofttimes the reverse order may be followed for convenience or variety. Perhaps an illustration of the procreation of a question is set forth in the first question asked, "Why study birds?"

The list is by no means comprehensive, nor is any question fully expounded. It is merely explanatory of what might be given in answer to a simple question in the field or on the lecture platform. Much has been added to serve as lecture material; and much has been omitted which might have been included except for want of space.

Q. - Why study birds?
A. - Bird study has a tremendous appeal to the interest and imagination. Its value arises from three divergent standpoints: (1) economic, (2) aesthetic, and (3) scientific, of which the second is of greatest importance to the nature guide or ranger naturalist.

Many birds are a source of food and ornament, although, fortunately, the redundant and murderous latter is gradually dying. Their economic value to the farmer and horticulturist is of much greater magnitude than is generally supposed, and since agriculture is the basis of the material wealth of the nation, any agency which contributes to its general welfare is of primary importance.

To many the economic phase of bird-study is of lesser interest, and these may be moved by the aesthetic when the material fails to do so. Birds appeal to the ear because of their exquisite songs and music, and to the eye because of their gorgeous

colorings and graceful demeanor, and to the spirit because of their abundance of life. They are the most active of living things, possess the highest blood temperature and most rapid circulation. Have you heard the remark when some one was handling a tame bird, "Poor little thing, it is so scared; its heart is beating so!", yet that same rapid heart beat indicative of fear to us is life and health to the creature. Birds are always gay and restless; they lead a "fast life". Their great activity demands much fuel to carry on life's processes. They are adapted to be one of Nature's best housemaids because of their mobility and the vast quantities of insects, weed seeds, plant and animal "vermin" which, unchecked, would soon devastate the earth.

Birds are great travelers. Their powers of flight have been acclaimed throughout the ages. "Oh, for the wings of a dove!" and similar passages ring through literature from the earliest times. This mobility has made it possible for the class as a whole to enjoy the widest distribution of any of the more highly developed forms of life. Their high mental development, busy life, beautiful colors, pleasing music, and marvelous flight have made them symbolic of all of the nobler human attributes in the minds of men, so much so that many of these birds are known in name if not in flesh and blood.

As a class, birds follow reptiles in the scale of evolution, and so are of special interest to the scientist. Science is further interested in their relations between themselves, with their environment, and with man, such as the effects of civilization and its movements upon the bird world.

How interesting it is to discover the many ways in which Nature has adapted each bird to fit in her various niches! How does the leucosticte survive the cold of wintry mountain peaks and what is its means of sustenance? How does the ouzel reach the caddis fly larva on the bottom of flowing rivers although apparently originally a land bird and possessing feet unwebbed and unadapted for swimming? How is the woodpecker or the creeper adapted to spend life on the perpendicular side of a tree? These are questions with appeal and what a wealth of this do they possess! And from them we may already learn that though it be very impressive to be able to step out with a party and explain with great accuracy: "that is a Cassin finch; those are cliff swallows flying overhead; these are Brewer blackbirds" in answer to the question "What bird is that?", it is far more important to be able, in addition, to answer such fascinating interrogatives as "What are its peculiar life habits?" "Of what intrinsic interest is it to us?" How do you know it to be a sparrow and how may I recognize it as such next time I meet it?" In answer to these the bird is more than a name and is made a source of pleasure forevermore.

There are now more than 13,000 known species of birds classified. More than 1,400 species are found in the United States and Alaska alone. Each bird has its own problems and its own story.

The loss of birds would soon render the world uninhabitable to man, and so man must study and know them. But such study soon opens a door of beauty, interest and joy; the scales drop from man's eye, his deaf ear is attuned to new and wonderful music, and no longer with regard to this fascinating field may it be said "With seeing eyes they see not, and with hearing ears they hear not".

Q. - What means does the bird student use in identifying a bird in the field?

A. - Most bird books go into elaborate descriptions of the colors and markings of a bird. The novice wishes to use these as his means of identification, but seeing the objects of his study placed against the bright light of the sky or blending with their surroundings despairs of ever learning to know the individuals of large numbers of species because of his inability to differentiate the colors and markings as he has seen them in the picture book. The normal trained bird lover relies on this means least in recognizing different birds, his means (obviously not universally applicable) in the order of their importance probably being:

(1) The song, call note, or vocal peculiarities. One of the first steps in learning to know the birds is learning to know their voices, even unseen individuals being recognized by this means. Without looking for the vocalist himself, the bird lover is oft able to say: "That is the roll of the purple finch in the tree-top yonder" - "That is the call note of the olive-sided flycatcher" - or, "That is the carol of the black-headed grosbeak." Nor is the voice used for this purpose alone. Thus we may hear the alarm note of the robin and hasten over to discover what disturbs his composure. The warbling vireo sings throughout daylight hours almost without ceasing, it being estimated that he repeats his abbreviated warble 4,000 times a day during the nesting season. The duties of incubation in the vireo household are most evenly divided between husband and wife, the former assuming his turn on the nest at midday. While thus engaged he continues his vocalizing so that ornithologists may locate nests of this little bird by following the singing of the male in the afternoon.

(2) Peculiar habits. A distant bird hops along the ground for a short distance, stops alert with head high and breast thrust forward, tilts his head sideways as if listening for the movements of a worm beneath his foot, hops along again and repeats the same procedure many times. We watch him and know he is a robin from these actions alone. Again, a bird perches upright on the bare limb of a tree, peers around himself, darts forward quickly into the air, stops just as abruptly, reverses his flight and perches on another bare limb. The bird is a flycatcher, engaged in procuring his dinner of insects. We need only combine this knowledge with size, location, call note, or some other feature to identify what kind of flycatcher we are watching.

(3) Silhouette or general contours. The plump shapes of the robins, the cross-bow outline of flying swifts, the contours of flying ducks or geese, and the outlines of soaring hawks are illustrations of identification by this means.

(4) And, lastly, color and markings.

Q. - What is the blood temperature of a bird as compared with the blood temperature of a mammal or a reptile?
A. - Birds, 100 - 112°. Mammals, 98 - 100°. Reptiles, 40° (average).

Q. - What is the yearly average loss to American agriculture due to insects?
A. - $200,000,000.

Q. - How many species of birds have been found within the Yellowstone?
A. - 208.

Q. - What bird is the sweetest singer?
A. - The answer, of course, depends upon the individual. The purple finch, blackheaded grosbeak, fox sparrow, green-tailed towhee, solitaire and hermit thrush have been preferred by the greater number of bird lovers I know. I personally prefer the towhee and thrush named.

In this connection it might be mentioned that a certain member of the San Francisco Symphony Orchestra went daily into Golden Gate Park of San Francisco with a pitch pipe and studied the bird songs that he heard. His conclusion, from his artist's viewpoint, was that the purple finch (Carpodacus pupureus californicus) was the most finished singer of all - pitch and quality being nearest perfection.

Q. - What are the courtship habits of non-singing birds?
A. - Birds are ardent lovers. Not only with song and display of plumage does the male court the female, but also with aerial gymnastics, mutual ceremonies, aquatic prowess, even with open hostility and battle to all opponents. Many birds, even those of non-singing families, have special notes or songs of courtship. The drakes swim around a dumure duck, displaying and preening their beautiful plumage. The sedate and retiring woodcock forgets dignity to rise high in the air in amazing geometrical figures - circles, dips, zigzags and others, all of the while uttering notes entirely foreign to his simple daily vocabulary, and even bursting into some kind of simple song when at the height of the flight. These gymnastics are preceded by a grotesque strutting on the ground, with feathers fluffed and bill pointed downward. The nighthawk engages in reckless dashing flight, with fanciful curves and downward plunges. Perhaps the most novel courtship of all is pursued by the phalaropes. The female is the courtier, bright-colored and amorous; the male is somber-clad and indifferent.

Q. - Are birds the only higher animals that fly?
A. - No, the bat, for example, is a mammal. The flying squirrel is fitted with loose skin stretched between foreleg and hindleg. It, like "flying fishes", volplanes rather than flies.

Q. - What other higher animals lay eggs?
A. - Fishes and most reptiles lay eggs. The duck-billed platypus and echidnas of Australia among mammals also lay eggs.

Q. - When do the commoner summer residents arrive in Yellowstone?
A. - March 1 to 10 Pink-sided junco
March 11 to 20 Mountain bluebird, robin, Intermediate junco, kildeer, red-winged blackbird, meadowlark, song sparrow, Cassin purple finch.
April 8 to 15 Flicker, coot, osprey and sparrow hawk.
April 21 to 25 Brewer blackbird
April 26 to 30 White-crowned sparrow
May 1 to 5 California gull, pipit, trumpeter swan, Audubon warbler, tree swallow.
May 6 to 10 Pelican, heron
May 11 to 15 Yellowheaded blackbird, chipping sparrow, and spotted sandpiper
May 26 to 31 Western tanager
(Yellowstone Nature Book by M. P. Skinner. P. 86 (1924)).

Q. - Which of the commoner birds are permanent residents?
A. - Mallard, Barrow Golden-eye, Canada goose, Wilson snipe, Richardson grouse, Franklin grouse, gray-ruffed grouse, Golden eagle, kingfisher, magpie, blackheaded jay, Rocky Mountain jay, raven, crow, Clark nutcracker, ouzel, Rocky Mountain creeper, red-breasted nuthatch, chickadee and solitaire.

Q. - What are the most important winter visitors?
A. - Snow goose, whistling swan, leucosticte, red-poll, snow bunting, tree sparrow, Bohemian wax-wing, Northern shrike.

Q. - Are hot springs or geysers ever fatal to bird life?
A. - Yes, but not with many disastrous results. Langford relates an interesting case in his diary of the 1870 Discovery Expedition of the catastrophe befalling a duck on Prismatic Lake, near Excelsior Geyser Crater, as follows: "As we stood on the margin of this immense lake a small flock of ducks came sailing down as if to alight; but as they skimmed the water a few inches above the surface, they seemed to scent danger, and with rapid flapping of their wings, all except one rose into the air. This one, in his descent, had gained too great an impetus to check his progress, and came down into the water, and his frantic efforts to rise again were futile, and with one or two loud squawks of distress, which were responded to by his mates who had escaped, he was in a moment 'a dead duck'."

Fatalities to birds are more often caused by carbon dioxide gas, which hangs in caverns or depressions because of its great density (15 times heavier than air). This gas emanates from old springs or craters, and though physiologically non-poisonous causes death by suffocation. The most deadly caves in the Park have been covered with wire netting. It is assumed that birds are attracted by warmth or the presence of water and insect life. The remains disappear very rapidly, due to various contributing factors.

Several victims have been claimed from species whose presence had been unsuspected in the Park; for example, a Calaveras and a Townsend warbler taken in Stygian Cave.

Q. - How do thermal areas otherwise affect bird life?
A. - By furnishing warmth, moisture, conditions favorable to abundant insect life, and open water throughout the winter. The last named is of great interest, for many birds abide throughout the year which could not remain if there were no open water. Among these are mallards, Canada geese, whistling swans, Wilson snipe, kingfisher, ouzels, and Golden-eyes.

Q. - Where do gulls spend the winter and why are they interesting?
A. - Gulls are usually thought of in connection with the seashore, but certain species nest inland, sometimes a thousand miles from the ocean. This is the case of the California gull, which is found on lakes and larger rivers of the Park at elevations between 7000 and 8000 feet. By means of banded birds, it is found that gulls found in Yellowstone Park winter along the California coast. Arriving late in April or early in May, they nest on Molly Island, along with pelicans and terns. The young gull is able to forage for itself in August, and is mottled grayish brown, quite different from the showy gray and white plumage of the adult. The young gull drops its mottled cloak only gradually, the completely unmottled adult plumage usually appearing after the third moult (the fourth year).

Gulls are scavengers, and as such perform very useful service to mankind. They not only devour dead fish, but will contest for a spot on the hotel garbage dump with the bears. Along with the raven and the eagle they will rob the skilled merganser of his catch of fish before he can swallow it. Gulls catch field mice and insects and have rendered great service in this fashion. In Temple Square of Salt Lake City, a monument has been erected to the God-sent gulls, which in 1848-50 rid the harrassed farmers of a scourge of black crickets that had threatened to make "the Promised Land" untenable.

Q. - What is the purpose of the pelican's pouch?
A. - The pouch is used as a scoop or dipnet for fishing, the water being separated from the catch by throwing up the bill, contracting the pouch and allowing it to run out over the edges. They do not store fish in it. Young are fed on regurgitated fish.

Q. - What is the purpose of the horny knob on a pelican's upper mandible?
A. - This knob or crest-like excrescence grows during the mating season, reaches fullest development by the middle of June and is shed shortly afterward. Its purpose is not known.

Q. - What large white birds are oft mistaken for swans on Yellowstone Lake?
A. - The white pelican.

Q. - Which swans are found in Yellowstone and where are they found?
A. - There are two species of swans found in Yellowstone - the trumpeter and whistling. The trumpeter, once quite abundant in Western America, has now only a pitiable remnant left. They are rarely seen in Yellowstone, although several pairs nest here. They have been seen on the larger lakes of the Park as well as on smaller bodies of water. During the past three or four years a pair has been nesting in a pond three or four miles from Tower Junction on the road to Cooke City. The swan is entirely white and looks like the tame swan, except that it holds its neck stiffly and almost straight. When disturbed, this bird utters a loud ringing note, hence its name. The bird was discovered by Lewis and Clark on the Columbia River in 1805. The whistling swan is a common fall migrant, appearing in October or later. Quite a number remain all winter within the Park.

Q. - Is the whooping crane still found in the Yellowstone?
A. - Unfortunately, no. This largest of our cranes, whose vast numbers once filled the air with their great clangor from the MacKenzie River to the middle west, is now almost extinct, only a few pairs remain that find a home and nesting place in out-of-the-way places. Federal Law protects this bird, but this protection has come too late.

Q. - What representatives of the Crane and Heron families are common in the Park?
A. - The Great Blue Heron and Sandhill Cranes are occasional summer residents. The former is found in meadows and along streams. It carries its neck folded back upon itself. The crane is a little larger, flies with head and neck outstretched, need not appear near water, and usually utters a loud call. The little brown crane is also found in the Park, especially during migration, although some non-breeding birds summer here. It is slightly smaller than the Sandhill, from which it has no other recognizable distinction.

Q. - Why is the phalarope of unusual interest?
A. - Contrary to bird fashion, the female is larger and more brilliantly colored than the male and does the courting. The male broods the eggs and cares for the young alone. The erratic swimming of this bird also commands interest. The whirling stirs up a source of food supply in the water, and also may be a courting antic.

Q. - Why are shore birds of such great interest?
A. - Among land-feeding birds, shore birds present the longest migratory flights. The best example is the American golden plover, which nests in the Arctic Circle in the Western Hemisphere, migrates to the Labrador Coast to fatten on the abundant native berries as soon as the young are old enough to fly, passes over Nova Scotia on a 2400 mile non-stop flight to the North Coast of South America if weather be propitious, and winters in the La Plata Valley in the southern part of that continent. On the return route, six months later, this bird invariably flies via northwestern South America, the Gulf of Mexico, over the Mississippi Valley to its summer haunts.

Of even greater interest is the migratory flight of the Pacific golden plover, which, nesting in Northern Siberia and the Bering Sea coast of Alaska is a near neighbor to the American golden plover, but winters in the Hawaiian Isles, Polynesia, Northern Australia, the East Indies and Southwestern China. Plovers flying from the Aleutian Islands to Hawaii must make a 2400 mile flight over an islandless sea without a possibility of a resting place.* It has been found that it takes 48 hours for this flight and that two ounces of the bird's weight is consumed on the average during the flight. This is remarkable efficiency, especially when considering that there is so much lost motion in the flapping of wings. With equal efficiency it is estimated that a 1000 pound aeroplane might be run at a high speed for 160 miles on a gallon of gasoline.

The courtship habits of shore-birds are of very great interest. There are curious anomalies in the study of shore-birds again exemplified by the "bossism" of the female phalarope. Birds, also, as a rule, have underparts which are lighter colored than the back. The black-bellied and golden plover have black breasts and bellies. The snowy plover has a snowy breast and sand-colored back. When approached, these birds wheel around, disclosing their sand-colored backs and making them practically invisible. If one remains very quiet, the whole flock wheels around at one time to flash their snowy breasts in a most mechanical fashion.

Q. - What shore-birds are common in the Park? Where do we find them ?
A. - The Wilson snipe is found around Mammoth in winter time. The spotted sandpiper is an abundant summer resident on the shores of every pond, lake and stream. It flies on bowed wings and utters its plaintive "pee-weet, pee-weet". It is also called "teeter-tail" from its habit of dipping when uttering its cry. The kildeer is a common summer resident and is found on hot springs formations. Its noisy "kildee, kildee" is characteristic of these in summer. The kildeer is a plover.

*See U. S. Department of Agriculture Bulletin #185, April 17, 1915, p. 17.

Q. - What grouse commonly occur in the Yellowstone?
A. - Of the five grouse reported in the Yellowstone only two, the Richardson and gray ruffed, are present in any numbers, the Franklin, Columbia sharp tailed and sage grouse being rare. The gray ruffed grouse is a grayish bird with a conspicuous black ruff on either shoulder. He lives near the edges of the forest and in underbrush, but is partial to groves of aspen. Though the ruffed grouse was once numerous and found widely distributed over the northern two-thirds of the United States and forested areas in Canada, this splendid game bird is now found in limited areas where rigorous protection will be necessary to curb its total destruction. This is the bird celebrated for its drumming in springtime, a familiar and characteristic noise of the northern woodland. This is produced by rapidly beating the wings against the air, while the bird stands on a fallen log or other convenient platform which, contrary to common belief, is unnecessary for the production of the noise. The courtship practice of the bird is a strutting with erect head, extended chest, wide-spread tail, and raised shoulder ruffs. The food consists of grains, buds, leaves, fruits and insects, the latter forming about ten per cent of the whole and consisting largely of injurious beetles. The diet has been carefully studied, and the bird pronounced a very valuable asset to the agriculturist.

The Richardson grouse is a larger bird with a bluish cast. It is partial to fir and spruce cover, and never gets far from the shelter of trees. It does not possess shoulder ruffs, but has two sacs on either side of the neck which may be inflated, and from which the air is expelled with a booming noise audible for several hundred yards. This bird has ventriloquistic powers, and much searching is sometimes necessary to locate a booming bird which may be perched on a limb close by.

Q. - What is generally conceded to be the most interesting bird in the Yellowstone?
A. - The osprey, or "fish hawk".

The most picturesque feature of broad shallow inland waters and tidal flats is the osprey or "fish hawk", whose habits of hunting and diving from the wing are a never failing source of interest. The osprey is a very large hawk, with a broad wing expanse, and is only slightly smaller than the eagle. It is brownish-black above and gleaming white below, has a white head and neck, a black bar over the ears, and a distinct occipital crest. It subsists entirely on fish which it catches. Soaring at a considerable height above the water, it hovers for a moment as its prey is spotted, then drops precipitously in a long swooping spiral. It strikes the water, with wings raised high over its back, with a splash that hides almost the entire bird. With one or two powerful wing-strokes the bird rises from the water clasping a struggling fish with its long talons. The prey may or may not be held with its back up, but it invariably makes its aerial journey head foremost. Nor is this trip always uneventful, for ofttimes the struggles of larger victims are a

sore tribulation to the hawk, and sometimes its inveterate enemy, the bald eagle, pursues and harasses it until it drops its hard-earned dinner, which the bold pursuer catches with a clever swoop as it falls.

The plumage of the osprey is firm, close and oily. Its feet are immensely large and strong, with pads or corrugations for clasping slippery fish. The wings are long and powerful and make the superb flight possible.

The home life of the osprey is model despite the fact that many a sagebrusher has been told that the male is kept on the nest by the female at night so that his deportment may be under her scrutiny even during the invisible hours. It is believed that the osprey mates for life and returns to the same nest each succeeding season. When the pair arrive in their Yellowstone home, they immediately repair, renovate and add to their nest. This is an unwieldly mass of sticks five feet or more in diameter, lined with needles, grass, bark and other soft rubbish. The eggs vary much in color, from white to tawny or reddish, and blotched with different browns. They are two or usually three in number. After an incubation period of four weeks the young are born in June or early July, little gray fluff-balls that are spotted with variegated brown or white colors. During their first days of life the mother bird is constantly on the nest while father fishes for his family's food. He gives his catch to the mother, who tears it into bits and gives each youngster a share in its turn. There is no hubbub nor excitement within the nest as there is in the nests of most birds, but each awaits its portion and takes it quietly when given to it. When danger approaches, the mother gives a peculiar cluck, the young freeze and, except for the blinking of eyelids, appear quite lifeless until reassured by mother's cluck that all is well (Skinner). About forty or fifty days are spent in the nest.

Ospreys are inoffensive and seldom fight among themselves. Smaller birds, such as grackles, often take advantage of their peaceful natures and build their tiny homes within the interstices of the osprey nest. Waterfowl are unalarmed by the soaring of this mighty hawk and swim peacefully and undisturbed even when it strikes for a fish in close proximity.

The bird is gradually growing rarer inland where his huge nest invites attack by human robbers. He apparently has no important economic status, and takes few fish of commercial or sporting value, although in the Yellowstone he does catch trout, but these can readily be spared.

Q. - What bird has built its nest on Eagle Nest Rock in the Gardiner Canyon?

A. - The osprey. The usual nesting site of this bird is on top of a tree, but here it has adapted itself to its environment and builds on rocking pinnacles. More nests and ospreys can be seen in the

Grand Canyon from Inspiration Point. The osprey is commoner and nobler than the eagle, for which it is often mistaken.

Q. - What hawk nests about Old Faithful Inn, and is commonly seen flying near there?

A. - The sparrow hawk, our only common falcon and the handsomest of hawks, which is found in all open country at lower elevations in the Park. The blue and rufous coloration with its peculiar black and white markings serves to differentiate this from all other hawks. It is small, being only slightly larger than a robin.

The falcons are bold hawks of great spirit, address, speed and endurance. They are the noble hawks of ancient falconry but drop like a bullet upon their prey and are undaunted by failure. They hover or fly with quick strokes of their pointed wings, being little given to sailing. Like its kindred falcons, the sparrow hawk hovers or poises over its prey before dropping lightly down upon it. Sometimes it swoops in a series of steps, dropping five or ten feet, hovering, dropping, and hovering again. This habit offers a strong field mark for its identification.

Over one half of the food of the sparrow hawk consists of grasshoppers, crickets, terrestial beetles, and caterpillars, and he is often seen hovering over cultivated fields in search of these. Of the remainder, half consists of mice and shrews while the other half consists of birds, reptiles and spiders; and so, on the whole, he renders excellent service to mankind. He is often seen perched on dead trees or telephone wires watching for movements that may betray the presence of prey. The home life is model; it is believed he mates for life, helps incubate the eggs and raise the brood. Nests in an old woodpecker holes have been known to be used for many years.

This bird calls "killy, killy, killy" as it wings over fields, and has often been called "the killy hawk". Other names are grasshopper hawk and mouse hawk, far more appropriate than sparrow hawk, not only because of its principal articles of food but also since it bears no resemblance nor is it directly related to the European sparrow hawk.

Q. - What other hawks are common in the Yellowstone?

A. - Next to the osprey, the Swainson is the commonest hawk found in the Park. It is usually a dark brown with a brown band across the lighter breast. It is a large hawk that prefers open country.

The commonest high-flying hawk is the red-tail, which slowly wings its way overhead in ever increasing circles as it watches for prey of rodents and snakes. Ofttimes it descends in a series of plunges with wings closed, regaining height by suddenly opening them. It is characterized by a rich chestnut tail which is crossed by several narrow black bands and which is spread like a fan while flying. Hawks, at best, are rather difficult to differentiate in the field, and this is especially true of the red-tail and its

close relative, the Swainson. Individuals of the same species vary greatly in size and color, but in general the red-tail has a breast lighter than the abdomen while the reverse is true for the Swainson. The red-tail is often mistaken for an eagle as it loves to sit on some exposed perch for hours. It is of greatest economic importance because it destroys many injurious mice.

The marsh hawk or harrier is easily recognized by a conspicuous white rump patch as he heats low over marshes and meadowland in search of mice. It is found throughout the Park. It is usually brown in color, but occasionally it is colored somewhat like a gull, with slate above, white below, and black on wing tips. In soaring it holds its wings elevated above the body instead of level with it as other hawks do. It is found in all parts of the Park.

The sharp-shinned or bird hawk is of small size, found in mixed woods or open fields. This is the American relative of the European sparrow hawk and is equally destructive to bird life. It flies just over the tops of bushes and trees, or over the ground, usually in a leisurely manner except when in pursuit of prey. With its short, rounded wings it progresses by a series of quick even strokes and short sails, never sitting in watch for prey nor darting down upon it like the sparrow hawk. It is bluish-gray above, with underparts of white, barred and spotted with reddish brown. The tail is long and narrow, crossed by three or four dark bands and tipped with white. Like the Cooper and goshawk, the sharp-shinned is destructive economically.

The pigeon hawk is a falcon of sharp-shinned hawk size and general coloration, of falconine outline (pointed wings, fan-shaped tail), found about the edges of copse and woodland. Unlike the sparrow hawk, it does not hover nor circle.

The hawks might be arranged according to size, thus: osprey (largest); red-tail; Swainson; marsh; and sharp-shinned, sparrow, and pigeon hawk (smallest).

According to frequency of occurrence, thus: osprey (commonest), Swainson, sparrow, red-tail, marsh, sharp-shinned, pigeon.

The current idea that all hawks and owls are harmful is not only erroneous but a grave economic error. Most are beneficial friends of the farmer and spend their entire lives in ceaseless pursuit of insects and rodents that destroy his crops. Over 100 grasshoppers have been found in the stomach of a single Swainson hawk, while more than 3,000 skulls of mammals have been discovered in the retreat of a single pair of barn owls, of which over 2,900 were of mice and rats. An increase of rodents is always noted where there is a marked decrease of hawks. Of all of the species of hawks found in the country only the three mentioned above are economically injurious.

Q. - What bird is the American national emblem?
A. - The bald eagle, a rare and picturesque feature of the landscape near open waters. The adult has a conspicuous white head, neck, and tail, but this distinction is not acquired until the third year, the juvenile bald eagle having blackish feathers during his first year and gray ones during the second, during which time he is distinguished from the golden eagle only with difficulty. The bald eagle lives largely on fish which it can capture by diving, similar to the osprey, but which it usually gets by stealing from the osprey or by picking up dead along the shores. Although it does sometimes attack living birds and mammals, even fawns, lambs or kids, it prefers carrion and offal, often gorging itself to the extent that it cannot arise in flight. But not all repellent in this stern-visaged monarch of the air. He possesses magnificent presence, is highly devoted to his family, and, though inferior to the golden eagle in power and grace, flies with long powerful strokes or sails for hours on air currents without moving a wing. About two or three pairs of bald eagles nest on the tops of pines near Yellowstone Lake.

A far more spirited and noble bird is the golden eagle, a bird of the mountain fastness. He is less of an habitual carrion feeder, and lives largely on birds and mammals that he catches.

Eagles are extremely rare. It has been estimated that less than a score live within the Park. They are our largest birds of prey, and deserve protection most everywhere.

Q. - What bird utters the weird howl that has been described by the uninitiated as the "cry of a mountain lion"?
A. - The western horned owl, our largest owl, whose piercing hoo-hoo-hoo-hoo rings far over canyon and plateau in the small hours of the night. It is a common resident, and sometimes flushed from heavy timber.

Q. - What bird utters a loud clatter as it flies over stream or lake?
A. - The belted kingfisher, a bird with a great ragged crest, large head, slaty-blue back, white neck, throat and underparts, that lives on small fish that it takes by dashing into the water from on wing. It will sit for hours on an exposed perch over water, watching for fish. It nests in the ground at the end of a tunnel driven deeply into the face of an exposed earth bank. It is a permanent resident in the park because open waters are found here the year around.

Q. - How are woodpeckers adapted for clinging on trees and obtaining insects under the bark?
A. - Woodpeckers have three or four toes ending in well-hooked claws, two of which are directed forward and with which they clutch the bark. The tail is firm and stout, and serves as a prop while the bird clings to the tree. The bill is straight and chisel-like, adapted for drilling into bark or wood. The tongue is long, pointed, and barbed in most species, enabling insects to be impaled

and withdrawn with the aid of a sticky fluid secreted by abnormally developed salivary glands. In the sapsucker the tongue is frayed like a brush, and is useful in withdrawing sap.

The flicker is the most common woodpecker in the Park, and the Rocky Mountain hairy the second most common. Others are the Lewis woodpecker and the red-naped and Williamson sapsuckers.

Q. - What bird flies at nightfall in swoops?
A. - The Pacific nighthawk, a curious looking bird with a short weak bill and a wide gaping mouth surrounded by long stiff bristles and acting as a fly-trap when the bird flies through the air. The bird has an irregular flight, uttering a screeching cry or a booming sound. It is dark, barred and streaked irregularly, and has conspicuous white wing patches. It is migratory, and nests on the ground.

Q. - What is peculiar about the flight of a swift ?
A. - He flies with alternate strokes of the wing, a "crawl stroke" in swimming parlance, while most other birds beat their wings simultaneously.

Q. - What is the smallest bird found in the Yellowstone?
A. - The Calliope hummer, scarcely three inches long, is sometimes seen around Mammoth. It has brown and green sides, and the male has a rose-colored gorget.

The only other hummer apt to be seen in the Park is the rufous, the author having seen about a half dozen in the Upper Geyser Basin during the 1928 season. The male is a rich brownish red with a gorget flashing fiery red, orange, or brassy green. The broad-tailed hummer has also been reported in the Park. All hummers are rare and their appearance during the course of a Nature walk is an occasion. They are extremely pugnacious and courageous, and are attracted by bright colors, especially red. They show a marked preference for red flowers, just as bees seem to prefer blue-colored ones. The hummers nest is a dainty structure of cobwebs, lichens, willow-down, and bits of bark, straddling a tiny branch.

Q. - Of what peculiar interest is the magpie in the Yellowstone?
A. - He inhabits the Park throughout the whole year except during the tourist season when he mysteriously disappears. This bird with striking black and white plumage, long wedge-shaped tail, and mischievous behavior, is peculiar to the arid plains of our West.

Q. - What bird is the "Camp Robber"?
A. - The Rocky Mountain jay - also called meat bird and whisky jack, a somber, unkempt, lean-looking bird of black, white, and brownish gray without marked patterns or strong contrasts like the Clark nutcracker. The bird has earned its name in hunter's parlance from its boldness in stealing from pot, kettle, or table whatever it can carry away.

Q. - Where are crows and ravens found in the Park? How do they differ in character?

A. - In general throughout the country, crows are absent wherever ravens abound. Both birds are found in the Park, but ravens are more common. The crow is never plentiful, but is found around Mammoth. It is scarce at higher elevations. The raven is a much bigger bird than the crow, its length being approximately two feet and its wing spread four feet or more, as contrasted with a length of one and one-half feet and a wing-spread of three and one-half feet for the crow. The raven has a characteristic soaring flight easily distinguished from the rough flapping of the crow. The voice of the raven is a hoarse croak, while the crow's sharper, raucous "caw-caw" is too well known to require description.

Q. - What is a Clark nutcracker?

A. - The Clark nutcracker is a heavily built bird with jaylike habits. It is wild, restless, noisy and talkative, a dweller of the alpine and sub-alpine regions of the Rocky Mountain region. In size it is intermediate between the jay and crow, to both of which it is related. The coloration is peculiar and distinctive, and is alike in both adults and the young. It is of a soft gray color, with black wings showing large white patches at the outer margin, and with a white tail except for the black feathers in the center. The bird utters a nasal cawing note repeated at irregular intervals. Although non-flocking, it is socially inclined. Its name comes from the food habits of the bird, as it is very fond of nuts. It was first described by Mr. Clark of the Lewis and Clark Expedition, and is consequently the Clark nutcracker or Clark crow.

Q. - What bird was reputed to build its nest between the horns of a buffalo?

A. - The cowbird, whose close association with the buffalo gave rise to this legend. Here, as elsewhere, the bird lays its eggs in the nest of another bird.

Q. - What is the glossy black bird with conspicuous yellow eyes, walking about the ground like a grackle?

A. - The male Brewer blackbird.

Q. - How does the song of the Western meadow lark compare with that of the Eastern?

A. - That of the Western species is more varied, richer, more plaintive and less shrill than that of the Eastern species. This is exactly counter to the usual rule, for most Eastern species have finer songs than the Western varieties. It is also true that the Eastern species are more brilliantly colored and somewhat smaller in size, although in the case of the two meadowlarks, there is only a slight difference in shading and it is impossible to distinguish the two in the field by sight. The ranges of the two overlap for several hundred miles (east and west), yet it is stated that there is extremely little evidence of interbreeding.

Q. - What common birds are included in the sparrow family?
A. - The sparrow family is the largest and most important family of perching birds. Being primarily seed-eaters the individuals have coni-rostral bills that combine great delicacy of touch with firmness for cracking seeds. Some of the members of the family are beautifully colored and some are superb singers. In addition to sparrows proper, the family includes the finch, grosbeak, bunting, longspur, junco, towhee, siskin, cardinal and canary. It is deplorable that the exotic English sparrow, rat of the bird world, has added such bad flavor to the word sparrow that this might confuse the unknowing or cast aversion over the general desirability of the family as a whole or its various genera.

Q. - What small common sparrow flashes very conspicuous tail feathers as it flies or sings?
A. - The junco. The male wears a black cowl and has a contrasting ivory-like bill. This is one of the commonest birds seen in the Park.

Q. - What is the most beautiful bird of the Park?
A. - The Western tanager is found in forests below 8,000 feet elevation throughout the park, and in Canadian and Transition zones throughout the West. The male has a lemon yellow body, black wings, back and tail, and an orange head and neck. The female is dull olive green.

Q. - What large family of birds is found in the New World only, and what are its commonest representatives in the Park?
A. - The wood warblers (Mniotildidae). The Audubon, western representative of the eastern myrtle warbler, is the commonest. Seven other species are listed in the Park: the Calaveras, orange-crowned, yellow, myrtle, Townsend, Macgillivray, and western yellowthroat.

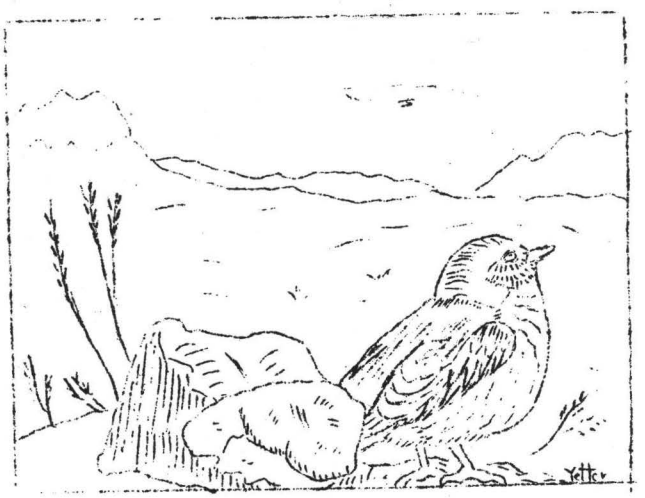
Q. - What hardy little bird nests on the windswept heights of Mount Washburn?
A. - The pipit, a ground-colored bird with conspicuous white outer tail feathers. It is gregarious and has a habit of dipping its tail. It loves to mount high in the air and sing like a skylark, and thus it is sometimes called titlark or American skylark. It winters in the mud flats, sand dunes and bare ground of warmer climes.

Q. - What bird has been made famous by a classic chapter of bird literature in John Muir's "Mountains of California"?
A. - The water ouzel or dipper. An intensely interesting land bird which has reverted back to the water for home and food. This is "the mountain streams' own darling, the hummingbird of blooming waters, loving rocky ripple slopes and sheets of foam as a bee loves flowers, as a lark loves sunshine and meadows." "No canon is too cold for this little bird, none too lonely provided it be rich in falling water. Find a fall or cascade, or rushing rapid,

anywhere upon a clear stream, and there you will surely find its complimentary ouzel, flitting about in the spray, diving in foaming eddies, whirling like a leaf among beaten foam-bells; ever vigorous and enthusiastic, yet self-contained, and neither seeking nor shunning your company."

Q. - What is the common but beautiful blue bird about the size of a robin found everywhere in the park? Why is he so well liked? How does he differ from his Eastern cousin?

A. - The mountain bluebird, placed by some authorities at the very end of bird lists, the most highly developed bird found in America. Its wonderful blue color, its habits of remaining poised in the air with rapidly beating wings like a hummingbird, and of gracefully placing wings back to back like a butterfly when alighting, and its marvelous, cheerful song endear it in everyone's heart. He does not possess the brown breast of the Eastern or Western bluebirds, and is a typical summer resident above the Transition Zone.



FLOWERS OF YELLOWSTONE NATIONAL PARK (OLD FAITHFUL AREA)

By Herma G. Albertson, Ranger Naturalist

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Ranunculaceae (Crowfoot or Buttercup family)

About 30 genera and 1,200 species of world-wide distribution. Prevalent in temperate climates, some found in arctic and alpine regions. Plants are nearly all herbaceaous and mostly perennial. The flower parts vary and are born on a torus, no cup being present. The prevailing type of fruit is a follicle with many seeds. This family is best known for its flowers which include peony, columbine, larkspur and clematis of our gardens. The most useful drugs obtained from this family are aconite, hydrastis, cimicufuga and staphissagaria.

Aquilegia

The various species have a wide range. The flower is found in all Europe, and that part of Asia between northern Siberia and the Himalayas. In the northern half of the world there are about 50 species of columbine, of which some 20 occur in North America. It is cosmopolitan enough to be at home from Nova Scotia to the Northwest and from Florida to the Rocky Mountains. It is a child of America. It is said that during the reign of Charles I, a young colonist kinsman of the king's gardener sent to him, from Virginia, specimens of the plant for the adornment of the gardens of Hampton Court.

The nectar is hidden far back in the five nectaries or cornucopias of the petals. Only those insects which are able to carry its pollen to some other flower can partake of the hidden sweets of the columbine so the nectar is mainly reserves for some large bumblebee or humming bird. The weak legs of the fragile butterfly will not allow it to stand the strain of the inverted position necessary for it to reach the nectar. Smaller bumble bees, unable to get the nectar with their short tongues, may be detected nipping holes in the tips of the columbine. As a defensive measure against this rape of sweets, the American columbine secretes a bitter juice that often foils the invaders.

The efforts of the flowers of the field to dress in the colors that delight the senses of the creatures which bear their pollen, are strikingly shown in the American columbine. In Europe the humming bird is a stranger. The plant wears colors varying from blue to red, for the bee is its pollenizing agent there, and, as Sir John Lubbock proved by a striking series of experiments, the favorite color of the bee is blue. On the other hand, in America, where the humming bird is the principal pollenizing agent, the columbine attires itself in a dainty red that is known to delight

the "king ruby throat". The columbine is too highly organized to permit self-fertilization; the pollen ripens and is shed before the stigma of that flower is ready to receive it and the pendant position of the flower makes it impossible for pollen to fall on the stigma.

The name columbine comes from the Latin for dove and was applied because the flower had a fancied resemblance to a group of dainty little doves huddled together. Its latin name, Aquilegia, was given it because the spurs of the flower possess a resemblance, somewhat distinct in the Colorado blossom, to the talons of an eagle. The columbine may, with equal claim, play the role of dove of peace or eagle of war.

The western red columbine is widely distributed throughout the Pacific Coast, ranging as far north as Alaska and east to Montana and Utah. It may be found in thickets and woodlands from sea level to timber line. The eastern red columbine (A. canadensis) has smaller flowers of a less brilliant hue and prefers somewhat more open situations.

Colorado's state flower, the blue columbine (A. caerulea) is very large-flowered, blue and white and occasionally pure white, and often grows in dense masses in grassy openings of the spruce woods of the Rockies.

The common garden columbine (A. vulgaris) has been brought over from its native haunts in Europe and, since it hybridizes readily, produces a great variety of forms and colors.

The yellow columbine (A. flavescens) grows at great altitudes and may be found among the rocks at a height of 8000 feet, where the soil is so light and sparse that there seems to be no foothold for any vegetation at all, much less for such tall and graceful plants as these. The foliage of this columbine is much more delicate than that of many. Most, if not all, of the columbines found in the park are yellow.

Delphinium (Low and Tall Larkspur, Poison, Poison Weed, Cow Poison)

The various species have a wide range, being found in Europe as well as America. The tall mountain larkspur is a very handsome plant and is nearly always a rich purple hue. It stands from one to four feet high in immense quantities in the mountain meadows. The tall larkspur grows abundantly in the gulches and canyons of the more elevated ranges while the low larkspur grows in similar regions but upon the open hills, in drier localities and extends to somewhat lower elevations. The low larkspur blossoms in May and June and seeds in June, after which the plant dies and disappears. It is found at altitudes of from 4000 to 10,000 feet on the open hillsides and in parks, sometimes covering large areas. The plant is seldom over a foot tall.

The seeds of the tall larkspur are very poisonous, although not eaten to any great extent by cattle. The recorded losses from larkspur poisoning have been almost entirely in the cattle ranges of the United States and Canada although isolated instances of poisoning are known in the eastern mountains. In the cattle regions of the West probably no other poisonous plant with the exception of loco weed has caused such heavy losses to the stockman. A conservative estimate, based on reports from a large number of ranges indicates that the annual loss is from 3 to 5 per cent. A great number of stockmen who have reported on the subject have given an estimate of 5 per cent. Specific cases are known in which from 20 to 50 cattle in a single herd have died within a few hours, and in other instances individual stockmen have lost as many as 200 head in a season. Larkspur is somewhat less poisonous to horses and seems to have no effect on sheep.

An extract made from the seeds of the field larkspur of Europe is poisonous if taken internally, but is useful as an ointment or lotion. Death results from paralysis of respiratory organs, the heart continuing to beat for an appreciable time after breathing has ceased.

The name comes from the Greek "delphin", meaning a dolphin, from a slight resemblance to a dolphin.

Aconitum columbianum (Aconite, Monkshood, Wolfbane)

Monkshood is a poisonous plant, but experimental work by the Department of Agriculture has shown that it does not poison livestock on the range. In certain parts of Yellowstone Park the swampy regions are blue with aconite in the summer months, while the larkspur is rarely met with. In the region between the Yellowstone Lake and the Grand Canyon, the larkspur is very abundant and the aconite comparatively rare. These plants are prepared to resist invasion of the rights of their offspring, but they do not seek "whom they may destroy" by poisoning everyone who comes in contact with them. They are moisture-loving plants growing from six to eight feet tall. Instead of masquerading in a saucy dunce's cap, as does the larkspur, it wears a queer little blue bonnet with floating ribbons. Our species bears a closer resemblance to the cowl of a monk.

It is so dependent upon the bumblebees for its fertilization that in countries where there are no native bumblebees, such as New Zealand, Arabia, Australia and South Africa, there are no monkshoods.

Many of the species have the poison in the flowers as well as in the roots. The cultivated monkshood (A. napellus) yields the drug aconite. It is often used to contract the pupil of the eye and also as a powerful stimulant. Many of our indispensible drugs, such as strychnine, digitalis, quinine, etc,, are developed

as a by-product of plant preparations for self-defense and have proven to be gifts of the plant world to man, even though poisonous in overdoses.

Actaea arguta (Red Baneberry)

This plant blooms in the early part of the season and the clusters of feathery white flowers are very attractive in the shady, moist woods. The first part of August the berries begin to turn red and make the plant even more attractive than in the spring. The berries are poisonous, hence the name Baneberry. The name Actaea comes from the Greek "aktea", an old name for elder. The white baneberry or cohosh is found in the East as well as in the West. For generations they have been called "Dolls' Eyes" in Massachusetts, for they closely resemble the china eyes of the old-fashioned china doll head. The white stamens and stigmas are the most conspicuous part of the flower as the petals soon drop. One type of red baneberry reaches a height of six feet, and being a busy plant, might readily be mistaken for a shrub.

Thalictrum sp. (Meadow-rue)

The name is said to be derived from the Greek "thallo", to become green, and probably refers to the young shoots. It is a dainty plant, resembling the foliage of the Maidenhair Fern, and is often mistaken for it. The lovely reddish-green tassels, which hang in clusters, are much more attractive than the other blossoms which are green and rather insignificant. The plant bears what botanists know as diclinous flowers, that is, the stamens and pistils may be borne on the same flower, or the stamens on one and the pistils on another although on the same plant, or the stamens may occur on one plant and the pistils on another. The flowers of this plant are usually seen above all of the surrounding vegetation, as it is not advanced enough in the scale of evolution to be pollinated by insects alone and must therefore depend upon the wind to help. The fruit resembles numerous seed-bearing stars, tipped with thread-like points. The leaves are very much like those of the columbines only somewhat finer.

Papilionaceae (Fabaceae) (Pea Family)

The name Leguminosae is often used to designate the pea family but it is really a larger and more inclusive term and should be given the rank of an order. The family Papilionaceae alone contains two-thirds of the order and is the second largest family of the dicotyledons, nearly equaling the Compositae in species number. It is more numerous in individual plants and is distributed farther northward. Fossil remains indicate that they were in existence in the Cretaceous period, but most of them are products of the Cenozoic era.

They are predominately herbaceous. The root system of the perennial species is usually large and deep as in the alfalfa. Movements of the leaflets or the leaves are fairly common. Many of the species show highly specialized devices for insect pollination, thus approaching the Orchidaceae. The fruit is a pod called a legume.

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The Papilionaceae rank second to the grasses in value to mankind, and probably have a wider range of usefulness than any other family. They are highly nitrogenous in all of their tissues, thus leaving the land in better condition after harvesting than it was before, as they bring much valuable nitrogen into the soil through their roots as well as through the stems and leaves. No other plant except timothy yields so much hay as clover and alfalfa. As a source of honey no other family can compete. The family ranks high in esthetic value not only in wild but in tame forms as well. From no other family are so many drugs obtained, they include licorice, haematoxylin, tragacanth, senna and physostigma.

Two important groups of stock-poisoning plants are found in this family, the locos and the lupines. The poisonous principle of these plants is not known in the locos and the effects may not be evident until several weeks or months of continuous feeding. The lupines cause acute poisoning especially to sheep, but the losses are mainly from young pods containing seeds.

Lupinus sp. (Wild Lupine, Old Maid's Bonnets, Wild Pea, Sun Dial, Bluebonnet.)

Farmers once thought that this plant preyed upon the fertility of their soil as we see in the derivation of its name, from the Latin "lupus", a wolf. Later investigation has proven that the lupine contents itself with sterile waste land especially steep, gravelly banks, railroad right-of-ways, and exposed sunny hills, where even it would often burn out under the fierce sunshine if its roots did not penetrate to such surprising depths.

Golden Gate Park, in California, was made possible through the planting of the yellow lupine, thus holding down the shifting sand dunes. They planted barley and lupine, the barley furnishing shade for the young lupine plants until they could get a start. At the end of the first year they had a dense growth of plants whose roots had penetrated to a depth of two or three feet. Now the roots have penetrated twenty feet and made it possible to plant trees.

There are approximately seventy species of lupines in North America and most of these arefound in the West. Thoreau says: "the earth is blued with it."

The upper of the five petals acts as a banner announcing to the passing bee that a banquet table is spread inside. The two side petals serve as landing stages and the two others, which touch at the bottom, resemble the keel of a boat. When the bee alights on the landing stage the keel opens up, and the table, all set and garnished, greets the hungry visitor's eye.

The lupines sleep at night. Some species transform their horizontal stars of day to vertical stars at night; others shut them down around the stem like an umbrella around the ferrule. Frequently the leaflets rotate as much as 90° on their own axis.

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Rosaceae (Rose Family)

The members of this family are of world-wide distribution, only about one-fourth of them being found in the United States. They are mostly perennial herbs with alternate leaves usually bearing stipules. It is the most important family for berries and probably no other family is so cherished for its flowers.

Potentilla sp. (Potentilla, Five-finger, Cinquefoil, Silver Weed)

The scientific name is diminutive of the Latin potens, meaning powerful, and was first applied to the true silver weed (Argentina anserina), which was thought to be medicinal. During the Middle Ages, when almost any plant was thought to be medicinal and was credited with healing virtues for all ills that flesh is heir to, these plants were considered most potent remedies. Since many of these plants have five-parted leaves, the name cinquefoil is often used, coming from "cinque", five, and "feuilles", leaves.

The little velvety yellow flowers look much like buttercups and one must look closely to see that they are miniature roses. During the short summer days of the higher altitudes one will find a low shrub with myriads of tiny yellow blossoms, and this is known as the shrubby cinquefoil. One species is often found at altitudes as great as 8500 feet.

Drymocallis and Geum are very closely related to the Potentillas.

Primulaceae (Primrose Family)

Mostly herbs with simple leaves. The stamens are opposite the petals which are four or five in number. The fruit is a capsule and the seeds are attached to the base of it.

Dodecatheon pauciflorum (Shooting Star, American Cowslip, Wild Cyclamen, Pride of Ohio)

Other vernacular names include Indian chief, Roosterhead, johnny-jump and birdbill. It grows on the prairies, in the open woods, along moist cliffs, and the warm streams of geyser basins and is found from Michigan to Texas and from Lower California to Bering Strait. It follows the receding snows and is among the first to take advantage of the spring rains. It is found through April, May and June. The name, derived from the Greek "dodeka", twelve, and "theos", God, is the name of the primrose, which the twelve superior gods were thought to protect. Linnaeus imagined he saw in the flowers of its umbel a little congress of divinities seated around a miniature Olympus. Ages ago Theophrastus called an entirely different plant by this same name. The shooting star is native to a land unknown to the ancients.

Each flower is so designated that the bee, clinging to it while sucking nectar, must receive some of the pollen forced out of the ends of the cone made by the stamens. The female bumblebees are the flower's chief benefactors, but one often sees the little bright yellow puddle butterfly about it.

FLOWERS OF YELLOWSTONE NATIONAL PARK (OLD FAITHFUL AREA) Albertson

Scrophulariaceae (Figwort Family)

The plants of this family are widely distributed over the earth, but are most abundant in the temperate zones. They are most herbaceous and have the tendency to degenerate into more or less complete parasites. In fact, about fifteen percent of the genera and species of this family have this tendency, the germinating seeds attacking various host plants. The flowers are gamopetalous and more or less irregular, usually two-lipped. The fruit is generally a capsule.

The greatest importance of this family lies in their flowers, although two rather important drugs are obtained from this family, digitalis and leptandra.

Pedicularis or Elephantella groenlandica (Elephant's Head, Little Elephant, Butterfly Tongue).

This plant is found in swamps and moist places often in beds with the wild orchid. It blossoms during June and July.

The resemblance of the individual flowers to a miniature elephant's head is responsible for the name, the flat forehead, long drooping ears and curving trunk being perfectly outlined. Farmers once believed that after their sheep fed on the foliage of this group of plants a skin disease, produced by a certain tiny louse (pediculus) would attack them, hence the name Pedicularis.

Mimulus sp. (Monkey Flower, False Snapdragon)

M. lewisii, known as the pink mimulus, is found in the moist mountain meadows and along the colder streams after the yellow and purple ones of the geyser basin are gone. The blossoms are large and showy, rose-pink with yellow throats, and borne in pairs.

M. moschatus, the musk flower, does not actually grow in the water but rather on those low marshy islands so frequently set in the middle of alpine streams. It is very hairy and ill-smelling.

M. Langsdorfi, bears abnormally large, quaint yellow flowers, and is found nestling amid the mosses and reeds which spring up luxuriantly between the stones by the river's bank. Some of the monkey flowers are found growing in the hot run-off streams from geysers and springs and often form an inner margin of yellow.

Mimulus is the diminutive of the Latin mimus, meaning "a mimic actor" and alludes to the laughing face of the flower, which appears to shoot out its ripe lips in mockery at the traveler as he passes by, opening its mouth in a droll grimace that displays its yellow throat. It is the buffoon to the Court of Nature.

FLOWERS OF YELLOWSTONE NATIONAL PARK (OLD FAITHFUL AREA) Albertson

Pentstemon sp. (Pentstemon or Beard-tongue)

From the Greek "pente", five, and "stemon", a stamen, because the fifth stamen is conspicuous although antherless. This antherless stamen is bearded and projects far beyond the other four; it is this pert little bearded tongue which gives the flower its name. It is bent across the opening of the throat of the flower and forms a gate to keep out insects which may visit only for the purpose of pilfering the nectar of the flower and not carry pollen to fertilize it. One western species has been selected by gardeners for hybridizing into showy flowers.

Castilleja sp. (Indian Paint Brush, Painted Cup, Narrowleaf Painted-cup)

The scientific name is in honor of D. Castillejo, a Spanish botanist; the common name is indicative of the appearance of the plant. It is also known as the "Gay Deceiver" for it lacks a good, honest, deep green color which betrays it as a thief guilty of petty larceny. Like other members of the family to which it belongs, it often breaks in and steals from the roots of its neighbors, such juices as the plant must work over into vegetable tissue. Some of the smallest rootlets possess tiny swellings at certain points, during part of the season, which show they were attached to roots of grasses or certain other plants. Having killed the slender roots of the plant to which they were fastened, the enlargements remain for a time as silent testimony to the stealthy practices of this plant.

The various species include a complete palette of colors ranging from white, cream-white, yellow, orange and crimson, only the blues being lacking. The flower, though actually a pale greenish-yellow color, is almost entirely enfolded in a calyx which is also greenish or slightly tinged with yellow, orange or pink, but the bracts or reduced leaves furnish the brilliant color. It is the only alpine flower which rivals the scarlet geranium of our gardens.

It is abundant in the Rocky Mountains, the high Sierras and the Great Basin of western North America.

When growing conditions become such that flowers struggle for an existance and only the higher slopes are covered with them, then the color becomes more brilliant than ever.

Thoreau, who objected to the name "Painted Cup", thought "flame flower" a much more appropriate one, but this name, which is the one the Indians give to Oswego tea, is applied to a flower whose actual flower parts are colored and not the bracts.

Some years ago the school children of the state of Wyoming chose the Rocky Mountain fringed gentian for their state flower, but many people in Wyoming thought it was not as representative

of the state as such a flower should be, and the feeling culminated in the legislative action in 1917, when the Indian paintbrush was chosen to take the lovely gentian's place.

"Flowers that with one scarlet gleam
Cover a hundred leagues, and seem
To set the hills on fire."

"Scarlet tufts
Are glowing in the green like flakes of fire;
The wanderers of the prairie know them well,
And call that brilliant flower the 'painted cup'."

Montropaceae (Indian Pipe Family)

The members of this family are found mostly in North America and are so rare that most people have never seen them. They are of importance only for scientific interest. By some authorities they are included in the family Pyrolaceae and these again in the Ericaceae. They are herbaceous annuals, lacking cholorphyll, waxy white, often tinged with pink, red, or purple when young, but drying to a dark brown.

The leaves are often reduced to mere scales. The fruit is a tiny capsule.

Pterospora andromedea (Pinedrops)

Because of the close resemblance of the seeds to those of the pine, the name is derived from the Greek "pteron", a wing and "spora", a seed. It is usually parasitic on the roots of the pine, but may grow on other coniferous trees. Occasionally it is a saprophyte.

This is another of Nature's thieves and is therefore deprived of wearing the lovely green of all plants which are independent. Its thievery has advanced to such a degree that leaves are no longer in evidence. The root is more truly a sucker which reaches down into the ground and absorbs from the root of some tree, the food which is needed for the sustenance of the Pinedrops. The tall reddish-brown spikes often reach a height of two or three feet.

The pinedrops is probably the nearest relative of the snowflower of the High Sierras.

Berberidaceae (Barberry Family)

This family is widely distributed throughout the northern hemisphere and South America but is not abundant enough to form a major part of the flora. The species found in the United States are all shrubs of perennial herbs. The fruit in many species is small and is classed as a berry, while in others it is a small capsule or akene. Cultivated barberries have been introduced into the United States from the Orient for hedges and ornamental shrubs. Some species form one of the alternate hosts for the wheat rust.

FLOWERS OF YELLOWSTONE NATIONAL PARK (OLD FAITHFUL AREA) Albertson

Berberis repens (Oregon Grape, Rocky Mountain Grape, Mountain Holly)

The name Berberis comes from the Arabic "berberys", the name for the fruit of these plants. This is an ornamental shrub whose bright green foliage turns to a lovely reddish color with the frosts of autumn in this section, but remains green on the Pacific Coast.

When the grape-like clusters of berries ripen the latter part of August or September, they are readily eaten by both birds and animals of various kinds. In Oregon and Washington the larger species furnishes fruit enough for delicious jam and jelly.

The yellow root contains a juice which was used by the Indians in dyeing willow baskets. The root also has medicinal qualities.

The cultivated barberry introduced from the Orient is used extensively as an ornamental shrub and it is practically resistant to the wheat rust which must have as one of its hosts the barberry. It is the common European barberry which is readily attacked by the wheat rust. Like many other plants the barberry loses much of its thorny armor when brought under cultivation. The thorns act as a protection for the plant against the grazing animals.

It is the state flower of Oregon.

Crassulaceae (Stonecrop Family)

The plants are succulent or fleshy. The fruit is a follicle containing few to many minute seeds. The plants of this group are used extensively in rock gardens for they can resist drouth and stand the hot sun.

Sedum stenopetalum (Stonecrop, Sedum)

The name is derived from the Latin "sedere", to sit, because the basal tuft of leaves if often flat on the rocks. Then, too, the plant seems to crop right out of the stones and makes it one of our finest plants for rock gardens. It grows upon the bleak, bald hills of high altitudes.

"Flower in the crannied wall,
I pluck you out of the crannies.
I hold you here, root and all, in my hand,
Little flower, but if I could understand,
What you are, root and all, and all in all,
I should know what God and man is."

Ericaceae (Heath Family)

This family is world-wide in distribution but is found more abundantly as an undergrowth in the forests of Africa and southeastern Asia. The plants are mainly shrubs and the fruit may be a capsule, berry or drupe.

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No other family compares with it for flowering shrubs. Considerable honey is obtained from various members of this family, which includes the sourwood, reputed to be the most valuable honey-producing plant in the southeastern states, both for quality and quantity.

The laurels contain andromedotoxin, which is poisonous to grazing animals

Arctostaphylus uva-ursi (Kinnikinnick, Bearberry, Red Bearberry)

The name comes from the Greek "arktos", a bear, and "staphylus" bunch of grapes. Bruin is also very fond of the fruit, as are many of the small game birds, especially the grouse, and it furnishes one of their favorite articles of food.

The Indians dry the bark and leaves and smoke them. They also prize it for its astringent properties and often use it in the "curing" of animal skins.

It is a handsome plant trailing over the dry, gravelly places in the woods. In autumn the leaves turn a deep bronze or lovely scarlet. One species is known as manzanita in the Southwest.

Ledum glandulosum (Smooth-leaved Labrador Tea)

The name comes from the fact that many old settlers, and also campers and lumbermen in the backwoods, formerly used the leaves of this shrub in place of tea. The leaves and flowers are both aromatic. The plant usually grows where the ground is damp and often marshy.

Geraniaceae (Geranium Family)

The members of this family are found mostly in the temperate climates and are especially prevalent in South Africa. The plants are all herbaceous except for a few exotic half-shrubs. The fruit has a beaked capsule which bears the resemblance to the head and neck of a crane.

Most of the members of this family make good forage. Probably no flower is grown in more homes than the cultivated geranium.

Geranium Richardsoni (Wild Geranium, Cranesbill, White Geranium)

The name is from the Greek "geranos", a crane; and refers to the crane-like beak of the pod. This beak is made up of the five styles that cohere at the top.

The shade forms are taller, smoother, and thinner-leaved than the plants that prefer the sunshine, the latter often becoming small and hairy.

The geranium depends wholly upon the bee for pollination. Sprengel, the great botanist, was the first one to come to the conclusion that the flower is cross-fertilized by the insects

that come to partake of the nectar. This was brought about by his study of the hairy corolla of the common wild geranium of Germany. A hundred years before, 1687, Nehemiah Grew said that it was necessary for pollen to reach the stigma of a flower in order that it might set fertile seed. Linnaeus had to come to his aid with conclusive evidence to convince a doubting world that this was true. Sprengel made the next step forward, but his writings lay neglected for over seventy years, because he advanced an incredible and only partially true statement about pollination by insects. It was left to Darwin to show that cross-fertilization is the great end to which so much marvelous mechanism is chiefly adapted, such mechanisms as hairy corollas to protect the nectar from the rain for the insect's benefit, spots of bright color or heavy veining to act as "honey guides" for insects, etc. Smaller bees, puddle butterflies, and flies are only pilferers as they do not come in contact with the pollen. Sprengel believed the insect caused the flower to fertilize itself, hence the wild geranium was a very poor plant for his studies as it guards itself against that very thing by maturing the stamens before the stigma is ready for the transfer of pollen.

It is a plant which shoots, for when the seeds are ready to be spread abroad, the pod, under a process of drying out, sets a spring, the trigger is pulled and the seeds are catapulted some distance.

Legend tells us that the geranium is a miracle-made descendent of the mallow. It relates that once the prophet Mohammed had occasion to wash his shirt on the bank of a stream. He then laid it on some mallow to dry. When they discovered the fact that theirs was the honor of supporting the garment of the Prophet, they blushed at the thought of such distinction and turned forthwith into geraniums, which they have remained ever since.

An extract from the root of the eastern species (G. maculatum) is used in medicine as an astringent.

Near relatives of the geranium are the common nasturtium and the garden balsam. In California the nasturtium often escapes and turns canyon floors into a kaleidoscope of color.

Polygonaceae (Buckwheat Family)

These plants are world-wide in distribution, the larger forms preferring the warmer climates. There is a strong tendency to the formation of red pigments in the stems and leaves of these plants. The sepals are often colored and petal-like. The fruit is an akene which is usually three-angled.

Buckwheat is extensively raised in the eastern United States, Europe, and parts of Asia. Since it can be grown of very poor soil, it is a valuable crop where no other crop is profitable. The large

petioles of the rhubarb are known throughout the world for pies and preserves. Many of the species are valuable as a source of honey.

Eriogonum sp. (Wild Buckwheat, Sulphur Plant, Umbrella Plant)

The scientific name comes from the Greek "erion", wool, and "gonu", knee, on account of the woolly and jointed stems.

It belongs to the open and dry places, usually a part of the undergrowth in the sagebrush regions. It invades the Mohave Desert and clings to the mountain slopes of Death Valley as part of the desert scrub.

The seeds are much like those of the cultivated buckwheat and form a source of food for the many birds of the Park. Chipmunks are also very fond of these seeds as well as the berries of the juniper.

It blossoms during July and the first part of August, and is beautiful whether in bud, full bloom, or after it has turned red and gone to seed.

Pyrolaceae (Wintergreen Family)

Pyrola sp. (Pink Pyrola, Pear-leaved Wintergreen)

The name Pyrola is diminutive of the Latin "pyrus", the pear tree, from the similarity of the leaves. The name wintergreen is given because of the evergreen leaves.

If one knows the "secret paths that thread the forest land", they will find this fragrant flower growing in the deep, shady woods, usually in a bed of moss beneath the spruce tree where it is sheltered from the wind and sun.

The green-flowered wintergreen is found in the dry woods among the moss, and always in the shade. It, too, has a faint odor, and in common with all the pyrolas, is an evergreen. All Pyrolas are lovers of cool northern and mountain woods of North America, Europe and Asia.

Umbelliferae or Ammiaceae (Parsley or Carrot Family)

A large family which is widely distributed but more abundant in the North Temperate Zone. The plants are herbaceous and the flower is umbel. The fruit is a schizocarp and is characteristic of this family.

Of the vegetables found in this family, carrots, parsnips and celery are the most important. Volatile oils, resins, etc., are produced in glands in the bark, leaves and fruits, and give the plants their fragrance. Caraway, dill and anise are used for flavoring. Angelica, carum oil, conium, asafetida and numerous other medicinal products are produced by this family. Angelica, cow parsnip, wild parsley and carrot are fine forage plants. Several species are poisonous, especially conium or poison hemlock.

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Contrary to the belief that the common garden parsnip if it escapes from cultivation is poisonous, it has often been proven that the plant is harmless.

Cicuta sp. (Parsnip, Poison Parsnip, Water Hemlock)

This plant is closely related to the comium, the plant from which they made the cup of hemlock for Socrates. It grows from a rootstock to which are attached roots, which may be small or may take the form of a group of thick, fleshy tubers. A longitudinal section through the rootstock shows a more or less distinct series of transverse chambers. It has been commonly thought that the tops when found in hay would poison stock, but it is the young shoots found in the spring or the root which contains the poison, mature tops and seeds never occasion poisoning. The loss among animals is mainly of cattle. Violent convulsions usually accompany poisoning. The poison hemlock yields not less than five per cent of conin. It is found in the fruit which should be gathered in August or September and stored in tight cans or boxes. It is not fitted to be used for more than two years. It is a very poisonous drug and is used in excited conditions of the nervous system and in rheumatism, neuralgia and asthma. The leaves are also employed medicinally.

Carum gairdneri (Caraway)

This plant closely resembles queen's lace but is a smaller plant with much finer leaves. It inhabits the dry regions of the Park, while true wild carrot or queen's lace is not found in the Park.

The name is derived from Carra, a country in Asia Minor, where it was first found.

Saxifragaceae (Saxifrage Family)

These plants are found mainly in the temperate zones, but may extend to the arctic regions. They are mostly perennial herbs or shrubs. The fruit is a capsule, follicle or berry.

Many of the members of this family are used as ornamental shrubs, others, as the currants and gooseberries, are a source of food. Among the currants are those which serve as an alternate host for the white pine blister rust.

Parnassia sp. (Grass of Parnassus)

This flower was named by the Greeks for their much-loved Mount Parnassus.

The flower is more like a delicate white buttercup than a grass. The petals are velvety and star-shaped and it was perhaps just such flowers as these which inspired Emerson to ask:

"Why Nature loves the number five,
And why the star-form she repeats?"

The European species which is told in fable to have sprung up on Mount Parnassus, is found also in the Canadian border states and northward.

Campanulaceae (Bellflower Family)

These plants are herbs with milky juice and alternate leaves. The flowers have five petals which are grown together in the shape of a bell. They grow throughout the northern hemisphere.

Campanula rotundifolia (Harebell, Bluebell of Scotland, Lady's Thimble, Witches Thimble)

The last two common names are English names and are not used in this country. The name is diminutive of the Latin "campana", a bell, referring to the corolla.

This plant is at home throughout the northern hemisphere. In America it is found as far south as the Mason and Dixon line in the East, to Arizona in the Rockies and to California in the Sierras.

Poets in every age have sung of this flower, which is the real Bluebell of Scotland, the favorite floral emblem of the "Land o' cakes and brither Scots", for, as the old song says:

"Let the proud Indian boast of his jessamine bowers,
His pastures of perfume, and rose-colored dells,
While humbly I sing of those wild little flowers,
The bluebells of Scotland, the Scottish bluebells."

The name "rotundifolia" refers to the roundish basal leaves of the plant which wither early, while the stem leaves, which are numerous, narrow and pointed, remain. The buds grow erect but the full-blown blossoms droop.

The common term "bluebell" is usually reserved for the wild hyacinth, or for Mertensia.

Labiatae (Mint Family)

This family has been recognized for centuries by its distinctive fragrance and appearance. The plants are of world-wide distribution. They are mostly herbaceous and the stems are usually square. The leaves are abundantly supplied with glands which secrete volatile oils. This group of plants is valuable for the volatile oils which are used in flavoring and medicine. Such oils as peppermint, catnip, hoarhound, thyme, sage, hedeoma and scutellaria are obtained from these plants. They also yield an abundance of nectar.

Prunella vulgaris (Self-heal, Heal-all, Blue Curls, Heart of Earth, Brunella)

It is found distributed over three continents: North America, Europe and Asia, where it grows abundantly in the grassy meadows, fields, and along roadsides, alpine streams and

waste places. It is usually an immigrant to this country (though also native), where it has readily adapted itself to the new environment because of the facility it offers insects to secure food, the quantity of fertile seed which it is thereby able to produce and its unusually long flowering season.

In England where the flowers are deeper hued, the heal-all is a rich purple.

This plant, which was called Prunella by Linnaeus, is more significantly named Brunella, because it is supposed to contain a remedy for die Braune, or the quinsy, and hence some ancient German botanist called it Brunellen.

Gentianaceae

These plants, although of wide geographic distribution, are most abundant in the temperate zones. They are practically all herbaceous, with a juice which is very bitter, making them unpalatable for livestock. The leaves are opposite and without stipules and mostly sessile. The fruit is usually a many-seeded capsule.

Formerly a great deal of importance was attached to the medicinal qualities of these plants, but their greatest value probably lies in the beauty and abundance of their flowers.

Gentiana elegans (Rocky Mountain Fringed Gentian)

These beautiful flowers are found on the geyser basins early in June, but appear in the alpine meadows as fall approaches. They are extremely elusive flowers, seldom reappearing in the same place for two consecutive years, since, being annuals, and therefore perpetuated by seed alone, their reappearance the following season depends altogether upon the direction of the wind which blows the little hairy scales hither and thither and by good fortune deposits a fewwhere the moist earth enables them to germinate.

They are named in honor of King Gentius of Illyria, who is said to have discovered the medicinal value. The gentian of the drugstore is the dried rhizome of the yellow gentian of Europe and is used in making tonics and bitters.

In dark weather this sunshine lover remains shut. In order to insure cross pollination the stamens mature and lose their power of fertilization before the pistils are developed. The fringe of the gentian not only adds grace to the flower, but is a protection against the pilfering of ants.

Because this flower is so rarely beautiful that few can resist the temptation of picking it, and an annual which is easily uprooted, it is becoming rarer each year. If extermination is to be avoided it must be left to propagate itself. In 1926 it was made the Park Flower.

In Switzerland, where they grow in profusion, as many as fifteen species have been gathered in a half-hour walk. There the pastures are spread with the sheets of blue.

The Rocky Mountain fringed gentian differs from the fringed gentians of the eastern part of our country in two respects; ours is a deeper blue, almost a violet, and the fringe is not so deep.

Apocynaceae (Dogbane Family)

Most of the members of this family are herbs with an acrid, milky juice. The leaves are entire and opposite and the petals of the flowers are grown together. The fruit is a follicle.

Apocynum androsaemifolium (Dogbane, Spreading Dogbane, Fly-trap Dogbane, Honey-bloom)

The scientific name comes from the Greek "apo", and "kyon" a dog, for some species are said to be poisonous to dogs.

In some places in British Columbia the plants cover hundreds of acres with their spreading green-leaved branches and pink lily-of-the-valley-like flowers. The tiny pink veins on the corolla serve as guides to insects so that they may find the nectar-bearing glands hidden at the base of the pistil. But not all insects are welcomed by this flower and those that are not, such as flies and some moths, are often found dangling by their tongues from the vice-like grip of this plant. He is held a prisoner by the horny teeth of the trap in the inside of the corolla until he finally dies of starvation. Thus they pay the penalty for poaching on the butterflies' rights.

This is one of the many plants which Henry Ford and others have been working with to determine how much rubber it is possible to extract from the milky juice. So far they have succeeded in getting a yield of about 5 per cent of good rubber. The plant also has some medicinal value and will blister the skin of many people.

Caryophyllaceae (Pink Family)

These plants are of world-wide distribution but are more numerous in the North Temperate Zone. They are all herbaceous and have opposite leaves. The fruit is a dehiscent capsule, with free central placenta. These plants are chiefly valuable for their flowers. They are unpalatable to livestock and many members are objectionable weeds.

Cerastium arvense (Field Mouse-ear, Chickweed, Star of Bethlehem)

The name is derived from the Greek "kera", a horn, and refers to the shape of the pod.

This plant is common on sunny banks and in dry meadows during June and July.

All chickweeds are white and like the meek, they inherit the earth. Their varying methods of cross and self fertilization have resulted in their following closely in the footsteps of man's civilization. Like most immigrants, that have undergone ages of selective struggle in the Old World, it successfully competes with our native blossoms by readily adjusting itself to new conditions, filling places unoccupied chiefly by prolonging its season of bloom beyond theirs to get relief from the pressure of competition for insect trade in the busy season.

Sir Joseph Hooker says: "Upon one occasion landing on a small uninhabited island nearly at the Antipodes, the first evidence I met with of its having been previously visited by man was the English chickweed; and this I traced to a mound that marked the grave of a British sailor, and that was covered with the plant, doubtless the offspring of seed that had adhered to the spade or mattock with which the grave had been dug.

One species (C. alpinum) has been found as far north as the 73rd degree.

Onagraceae (Evening Primrose Family)

These plants are most abundant in the sub-tropical portions of the western hemisphere. They are nearly all annual herbs. The fruit is a capsule which is borne below the flower.

Fireweed is the only one of this group which is palatable to livestock. The cultivated plants which belong in this family are the evening primroses, Fuchsias and Clarkias.

Epilobium or Chamaenerion angustifolium (Fire-weed or Willow-herb, Blooming Sally)

Because this is one of the first plants to take advantage of a region which has been swept by fire and thereby turn acres of land which is desolate and charred into a garden of flaming beauty, this plant is called the fireweed. The leaves so closely resemble those of the willow that it is known as willow-herb.

In the fall the leaves take on the tints of the flames which swept the land previously. Whole mountainsides in Alaska are dyed crimson with it. If there is no burned or logged-over area for it to adorn, it will take to the fallow fields and dry roadsides.

It is not only found in America but in Europe and Asia. The seeds are provided with a parachute much like the one the milkweed has, and their distance of flight is limited only by the velocity and duration of the winds.

The Greek name comes from "epi", on, and "lobion", a little pod, and probably refers to the flower parts which are borne upon the pod.

FLOWERS OF YELLOWSTONE NATIONAL PARK (OLD FAITHFUL AREA) Albertson

"Strange flower, thy purple making haste
To glorify each blackened waste
Of fire-swept land
Is with a blessed meaning fraught,
And we, when pain hath fully wrought,
Shall understand."

Oenethera sp. (Evening Primrose, Night Willow-herb, Sun-cups)

A flower of the "Great White Way of the Flower City" and therefore a night reveler whose dissipated and dejected appearance the following day are readily detected by the drooping, bedraggled petals, is the evening primrose. Between 5 and 7 o'clock in the evening this flower maiden prepares to meet her admirers. Her dressing does not take as long as the typical ballroom belle, for in thirty seconds she may be ready, although some authorities claim it takes five to seven minutes, for the lightning change to take place. She is dressed in a lovely lemon-yellow and perfumed with the most seducive of odors; indeed a rare beauty.

Often only one flower is open on a single stalk. If no visitors come that night, an open house is maintained in the morning for a couple of hours until some bee or humming bird comes to pollinate the flower. After several flowers on the stalk have been pollinated, the flowers may remain open the greater part of the day.

The day following the night of revelry, the flower presents a very forlorn and dejected appearance, the corolla wilts, hangs on for a while and then drops off leaving a long seed pod.

The younger flower buds point earthward, but on the day they are to open they take an upward direction, and thus one can tell the next to blossom. These flowers are usually pollinated by hawk-moths, and are believed to be guided to the flowers by the radiance which they shed in the dusk. The blossoms were formerly believed to be luminous at night, shining by the sunlight stored in the daytime. The hairs which are directed upward in the tube of the corolla keep pilfering insects from stealing the nectar.

This plant is found along road sides, in dry fields, thickets and along old fences. It is as much at home in Labrador as in Florida.

"A tuft of evening primroses
O'er which the mind might hover till it dozes,
But that it's ever startled by the leap
Of buds into ripe flowers."

The young roots are edible and used either pickled or boiled. It is also used like celery in salads, and is useful as a tincture in medicine.

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Liliaceae (Lily Family)

This family includes many of our splendid ornamental plants. They are distributed over the entire world and are found in the most humble homes and in the most palatial mansions of the world. They are nearly all perennial or biennial herbs reproducing from bulbs, corms, rootstocks or seed. Most of the bulbs and corms serve only for food storage. The fruit is a three-sided capsule.

Their chief value, aside from the esthetic, is as a source of food for our use, such bulbs as onions and camas belonging in this family.

Allium sp. (Wild Onion. Various species have different names)

The word "allium" is a Latin name for garlic.

At least six different kinds of onion are found in the Park, but only one, the Siberian onion or purple garlic, has hollow stems and leaves like the cultivated onion. It is frequently cultivated in gardens for the beautifully colored blossoms.

Convallariaceae (Lily-of-the-Valley Family)

These plants are much like the Liliaceae with which they are often included, differing mainly in the fruit, which is a berry. Some members of this family are much cherished as flowers, while asparagus is grown extensively as a vegetable.

Vagnera sp. or Smilacina (False Solomon's Seal, Wild Spikenard, Solomon's Zig-zag).

The foliage resembles both the true Solomon's seal and the twisted stalk, but the flowers are in close terminal spikes and are open like a star, while those of the others are bell-shaped and arranged in the axils of the leaves. It closely resembles the lily-of-the-valley and many species are fragrant like it.

The berries are at first green with dark stripes and become red or black when ripe. Birds are glad to find them when they wander through the woods with their hungry late broods in the fall.

Orchidaceae (Orchid Family)

The climax development of the monocotyledons is reached in this family which has the highest development of flower parts known. This is the largest family except the Compositae (Asteraceae) and, when the tropics have been fully explored, may exceed that group. There are about 9,000 known species and most of them are tropical or subtropical. They are the most cherished flower known, but unfortunately are sensitive to abuse and easily exterminated by the ruthless flower picker. They are perennial herbs, mostly terrestial and green, but a considerable number are epiphytic with aerial roots, while some are saprophytes.

FLOWERS OF YELLOWSTONE NATIONAL PARK (OLD FAITHFUL AREA) Albertson

The most peculiar thing about the flower is the fact that the three stamens and the pistil have grown together. The specialization of this flower is not exceeded anywhere in the plant kingdom.

Limnorchis borealis or Habenaria (Wild Orchid, Wild Rein Orchis)

The name comes from the Greek "limne", a swamp or pool, and "orchis", the Greek name of some of these plants. They are abundant in the swamps throughout most of the Park during the early and middle part of the season, often growing in great profusion with little elephant.

Not for man, but for the bee, the moth, and the butterfly are the orchids where they are and what they are. As wonderfully constructed as the most costly exotic in a millionaire's hothouse, is this tall spike of delicately perfumed flowers.

Corallorhiza innata (Coral-Root)

Derived from the Greek "korallion", coral, and "riza", a root, on account of the knotted, fungus-bearing roots (really rhizomes). The coral-root is a saprophyte, and is a degenerate of the orchids. When the coral-root refused to manufacture its own upbuilding materials out of the carbon dioxide of the atmosphere, and proceeded to prey upon decaying matter, Nature took away its leaves and chlorophyll and only left it sufficient branching extensions at the base to secure it in the soil.

Asteraceae (Aster Family) (Compositae)

This is the largest and the highest of all the plant families and is of world-wide distribution. Its members are nearly all herbaceous. The flowers are arranged in a head subtended by an involucre, an arrangement which insures a greater cross-pollination. The fruit is generally a simple akene which is often provided with bristles or pappus to help in the dispersal of seeds.

The family as a whole is very valuable as forage although some species are poisonous and others are troublesome weeds. Many drugs are obtained from this group being exceeded only by the Solanaceae. Several kinds of sagebrush shed pollen that causes hay fever. Many of the members of this family are given a prominent place for decorative purposes.

Aster sp. (Aster - the name varies with the species)

Like its cousin, the thistle, and like the daisy and the sunflower, the Aster is one of the most civilized of flower peoples; so well have they adapted themselves to the necessity of varying environment that they have been able to travel around the earth and to make themselves at home wherever they go. They ask odds of nobody. Through countless generations they studied the best methods of insuring their survival against the fiercest competition, and finally developed the idea of the composite flower. Today they are the people of the land with a vision. The daisy army transforms millions of acres into white and gold in summer,

while the aster and goldenrod proclaim their triumph through millions of acres of blue and yellow.

There are 120 species of aster in the United States and the greatest part of the 250 species known to scientists are to be found in North America.

A more common English name is Michaelmas Daisies, because they bloom at the feast of Saint Michael according to

"The calendar,
Faithful through a thousand years
Of the painted race of flowers,
Exact to days, exact to hours."

Achillea millefolium (Yarrow, Milfoil, Old Man's Pepper, Nosebleed)

Chiron, the centaur, who taught its virtues to Achilles so that he might make an ointment to heal his wounded Myrmidens after the siege of Troy, named the plant for this favorite pupil. The name milfoil comes from the very fine foliage which it possesses. It is a plant found growing along the waysides of the world. It is also known in the mythology folk-lore, medicine and literature of many peoples. It has served as a love-charm, a cure for diverse ills from loss of hair to ague, to induce nosebleed following a congested headache, as an ingredient of an especially intoxicating beverage made by the Swedes, and many other things referred to in old books. A girl will wrap it in a piece of flannel and put it under her pillow, repeating some verse supposed to charm. The next day it is to be put in her shoe and then guides her footsteps to her future husband. The first single man she meets is supposed to be the one the yarrow points out.

More than 120 species of insects have been reported to have visited a watched plant in a single day. It certainly has a world-wide reputation, not only in the realm of human beings, but in the insect world as well.

Balsamorhiza sagitatta (Balsam-root)

The name is derived from the Greek "balsamon", balsam , and "rhiza", a root, for the root is very aromatic, tasting and smelling like balsam. It grows abundantly in the semi-arid regions of the West and is one of the finest forage plants which we find in the spring and early summer. The hillsides around Mammoth are fairly golden with the abundance of bloom of these plants in June and July.

Arnica sp. (Arnica - the name varies with the species, although all are called Arnica)

The name is said to be from the Greek "arnakis", meaning a lamb's skin, and refers to the softness of the heads.

FLOWERS OF YELLOWSTONE NATIONAL PARK (OLD FAITHFUL AREA) Albertson

Some of the Arnicas are medicinal while others are poisonous. Some species are in blossom throughout the entire season in Yellowstone Park for so many kinds are found here. Many of the species are tall, handsome plants, while one has no ray flowers at all. The arnica which is used to heal and soothe sprains and bruises comes from the plant, Arnica montana, and is extracted from the flower as well as the root.

Senecio sp. (Ragwort or Groundsel)

The name Senecio comes from the Latin "senex", an old man, and refers to the hoary heads of some species. The most beautiful one found here is the golden ragwort and is the first one to blossom around Old Faithful.

Other species are rank-growing weeds filling the swampy regions of the entire park. They all have yellow flowers of various hues and are largely distinguished by their foliage.

Antennaria sp. (Includes Pussy Paw, Cat's paw, Indian Tobacco, Cudweed, Pink Everlasting).

The pappus bristles of the sterile flowers suggest the antennae of insects, hence the name Antennaria. They are readily recognized by their dry, papery-like, little flowers and their silky, whitish leaves.

One species, Antennaria lanata, grows at the great altitude of 8,000 feet, somewhat resembling the Edelweiss of the Alps, and is the nearest approach to that flower found on this continent. It is known as the arctic antennaria or everlasting. It grows close to perpetual snow.

The pink everlasting is conspicuous by its rosy, crackling flowers with silky centers and woolly stems and leaves. They often grow to be a foot high and are found in the same localities as the white species.

Anaphalis margaritacea

The name Anaphalis comes from the Greek meaning "not", and "knaphalon", meaning a lock of wool, because the heads are chaffy rather than woolly.

Being absolutely dependent upon insects for fertilization, this plant protects its pollen from pilfering insects by the cottony substance on the wiry stems, a device also employed by the thistles.

If picked and carefully kept in a vase, these flowers will remain fresh-looking for months.

The flowers are sweet-scented and pearly white, hence the name pearly everlasting.

FLOWERS OF YELLOWSTONE NATIONAL PARK (OLD FAITHFUL AREA) Albertson

Erigeron sp. (Fleabane - names vary with the species)

The name comes from the Greek "er", meaning spring, and "geron", an old man, for some of the early species are very hoary and many of the species grow hoary-headed after they have been fertilized by the insects which crawl over them. That any of these plants drive away fleas, is believed only by those who have not used them dried, reduced to powder, and sprinkled in kennels, from which, however, they have been known to drive away dogs.

Nineteen or more species of fleabane are to be found in Yellowstone Park, and since they are not readily distinguished from the asters, the groups are rather difficult to distinguish from one another. The fleabanes differ from the asters in one very essential particular, the rays of the former are much narrower and very much more numerous than those of the asters. In the fleabanes the rays form a very thick fringe around the edge of the flowers. As a rule the fleabanes bloom earlier than the asters, but this does not always hold true in this region where the seasons are not well marked.

Solidago sp. (Golden-rod - Names vary with species, determined mainly by habit).

The name Solidago comes from Rome, where they thought the golden-rod possessed healing qualities of such strength that it well might be called the "makes-whole" plant.

Some 85 species are to be found and they have invaded not only Mexico, but some have even gone into South America to live. They are cultivated in Europe, but in our country they are able to shift for themselves and have spread over the entire continent, growing in moist woods and thickets, along shady roadsides, in open meadows, along the seashore, in swamps and bogs, in the sunshine, shade or dust. It is one of the most conspicuous and beautiful of all the flowers of autumn; their bright yellow color seeming to retain the last warm rays of the summer sun.

"The Golden-rod lights slowly
Its torch for the Autumn blaze."

Some species grow to a height of six feet, others are almost prostrate forms of the alpine valleys; some are slender-stemmed, some have a stout woody support, some bear great panicles of golden bloom, while others have only a few blossoms clinging closely to the stem.

Fields of golden-rod are an entomologist's paradise, for hovering about these flowers or crawling over the clusters of florets may be found any number of insects. These flowers have adapted themselves so perfectly to conditions that they are almost sure of pollination. Sparrows, finches, buntings, juncos, and other seed-eating birds congregate about the banquet table which this flower offers when the fields become sear and brown.

One species is fragrant and makes a very delightful drink. Some species are poisonous to livestock.

In the days of Queen Elizabeth, the golden-rods had a great reputation for healing properties and were imported into England in considerable quantities and sold in the markets of London in the powder form for half a crown a pound. By action of the legislature it is the state flower of Nebraska, and by the vote of school children it is the representative of Alabama.

Helianthus and Helianthella (Sunflower)

Innumerable are the flowers which might well bear the name which is derived from the Greek "helios", the sun, and "anthos", a flower. One ninth of all the flowering plants in the world belong in the aster family.

"The ancient Greeks believed that the Helianthus was the incarnation of the nymph Clytie, who by reason of her great love for Apollo sat for nine days upon the ground intently gazing at the orb of day, until at length she became rooted to the earth and her face was transformed into the shining disk of the sunflower."

"When the Spaniards first visited Peru, they found it as much the national flower of the Incas as it today is the State flower of Kansas. The Incas gave it a deeper reverance because of its resemblance to the radiant sun. In their temples the priestesses wore sunflowers on their bosoms, carried them in lieu of tapers, and otherwise used them in their services. The Spanish invaders found many images of sunflowers wrought with exquisite workmanship in pure gold. These wonderful images, among many others, helped to excite the cupidity of the conquistadors and thus to bring about the downfall of the Incas."

When Champlain and Segur visited the Indians who lived along the eastern shores of Lake Huron about three centuries ago, they saw them cultivating this plant, which must have been brought from the native prairies west of the Mississippi. It was used much the same as bamboo, serving many and varied purposes. From the stalk they obtained a fiber used in textiles, the leaves they used for fodder, the petals furnished a yellow dye, the seeds furnished food and hair oil. But its uses are not confined to America alone, for in other countries into which it has been introduced it has many other uses. In China the fiber is used as an adulterant of silk, in southern Russia the seeds are used in making oil and are eaten as we eat peanuts. Much of the oil is also used in making soap and candles. It is the most important oil used in Russia and is a finer type of oil than many other oils. No oil will retain its original sweetness and not become rancid as does this oil; it also has a very low melting point, 12 degrees below zero. This plant is cultivated in Europe, Asia and Africa. The seeds of the sunflower were carried to Spain as early as the middle of the 16th century and from there to all parts of the Old World. All of the sixty known species of wild sunflowers are North American.

LATIN AND COMMON NAMES OF SOME YELLOWSTONE PLANTS

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1.	Abies lasiocarpa	Alpine fir
2.	Acer glabrum	Mountain maple
3.	Achillea millefolium	Yarrow
4.	Aconitum columbianum	Monkshood
5.	Actaea arguta	Baneberry
6.	Agoseris	Goat dandelion
7.	Allium	Wild onion
8.	Alnus tenuifolia	Mountain alder
9.	Alopecurus aequalis	Foxtail
10.	Amelanchier	Serviceberry (Sarviceberry)
11.	Anaphalis	Everlasting
12.	Androsace	Blue primrose
13.	Anemone globosa	Anemone, windflower
14.	Angelica pinnata	Wild parsnip
15.	Anogra Nuttallii	White evening primrose
16.	Antennaria	Pussy Paws
17.	Apocynum androsaemilolium	Dogbane
18.	Apocynum cannabinum	Dogbane
19.	Aquilegia flavescens	Columbine
20.	Arabis	Rockcress
21.	Aragallus	Locoweed
22.	Arceuthobium americanum	Pine mistletoe
23.	Arctostaphylus uva-ursi	Kinnikinnick, Bearberry
24.	Arenaria	Sandwort
25.	Arnica	Arnica
26.	Artemisia	Sagebrush
27.	Asplenium	Spleenwort fern
28.	Aster	Aster
29.	Astragalus	Vetch
30.	Balsamorrhiza sagittata	Balsam root
31.	Batrachium	Water crowfoot
32.	Berberis repens	Oregon grape, Mountain holly
33.	Betula glandulosa	Mountain bog birch
34.	Betula fontinalis	Mountain birch
35.	Botrychium Coulteri	Grape fern
36.	Caltha rotundifolia	Marsh marigold
37.	Calypso bulbosa	Spring orchid
38.	Camassia esculenta	Blue camass
39.	Campanula rotundifolia	Harebell
40.	Capsella bursa-pastoris	Shepherd's purse
41.	Carex	Sedge
42.	Carum gairdneri	Wild caraway, Queen's lace

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43.	Castilleia	Indian paintbrush, painted cup
44.	Ceanothus velutinus	Mountain mahogany
45.	Cerastium	Mouse-eared chickweed
46.	Chaenactis	?
47.	Chamaenerion augustifolium	Fireweed
48.	Chenopodium	Pigweed
49.	Chimaphila umbellata	Pipsissewa
50.	Chrysopsis	Golden aster
51.	Chrysothamnus	Rabbit brush
52.	Cirsium	Leafy thistle
53.	Cicuta occidentalis	Water hemlock
54.	Claytonia lanceolata	Spring beauty
55.	Clematis Douglasii	Leather-cup
56.	Clematis ligusticiofolia	Virgin's bower
57.	Clematis occidentalis	White clematis
58.	Cleome pungens	Rocky Mountain bee plant
59.	Cogswellis platycarpa	Wild parsnip
60.	Collinsia parviflora	Two-lips
61.	Collomia linearis	Collomia
62.	Corallorhiza	Coral-root
63.	Cornus instolonea (C.stolonifera)	Red osier dogwood
64.	Corydalis aurea	?
65.	Crepis	Hawksbeard
66.	Cryptogramma acrostichoides	Parsley fern
67.	Cryptanthe	Crypthanthe
68.	Cystopteris fragilis	Brittle fern
69.	Disporum trachycarpum	Fairy bells
70.	Delphinium cucullatum	Delphinium, larkspur
71.	Delphinium Nelsonii	" "
72.	Delphinium Nuttallianum	" "
73.	Dodecatheon pauciflorum	Shooting star
74.	Drymocallis	?
75.	Elymus	Lime grass
76.	Epilobium	Willow-herb
77.	Equisetum	Horse tail, snake grass, joint grass, scouring rush
78.	Erigeron	Fleabane
79.	Eriogonum	Wild buckwheat
80.	Erysimum	Wall flower
81.	Erythronium grandiflorum	Dog-tooth violet
82.	Fragaria	Strawberry
83.	Frasera speciosa	Green gentian
84.	Fritillaria atropurpurea	Spotted lily
85.	Fritillaria pudica (Ochrocodon)	Yellow bells
86.	Gaillardia aristata	Sunflower
87.	Galium	Bedstraw
88.	Gentiana affinis	Blue gentian
89.	Gentiana elegans	Fringed gentian
90.	Gentiana plebeja	Lavender gentian
91.	Geranium Richardsoni	White geranium, cranesbill
92.	Geranium viscosissimum	Red geranium, Cranesbill

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93.	Geum strictum	Avens
94.	Gilia	Gilia
95.	Gnaphalium thermale	Everlasting, strawflower
96.	Grindelia subalpinum	Gumweed
97.	Halerpestes cymbalaria	Trailing buttercup
98.	Helianthella quinquenervis	Little sunflower
99.	Helianthus	Sunflower
100.	Heracleum lanatum	Cow parsnip
101.	Heuchera	Alum-root
102.	Hydrophyllum capitatum	Water-leaf
103.	Iris missouriensis	Iris, flag, fleur-de-lis
104.	Juncus	Rush
105.	Juniperus scopulorum	Rocky Mountain cedar
106.	Juniperus sibirica	Trailing juniper
107.	Kalmia polifolia	Swamp laurel
108.	Lappula	False forget-me-not, stickseed
109.	Ledum glandulosum	Labrador tea
110.	Lemna	Duckweed
111.	Lepidium Apetalum	Pepper-grass
112.	Lewisia	Bitter-root
113.	Limnorchis boralis	Marsh orchid
114.	Limnorchis viridiflora	Marsh orchid
115.	Linnaea americana	Twinflower
116.	Linum Lewisii	Wild flax
117.	Listera nephrophylla	Twiblade
118.	Lithospermum	Stoneseed
119.	Lonicera	Honeysuckle
120.	Lupinus	Lupine, Texas bluebonnet
121.	Lycopodium annotinum	Club moss
122.	Lysiella obtusata	Orchid
123.	Machaeranthera pulverulenta	Prickly aster
124.	Melilotus officinalis	Sweet clover
125.	Mentha canadensis	Field mint
126.	Mentzelia	Stickleaf
127.	Mertensia	Chiming bells
128.	Mimulus Langsdorfii (M.guttatus)	Yellow monkey-flower
129.	Mimulus Lewisii	Red monkey-flower
130.	Mimulus moschatus	Yellow monkey-flower
131.	Mitella pentandra	Mitrewort, bishop's cap.
132.	Moneses uniflora	Wintergreen
133.	Monotropa hypopitys hirsuta	Indian pipe
134.	Montia chamissonis	Miner's lettuce
135.	Myosotis alpestris	Forget-me-not
136.	Myosurus apetalus	Mousetail
137.	Myriophyllum spicatum	Water milfoil
138.	Nuphar polysepalum	Water lily (yellow)
139.	Oenothera strigosa	Yellow evening primrose
140.	Opuntia polycantha	Prickly pear cactus
141.	Orthocarpus luteus	Owl clover
142.	Osmorrhiza	Sweet cicely

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143.	Oxyria digyna	Mountain sorrel
144.	Pachylophus caespitosus	Stemless evening primrose
145.	Pachystima myrsinites	Staff tree
146.	Parnassia	Grass of Parnassus
147.	Pedicularis bracteosa	Yellow lousewort
148.	Pedicularis cystopteridifolia	Red lousewort
149.	Pedicularis contorta	White lousewort
150.	Pedicularis groenlandica (P.surrecta)	Little elephant
151.	Penstemon	Beardtongue
152.	Phacelia	Water-leaf
153.	Phlox	Phlox
154.	Phyllodoce empetriformis	Mountain heath
155.	Physaria didymocarpa	Bladderpod
156.	Physocarpus malvaceus	Ninebark
157.	Picea Engelmanii	Engelman's spruce
158.	Picea Engelmanii var. pungens	Colorado blue spruce
159.	Pinus albicaulis	Whitebark pine
160.	Pinus Flexilis	Limber pine
161.	Pinus murrayana latifolia	Lodgepole pine
162.	Plantago major	Plantain
163.	Polemonium occidentale	Polemonium, skunk plant
164.	Polemonium parvifolium	Jacob's ladder
165.	Polygonum bistortoides	False bistort
166.	Populus augustifolia	Narrow-leaf cottonwood
167.	Populus balsamifera	Balsam poplar
168.	Populus tremuloides (aurea)	Quaking asp, quivering aspen
169.	Potamogenton	Pond weed
170.	Potentilla fruticosa	Shrubby cinquefoil
171.	Potentilla	Cinquefoil
172.	Prunella vulgaris	Heal-all
173.	Prunus melanocarpa	Choke cherry
174.	Pseudotsuga taxifolia	Douglas fir
175.	Pteridium aquilinum	Bracken fern, brake
176.	Pterospora andromedea	Pinedrops
177.	Pulsatilla hirsutissima	Pasque-flower
178.	Pyrola	Wintergreen
179.	Ranunculus	Buttercup
180.	Rhus trilobata	Sumac
181.	Ribes cereum	Squaw currant
182.	Ribes Hudsonianum	White-flowered currant
183.	Ribes setosum (saximontanum)	Wild gooseberry
184.	Ribes viscosisimum	Wild currant, sticky c.
185.	Roripa hispida	Marsh cress
186.	Rosa	Rose
187.	Rudbeckia occidentalis	Rayless coneflower
188.	Rubus strigosus	Raspberry
189.	Rubus parviflorus	Thimbleberry
190.	Rumex	Dock
191.	Sagittaria arifolia	Arrowleaf
192.	Salix	Willow

LATIN AND COMMON NAMES OF SOME YELLOWSTONE PLANTS — Yeager-Arnold

193.	Salsola pestifer	Russian thistle
194.	Sambucus melanocarpa	Elderberry
195.	Sarcobatus vermiculatus	Greasewood
196.	Saxifraga	Saxifrage
197.	Scirpus	Bullrush
198.	Scutellaria galericulata	Skullcap
199.	Sedum	Stonecrop
200.	Selaginella densa	Selaginella
201.	Senecio serra	Golden Alexander
202.	Senecio	Ragweed
203.	Shepherdia canadensis	Buffalo-berry
204.	Sieversia	Pink plume
205.	Silene	Catchfly
206.	Sisyrinchium	Blue-eyed grass
207.	Sium cicutaefolium	Water parsnip
208.	Smilacina	False Solomon's seal
209.	Solanum triflorum	Nightshade, wild tomato
210.	Solidago	Goldenrod
211.	Sorbus scopulina	Mountain ash
212.	Sparganium augustifolium	Burr weed
213.	Sphaeralcea rivularis	Globe mallow
214.	Spiraea lucida	Meadowsweet
215.	Spiranthes stricta	Lady's tresses
216.	Stellaria	Chickweed
217.	Stenotus caespitosus	?
218.	Streptopus amplexifolius	Twisted stalk
219.	Symphoricarpus occidentalis	Snowberry, buckbrush
220.	Symphoricarpus rotundifolius vaccinioides	Snowberry, buckbrush
221.	Synthyris Wyomingensis	?
222.	Taraxacum	Dandelion
223.	Taraxia	False dandelion
224.	Tellima	Fringe-cup
225.	Thalictrum	Meadow rue
226.	Thermopsis montana	Thermopsis
227.	Thlaspi	Wild candytuft, pennycress
228.	Tofieldia intermedia	False asphodel
229.	Townsendia Parryi	Large purple aster
230.	Tragopogon	Goat's beard
231.	Triglochin	?
232.	Trifolium	Clover
233.	Trollius albiflorus	Globe flower
234.	Typha latifolia	Cattail
235.	Urtica gracilis	Nettles
236.	Vaccinium	Huckleberry
237.	Valeriana	Valerian
238.	Verbena bracteosa	Verbena
239.	Veronica	Speedwell
240.	Vicia linearis caespitosa	Vetch
241.	Viola	Violet
242.	Woodsia	Rock fern
243.	Wyethia helianthoides	Giant white daisy, white sunflower
244.	Zygadenus	Death camass

THE ELEMENTS OF NATURE GUIDING

By Dorr G. Yeager, Park Naturalist

Approved by:
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The first trips which I conducted over Yellowstone Park trails back in 1925 were rather snickered at by the audiences when announcements were made at the lectures that such a trip would be conducted the following morning. Those days, however, are over, and we are entering a new era, an era in which the study of living things in their natural habitat is coming into its own. The Nature Guide is being looked up to more and more as one who understands and can interpret Nature in all her varied moods and changes. There is nothing "peculiar" about one who knows trees, birds and animals.

The elements of Nature Guiding - how many there are! A successful guide must be a psychologist as well as a scientist. He must be a poet, an artist, a story teller and an observer. He must be, as Enos Mills says "...entertaining, instructive, commanding and watchful, all without his party realizing it." He must be able to "... give an interesting biography of every subject considered - its name, classification and family being wholly secondary." A little incident comes to my mind in connection with Dr. H. S. Conard, one of the most successful Nature Guides I have ever known. While conducting a party from Camp Roosevelt one morning a tourist asked Dr. Conard the name of a certain grass. "That", replied the guide, "is commonly known as bunch grass. It is used for food by cattle and the deer, buffalo and elk use it a great deal here in the park." The tourist turned to Dr. Conard and exclaimed "Don't bluff. If you don't know the name of it why don't you say so?" Whereupon the guide, who is as much of a gentleman as he is a scientist, humbly begged the other's pardon. "This grass", he said, pointing to the one under discussion, "is Festuca branchyphylla. This is Gaillardia aristata, this Erythronium grandiflorum, this Helianthella quinquenervis, this is Fragaria platypetala, and this ...." The tourist blushed. "Never mind", he said, "I apologize for my rudeness."

To me this little story nearly sums up the true elements of Nature Guiding. Detailed knowledge without an attempt at show, courtesy and dignity, level headedness and a complete command of the situation at all times.

Let us look at the first element "Detailed knowledge without an attempt at show." The average tourist is keenly interested in the things about him. That interest, however, is quickly smothered by technical science. In my opinion it is as bad to try to impress your party with your knowledge of scientific names as it is to call a lupine a larkspur. True, they stand in awe of one who is able to speak of Euphorbia serpyllifolia without stuttering, or one who refers to an andesitic porphery with radial spherulitic inclusions, but to them it is overwhelming and they soon become self-conscious and bashful at their own

inabilities. I am not a chemist, I stand in awe when a chemist speaks of his compounds - and I have learned nothing. The statement has been made by Yellowstone guides that such language gives the party confidence in their guide. I disagree with that statement. It tends rather to make them lose confidence in him as a teacher. He is not teaching them anything except the fact that he can use big words, and Nature Guiding does not call for this use except on rare occasions. Far better to call a tree "Douglas fir" than "Pseudotsuga", because "Pseudotsuga" means nothing to the ordinary person. The common name, the name which the layman uses and is able to understand, is the name a Nature Guide should use. Not that the scientific name is not important - it is, and many a scientist has made a Nature Guide feel foolish because he did not know it, but save the technical science for the scientist and then talk to him in his own tongue.

And then we come to the next element, "Courtesy and dignity." I once knew a good student of Natural History who aspired to become a Nature Guide. He was ambitious, he knew Nature and he knew science but he was not a successful Nature Guide. Why? Because he was curt and short in his answers and because it was impossible for him to keep hishead when his word was disputed. He would argue a point with anyone and continue it throughout the whole trip. Such men make good debaters but poor Nature Guides. Many times during my days of Nature Guiding I have had an insane desire to commit manslaughter. I remember well one morning when a rabid Fundamentalist accompanied me on a trip. Not knowing, of course, that such a person was in the party, I launched forth on a discussion of the land snails along the trail, bringing in the evolution of the land snail from the water form. No sooner did she get the gist of my discussion than she became rampant and made the trip as disagreeable for the rest of the party as for me. It was not my place to argue the point with her so I answered her questions as politely as I could and let it go at that. On another occasion I was discussing the age of the formations and an elderly lady sprang to her feet exclaiming "Young man, you haven't studied your Bible!" I let her think so but was sorely tempted to make the same reply that one of the guides had the preceding year when a similar incident arose "Madam, you haven't studied your geology!" Courtesy and dignity, of course, go hand in hand. It is needless to emphasize the importance of dignity. Do not confuse dignity with high-hattedness. It is necessary to bring one's self to the intellectual level of those of the party in order to make them understand your statements but they will honor you more and have your confidence if you still retain the dignity of your position.

The third element is "Level headedness and a complete command of the situation at all times." This has been treated in the preceding paragraph. Dr. Conard in his discussion with the tourist was level headed and at the same time had complete control of the situation. Day after day on the trail a Nature Guide is called upon when an emergency arises. A woman faints from high altitude. Someone turns an ankle. Someone strays from the party and becomes lost. At such times as these everyone is ready to give suggestions, most of which are useless

and everyone has a different remedy for the situation. It is not an easy thing to keep such a situation well in hand but it is essential to good guiding.

And then we come to another element which the story of Dr. Conard and the tourist does not illustrate, a characteristic, nevertheless, which the former has and which is perhaps the most vital of all the points I have taken up. This element is a "Love of Nature itself." If you do not love Nature, if She does not fill you with a longing to know more of her secrets, if you do not thrill at a sunset, or a great tree, or the delicate lace of a spider web, you will never be a successful Nature Guide, as it is impossible to instil a love and interest for Nature into your party. And after all, I have come to the conclusion that that is the big thing. Many times on my return from trips I have sat down and gone over the experiences of the morning. I have asked myself "Did it start them thinking?" In those cases where an interest was not aroused, I felt the trip a failure. It matters not to me if they have learned what a wild geranium is, or whether they can distinguish a Clark's crow from a grasshopper. What does matter, is whether they have been left with an aroused interest in living things. Whether or not that interest has become so aroused that they will not stop at learning a wild geranium but will continue in this great field of knowledge and delve further and further into the mysteries of Nature. If the trip has instilled into them a desire to learn more I feel that it has been worth while and that much has been accomplished. It always gives me a feeling of satisfaction, and, it must be admitted, a little pride to see the same person with me several trips in succession.

Another important element is originality and a sense of humor. Many hikes are failures because of a lack of originality and humor. It is an easy matter to fall into the cut and dried form of hike where each object brings forth the same speech delivered on previous hikes in the same mechanical manner. It is an easy matter, but it brings poor results. New things are constantly appearing on the trail, new plants are coming on, others fading, new animals are constantly being seen. The new material is at hand for every hike if you but use it. Just as hikes are ruined by stereotyped form of conduction, so are they ruined by a guide lacking sufficient sense of humor to keep a crowd in good spirits over rough trails.

So much for the elements of Nature Guiding as related strictly to the guide himself. Let us turn now to the methods of guiding. Just as the laboratory methods are replacing more and more the set lecture methods in our universities, and the hand specimen exhibits are replacing the case exhibits in our museums, so the idea of handling the objects themselves are becoming more and more popular on our Nature Trails. This method gives the tourist a better idea of the object and the impression which he receives is more lasting. It is not necessary to denude the landscape of vegetation in order to carry out this practice. They can feel the leaves of a Mountain Holly without tearing up the plant and they can examine the needles of a pine without breaking off the limb.

THE ELEMENTS OF NATURE GUIDING Yeager

One of the most successful methods of arousing interest is to make the people think for themselves. No matter how interesting or instructive a teacher may be, the student is never quite so alert as when a question is apt to be shot at him. Think back over your college days and see if this is not correct. The same principle can be applied to Nature Guiding. It is far more effective to obtain the leaves of a pine and fir and ask the people what the differences and similarities are than it is to point out those differences and similarities yourself. Such questions as "Have you ever seen a plant with leaves like this before?", "Do you know how a Dogwood got its name?", or "From looking at this tree can you tell how many claws a bear has?" always arouse interest and stimulate thought. In order to better illustrate this "thought stimulating" method, I am recording a conversation which might easily take place between a guide and his party in a grove of aspen.

Guide: Have you ever seen trees like this before?
Tourist: Yes.
Guide: Where?
Tourist: In Illinois; aren't they birch?
Guide: Not quite, the bark is white all right, but look at the leaves. They aren't shaped like birch.
Tourist: No, I guess you're right. They look like cottonwood leaves.
Guide: Correct. You're getting near. It belongs to the cottonwood family. Does anyone know what it is?
No Answer: Well, they are known as aspen, quivering or quaking aspen.
Guide: Now watch the leaves and see if you can see any significance of the word "quivering".
Tourist: Why they move all the time!
Guide: Certainly, that's the secret. Now, look at the difference between this aspen leaf and the leaf of birch and see if you can discover why they move so easily, etc. etc.

The above is crude, but it will serve to illustrate what I am referring to by arousing interest through questioning. It will bring results, even with a cold and unresponsive party, where the straight lecturing hike will fail.

In connection with the methods of guiding, let me say a word concerning the necessity for making accurate statements. It is no crime to admit ignorance, but it is a crime, an unforgivable crime to bluff. When a party has confidence in its guide to give them authentic information, and that guide, because he is afraid to say "I don't know" will deliberately bluff them into thinking that he does know and thereby give them inaccurate information, he is no longer worthy of the name Nature Guide. If a question comes up which you are not able to answer, say so, but give them a reference where they will be able to find it, or offer to look it up for them after the hike, but do not, under any circumstances, deliberately bluff. To do so not only lowers the

standard of the service but lowers yourself as well, as there is usually someone in the party who does know and will beat you at your own game. It is a mistaken idea to think that you are talking to a group of ignorant people. You are not. Instead you are talking to a cross section of the American public. And in that cross section you will have professors of botany, zoology and geology, who never make their presence known until after the trip, if at all.

And so, in summing up the essentials of Nature Guiding, we may say they consist of:

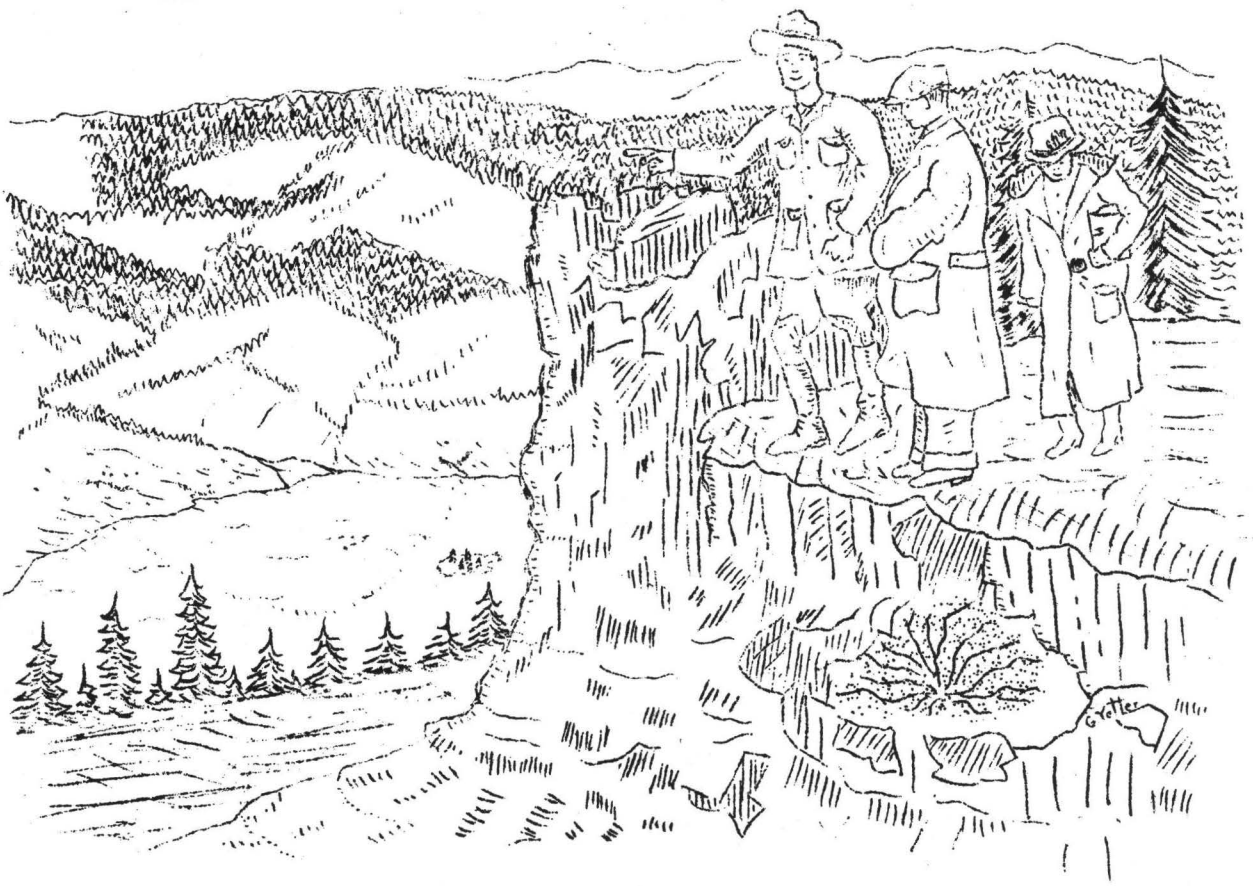
1. A love for Nature and the ability to stimulate an interest and a corresponding love for living things to members of your party.

2. A thorough knowledge of your subject, and the ability to pass that knowledge on in simple, interesting terms.

3. Courtesy and a level head.

4. A character big enough to be able to say "I don't know." Originality and a sense of humor.

All of these are important, perhaps no one more so than another, and all are essential for the making of a well-rounded, successful Nature Guide.



THE TOURIST AS A CRITIC

By Dorr G. Yeager, Park Naturalist

Approved:
Ansel F. Hall, Chief Naturalist, National Park Service.

Someone has said that America is not a nation of critics. That we are satisfied with the surface and that we do not investigate. However true that may be of the nation as a whole, I believe that every experienced ranger naturalist will agree with me, and the new men will admit before the coming summer is over, that it is not true of the Yellowstone tourist.

Because the Yellowstone tourist is a critic, because he is interested in his surroundings and because he is very likely to know as much about the subject upon which you are talking as you yourself do, it is the duty of every naturalist to watch carefully the statements which he makes.

The critical Yellowstone visitor falls into one of two classes: those who criticize for the pure love of trying to make someone else miserable, and those who want to be helpful and give constructive suggestions for the work.

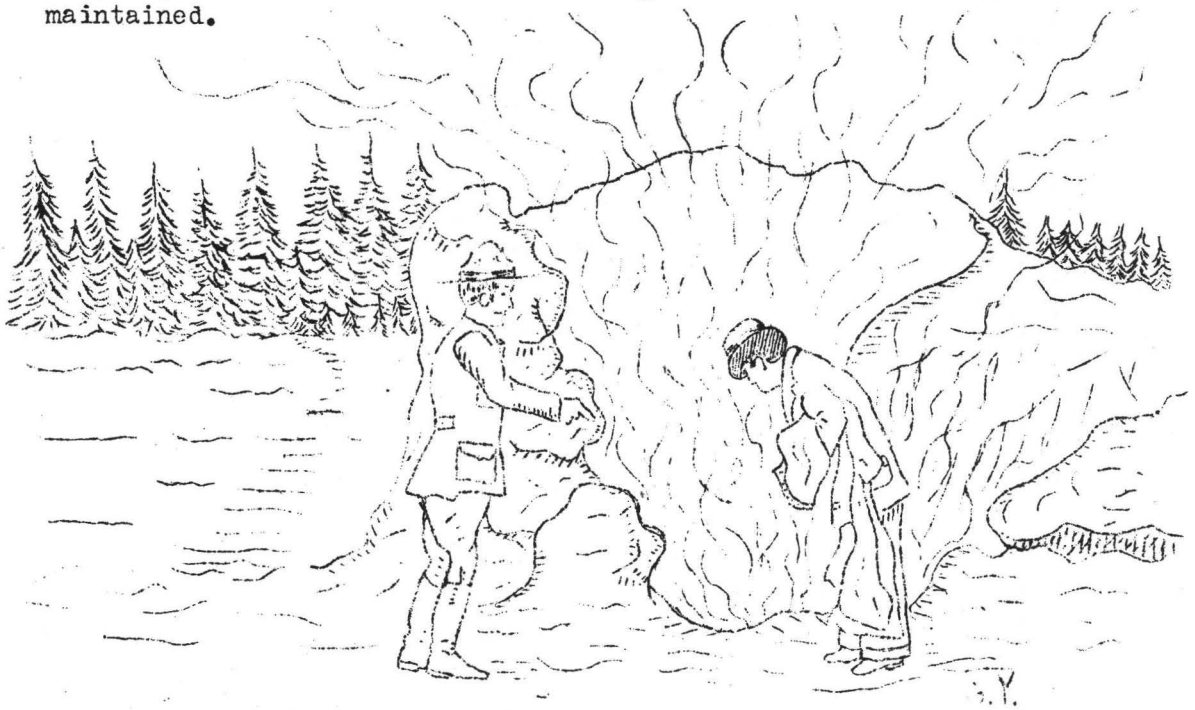
The first is by far the most difficult to handle. He will ruin a lecture or a guide trip if he possibly can. He will make life miserable for the guide and the party in general. He will attempt to belittle everyone in order to display his own knowledge of the subject, which is usually scant. In a previous article I pointed out the necessity of a ranger naturalist being a diplomat. This is especially true with a person of this sort. When one is in your party or audience it is a case of prevention instead of cure, and you can always take it for granted that you have one with you. Pick your statements carefully. Pick those statements that will offend no one nor cast reflections on any creed or nationality. I well remember an incident that occurred a few seasons ago. A naturalist at Mammoth thoughtlessly offered up a prayer to the Devil upon entering the "Kitchen" on the formations. It was a good prayer, too, but it offended certain people and reports kept coming in that the naturalists were sacrilegious. It was necessary to do away with prayer in that case. On another occasion several years ago a naturalist caused a near-riot by speaking lightly of a past president. It was carelessness on his part, as no Government man in uniform should ridicule either present or past administrations. I well remember a story I used to tell at lectures which illustrated a certain point. The story had to do with why it was always the woman who asked the foolish questions in Yellowstone. I soon found out that I must eliminate this story, as it invariably struck home to some woman in the audience.

There is another thing, which has no direct bearing on the subject, but which might well be taken up here. In the above paragraph I used the phrase "foolish question". It is a byword in the Park during the

summer. However, I believe all of the men who have spent several seasons in Yellowstone will admit that there is no such thing as a foolish question. When you first hear questions of this type you will likely disagree with me. However, if you stop and analyze it you will find that the person was really trying to find out something and that it was the wording rather than the context of the question that made it sound foolish. Such questions as "Do the hot pools freeze over in the winter?" and "Were the trees in the formations always dead like that?" are really not so foolish if you get down to the thought behind them. Again I say, it is the wording rather than the real context that sounds foolish. Never let a tourist know that his question amuses you. Even though the rest of the audience laughs, keep a straight face and explain what the person really meant to say before answering it. Then, after the lecture, you may laugh and nine chances out of ten the person who asked the question will laugh with you.

Then the second type of person, he who criticises from a purely unselfish and helpful motive. One thing I have found. The man who really knows his subject will seldom criticise or argue with you in front of a crowd. He will wait until after the lecture and then come to you quietly and talk it over. You need never worry about this man. He probably knows more about the subject than you do yourself. He may be a renowned scientist, for all you know. Talk it over with him and thank him for making the suggestion. It is from that type of man that we can learn much if we will let ourselves.

I think you will be able to see why it is necessary to lay so much stress on accurate information, as well as statements that will offend no one. It is not an easy job, but it pays in the end and it is the only way that the standard of the Ranger Naturalist Division can be maintained.



OUR NATIONAL PARKS

Prepared By:
Dorr G. Yeager, Park Naturalist

Approved By:
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Arno B. Cammerer, Associate Director, National Park Service
Miss Isabelle F. Story, Editor, National Park Service

On the evening of September 19, 1870, a group of men sat by a campfire at the junction of the Firehole and Gibbon Rivers, under the shadow of the present National Park Mountain. The names of these men will go down through the ages, burned on the pages of history, as the forerunners of American Conservation. It was at this spot that the famous "National Park idea" was born. It was this group of men, constituting the Washburn-Langford-Doane Expedition, which first suggested that the great area now known as Yellowstone National Park be set aside as a playground for the American people. Two years later an act of Congress, signed by President Grant, created the first National Park "For the Benefit and Enjoyment of the People."

Since that time 23 more national parks have been established in various portions of this country. The "national park idea" has borne fruit not only in the United States but it has spread abroad. Unique among these foreign parks is the one recently established by the Belgian Government in the heart of the Congo. In 1916 we established our "Island Park" in the Hawaiian Islands under the name of Hawaii National Park.

It is interesting to read the accounts of the early tourists in the parks. Travel was made largely on horseback and provisions were brought in with pack train. But the early days have gone. Just as the steel trains replaced the ox-drawn wagons, so has the automobile replaced the horse-drawn stage. Trails have been supplemented by modern highways. Such modern conveniences as sewage and water systems, electric and telephone service have been installed. It is now possible to travel in America's playgrounds as comfortably as in a city, stopping at well-appointed hotels and inns, and enjoying civilization in the heart of a wilderness.

From the creation of the park until 1886 civilian superintendents supervised the Yellowstone. In 1886, however, its administration and protection was taken over by soldiers and not until 1918 was it returned to civilian control. On August 25, 1916 Congress created the National Park Service as a bureau in the Department of the Interior. Honorable Stephen T. Mather, then Assistant Secretary of the Interior in charge of National Parks was made Director of this new Service. In January 1929, owing to ill health, he resigned and Horace M. Albright, who had been Superintendent of Yellowstone National Park and Field Director of the Service since 1919, succeeded him. During the twelve years as head of the National Park Service Mr. Mather gave America the finest system of national playgrounds the world has ever known.

OUR NATIONAL PARKS Yeager

We have briefly surveyed the history of the National Park Service. Let us now review a few of the individual parks. All but one of these national parks is west of the Mississippi River. No single park can claim the distinction of being the greatest. No single park is more beautiful than any other. Each is a gem in its own way and each surpasses the next in its own distinctive features. Beginning at Yellowstone in the northwest corner of Wyoming, we are able to make a complete circle of most of the western parks, never encountering the same one twice.

Yellowstone National Park, the first of the series to be created, lies in the northwestern corner of Wyoming with a small portion encroaching on Montana and Idaho. It has a total area of 3,426 square miles, or 2,192,640 acres. When first established, the protection of the natural phenomena such as hot springs and geysers was the only motive. In later years, however, with the growth of the idea of game conservation, the animals themselves were protected until now the Yellowstone is one of the largest game sanctuaries in the world. Deer, elk, moose, antelope, and bear roam unmolested throughout this great area; mountain sheep inhabit the peaks; more than a thousand buffalo roam over the northeastern section; beaver, otter and mink inhabit the streams and lakes.

But the fame of the Yellowstone is not due to its herds of elk or buffalo, its forests or its rushing waterfalls, but is due to its geysers and hot springs, which outnumber those in all other parts of the world combined.

The Canyon of the Yellowstone holds one in awe. It is a spectacle beyond comprehension. One can stand on the rim and gaze at those highly colored walls with a feeling that man is only man, and not a god. Many consider it the most highly colored and beautiful canyon in the world.

And so from the Yellowstone with its elk and buffalo, its canyons and waterfalls, its geysers and hot springs, we pass on to the next in the chain, located 400 miles northwest, nestling on the northern boundary line of the United States.

The United States Government bought the area east of the Continental Divide from the Blackfeet Indians in 1896 for the copper which supposedly existed in the mountains. The copper soon ran out and the area lay idle, visited by few persons other than big game hunters. In 1910, however, it was made a national park and the unsurpassed scenery of the area was forever made secure.

It has been said that "Glacier National Park is the Canadian Rockies done in Grand Canyon Colors." The rocks making up this park are sedimentary in origin. After the sea withdrew from the Cordilleran trough the mass was uplifted and folded. Faulting occurred. Glaciers and erosion did the rest. The valleys, glacial

carved, terminate in wondrous alpine wild flower gardens. In this area of 1,534 square miles there are 60 small glaciers and 250 known lakes. It is a land of rugged beauty and world-renowned scenery. With the exception of Mount McKinley, probably none of our national parks are so little explored as this. There are mysterious valleys where the foot of white man has never trod. Down from the Continental Divide descend 19 principal valleys, the streams of 7 flowing into the Atlantic and 12 into the Pacific. Among the most famous of its wonders are Lake McDonald, Grinnell Glacier and Lake, Two Medicine Lake, and Gunsight Pass.

Here the mountain goat is still found and streams abound with gamey trout which call sportsmen from far and wide.

Glacier is a paradise for the hiker. A few good roads exist but most of the travel throughout the park is by trail. Hotels and chalets are found on both the east and west sides of the park, while the railroad terminates at its southern boundary.

Leaving the glaciers and traveling westward we arrive at Seattle where we board an Alaskan-bound steamer for the next National Park, located in our territorial possession of Alaska.

Although less than a thousand people visited Mt. McKinley National Park in 1928, due to its rather isolated situation, this park is one of the most beautiful of all. Mt. McKinley rears its majestic head over 20,000 feet above the sea, dwarfing such peaks as Pike's, Long's and Rainier. Alaskan brown bear, moose and caribou roaming throughout the park, glaciers flowing from the crest of the highest mountain in North America, and the sublime wilderness beauty of this park all give promise to the great popularity of Mt. McKinley National Park in the near future.

Returning to Seattle and then traveling 50 miles southeast as the crow flies brings us to "The Mountain That Was God". Many fascinating Indian legends are woven about Mount Rainier, some beautiful in their simplicity, all romantic in their treatment.

Mount Rainier National Park was created in 1899 by an Act of Congress. Its area is 325 square miles, containing for its size, more glaciers than any other part of the United States. From its snow-covered cap, 14,408 feet above the waters of Puget Sound, flow 28 rivers of ice. This snow-covered summit has long been a landmark for homing sailors who guided their course by its glistening crest.

The mountain is nearly 3 miles above the waters of the Pacific Ocean. As are many of the peaks in the coastal range, Mt. Rainier is an extinct volcano. Once a complete cone, like Japan's sacred Fujiyama, this mountain stood for countless ages towering above the surrounding country. Then came an eruption which is estimated to have blown probably 2000 feet of the cone away, leaving it with the present height of 14,408 feet.

OUR NATIONAL PARKS Yeager

The flowers of Mt. Rainier are famous in song and story. Paradise Valley in the spring is a never-to-be-forgotten sight and as the snows retreat farther and farther up the slope, myriads of beautiful forms appear. John Muir speaks of the richness of the flora as follows" . . . daisies, anemones, geraniums, columbines, erythroniums, larkspurs, etc., among which we wade knee-deep and waist-deep, the bright corollas in myriads touching petal to petal. All together this is the richest sub-alpine garden I have ever found, a perfect floral elysium."

And so from the glaciers and flowers of Rainier we turn southward into Oregon and the far-famed Crater Lake National Park. Here, too, we find an old volcano, but this time the crater filled with azure water "of wonderful color in a setting of pearly lavas relieved by patches of pine green and snow white - a gem which changes hue with every atmospheric change and every shift of light." Created a National Park in 1902, this area surpasses any volcanic lake in the world in coloring and sheer beauty. It is often referred to as "The Sea of Silence". Truly it is a "Sea of Mystery". The lake is never the same and each hour of the day brings a shift of scenes. Objects completely disappear as new shafts of light play on the water, while other objects heretofore hidden, come into view.

Crater Lake is rich in Indian lore. Many fantastic and beautiful legends have been built up around it, conspicuous among which is the famous legend of Llao, who was torn to pieces by a rival monster and whose head can still be seen in the form of what the white man calls Wizard Island.

Trails and automobile roads circle the rim of the Lake. Hard fighting trout swarm its waters, while black bears roam the wooded slopes nearby. It is the mecca for Oregon nature lovers and tourists the world over. Crater Lake Lodge on the rim, 1000 feet above the Lake, as well as cabins and free auto camp grounds, provide ample accommodations for the summer tourist.

One of the smallest of the major parks is Crater Lake, but its resplendent ever-changing beauty, its wealth of mystery and silence, beckon those who love nature in all of her varied moods.

Although by far the greatest part of our northwest is made up of volcanic material, it was thought up to 1914 that no active volcano remained within the boundaries of the United States. Then suddenly toward the end of May, 1914, Lassen Peak, situated in the northern part of California, broke out in a violent eruption. Quiescent for over 200 years, this volcano began emitting great clouds of steam and gas "as if precursor of the cataclysm of war so soon to follow". Had this eruption of 1914 never occurred we should probably have had only 20 National Parks instead of the present number. Congress, however, was quick to see the educational and scientific interest connected with this revived giant and so Lassen Volcanic National Park was created in August 1916.

OUR NATIONAL PARKS Yeager

Although small in extent, containing but 163 square miles, this park is unique among the parks of America. In no other place in the United States can be seen an active volcano. It is the Mount Rainier of thousands of years ago. Since its establishment as a National Park, and, in fact, ever since its eruption in 1914, it has been one of the centers of interest in the United States for students of volcanism.

From the first explosion in 1914 to the end of January, 1916, this volcano was in an almost constant state of eruption. Within that time 220 explosions occurred, while night and day the mountain emitted great quantities of gas and smoke. The most violent eruption occurred on May 22, 1915. A great cloud of smoke rose in a mushroom shape over the mountain. This was followed by quantities of hot gas which rolled down the side, killing everything in its path and leaving fire and destruction in its wake.

As in so many regions of recent volcanic activity, this park possesses hot springs and mud geysers. Lassen Peak itself has an elevation of 10,460 feet. Nearby, Cinder Cone, which showed activity some years ago, raises its crest 6,907 feet. Other prominent peaks within the park are Prospect Peak, North Peak and Southwest Peak.

Southward, our journey leads us to San Francisco, thence by boat to one of our most famous parks, located in mid-Pacific. Congress created Hawaii National Park in 1916, more for the volcanic phenomena to be seen there than for the sound of Hawaiian music. Both, however, call the tourist to our island possession. This park "includes the summits of three volcanoes of world celebrity - Haleakala, on the island of Maui, and Mauna Loa and Kilauea on the island of Hawaii." The former lifts its head 10,000 feet above the coral reefs and the warm waters of this island paradise and constitutes one of the most beautiful and interesting sights in all the islands. Another feature of great interest is "Halemaumau" or the "House of Everlasting Fire", which has drawn travelers from far and wide. "This inner crater often contains a boiling, bubbling mass of molten lava whose surface fluctuates from bottom to rim. Its risings are accompanied by brilliant fountains and flows of liquid lava, and its lowerings by tremendous avalanches which send up enormous clouds of dust."

In addition to the volcanic phenomena, Hawaii National Park is rich in a tropical flora and fauna. Prominent among the botanical features of the park are the giant ferns which grow often to a height of 40 feet with single fronds attaining a length of 25 feet. The birds of the Pacific Island are famous in song and story. Hawaii National Park is endowed with a rich and interesting bird fauna and many beautiful and rare species are to be found, especially in the little area of 56 acres known as Bird Park.

Hiking, golfing, automobiling and horseback trips are all available. Comfortable accommodations may be secured at either Volcano House or Kilauea Camp at reasonable rates.

OUR NATIONAL PARKS Yeager

Notwithstanding the fact that Hawaii National Park lies from 4½ to 6 days from the United States, it is one of the most popular and ranks high among the major parks of the system.

Our journey leads us back again to San Francisco, thence eastward either by rail or over splendid auto roads, to the land of world famous waterfalls. As I said in the beginning, each park is most beautiful in its own way. Yosemite has, without a doubt, the most beautiful waterfalls in existence. To be sure, they do not compare in volume with those of Yellowstone nor in width with Niagara, but there is something about the delicate films of water pouring nearly 2000 feet down the sheer face of granite walls that fills the visitor with wonder and admiration. Yosemite the beautiful, Yosemite the incomparable. It nestles on the east slope and crest of the Sierras, where everlasting snows crown the peaks and pink shadows play at sunset over the range.

Of all the parks, Yosemite is probably the most romantic. Here we encounter such falls as Bridalveil, Ribbon and Illilouette, all as beautiful as the name, and each wrapped in a wealth of Indian lore and legend. Such giants as El Capitan, a mass of solid granite towering 3,604 feet above the valley floor with its perpendicular face forming one portion of the valley wall, stand guarding the entrance to the valley. Truly, is this mighty cliff "El Capitan" - three times the size of Gibraltar. Further down the valley, guarding beautiful Mirror Lake, Cloud's Rest rears its proud head 5,964 feet. Across the Valley from this, Glacier Point stands like a mighty sentry, towering 4,000 feet above the little village of Yosemite.

But Yosemite Valley is only a scant eight miles in the 1,126 square miles of the park. Unfortunately the average visitor sees only the valley itself. If you desire further scenery, if the lure of the mountain trails and lakes haunts you, then put aside the artificiality of civilization, strap a pack to your back and trek into the country above "the rim". Miles of good trails through the heart of the Sierras, towering peaks, treacherous snow fields, great forests and the music of swift churning mountain streams rushing to the sea. Cathedral Spires, the rushing waterwheel of the Tuolumne, beautiful Merced Lake and mighty Vogelsang Pass challenge you to test your endurance to conquer them. Small camps have been established within a day's journey apart and the traveler may find food and shelter at the end of each wilderness day.

Yosemite is a land of granite walls and lofty peaks; of glaciers and purple sunsets; of mighty forests of fir, balsam and sequoia. Established in 1890, Yosemite stands today as the leader of our national parks in visitors. It is open the year around and although most of the high country is impassable during that season the valley teems with toboggans, skis and snowshoes as the week-enders from the coast cities, as well as the tourists from all over the world, join in the winter sports of Yosemite.

CUR NATIONAL PARKS Yeager

The accommodations are excellent; Hotel Ahwahnee, Sentinal Hotel, as well as Camp Curry and Yosemite Lodge, are at the disposal of the tourist.

By all means see Yosemite at some time during your life. Life is not complete and surely a tour of America's playgrounds is not complete, without a trip to this wonderland.

Our journey leads us southward again and we enter the land of giants. Sequoia National Park was created in 1900 for the express purpose of keeping the great trees ever inviolate for generations to come. In this park, which rests upon the upper slope of the Sierras in Central California, and its tiny neighbor, General Grant National Park, we find several thousand sequoias.

Youth is romantic, but surely a cloud of romance rests over these venerable trees, the largest and oldest of living things. What stories they could tell. Trees that were growing before the pyramids of Egypt were built; trees that had seen a thousand summers before Christ was born; trees that flourished when Babylon was in its prime, and outlived not only Babylon but all her conquerors.

As one walks on the forest floor beneath these trees it is like walking on the floor of an ancient temple. There is no underbrush and the floor is carpeted only with the leaves of the temple's pillars. Rays of sunlight stream down from the almost inpenetrable tops, rays of light that might come from stained glass windows.

Once again, as we stand beneath these mighty trees, we have the feeling that man is small, the same feeling that we had when we stood on the rim of the Yellowstone Canyon. These trees are not for men - they are for gods. The General Sherman Tree, with a diameter of 37.3 feet and a height of 273.9, is the largest living Sequoia known. Several fallen giants are still larger. Thousands there are with a diameter of over 10 feet.

The secret of the Sequoia's long life lies, no doubt, in the bark itself. It is nearly indestructable and unusually resistant to the usual enemies of the forest, such as fire, fungus and insects.

As we turn to look back upon leaving these giants we remember again the words of John Muir when he speaks of the Sequoia "Poised in the fullness of strength and beauty, stern and solemn in mein, it glows with eager, enthusiastic life to the tip of every leaf and branch and far reaching root, calm as a granite dome, the first to feel the touch of the rose beams of morning, the last to bid the sun goodnight."

Zion Canyon has been aptly referred to as "The Rainbow of the Desert". Stratified sandstones of crimson, vermilion and white, cut and carved by wind and water erosion, give us this little gem of the southwest.

OUR NATIONAL PARKS Yeager

The region now known as Zion National Park was known to the Mormons as early as 1861. In fact, it was given the name Little Zion Canyon by Brigham Young in that year. Government geologists explored and described it a few years later and within a short time it was set aside as Mukuntuweap National Monument. Years later, in 1916, its superb beauty began to draw crowds of tourists and in 1918 the boundaries were enlarged and the name changed to Zion National Monument. The next year it was given a place among the National Parks of America.

Like the Grand Canyon of the Colorado and the Grand Canyon of the Yellowstone, Zion is a product of erosion. Stratified sandstones of brilliant colors form the walls of the canyon. The cliffs are high and are not dissimilar to those of Yosemite Valley in shape. Prominent among the points on the walls are El Gobernador (The Great White Throne) with an elevation of 3,100 feet, Western Temple 4,000 feet, Vermilion Cliff, Angel's Landing, Brown Wall, Sentinels, and the Three Patriarchs. Directly opposite Western Temple but two miles back from the rim, Eastern Temple rises 5,000 feet into the air.

Although among the youngest of our parks, Zion's unique beauty, its mighty cliffs and its highly colored canyon walls are rapidly bringing it out of obscurity and into the mind and memory of the National Parks tourist. It is readily reached by rail and auto and accommodations are available either in lodge or auto camp.

The southwest is famed for sandstones of brilliant colors and Bryce Canyon National Park is no exception. Although only 32 square miles in area, this little park is one of the most famous areas in the entire world for color. It rivals the canyons of both the Colorado and the Yellowstone in this respect and probably surpasses its neighbor, Zion.

Although the Pahreah River began this marvel of Nature when it started cutting through the Paunsaugunt Plateau, it left it far from complete. It cut through the sandstones to a depth of 1,000 feet but the finer work of sculpturing the leaning towers, the lotus columns, the colonnades, the fairy castles, shrines and alters, was left for the wind and sand. It is one of the finest examples of Nature's handiwork.

The name Bryce Canyon is misleading, as it is not a canyon but a huge amphitheater of horseshoe shape resting on the eastern edge of Paunsaugunt Plateau. Looking down from the rim of this huge horseshoe, the visitor beholds a fairyland of sculpture and color. It is as if thousands of stalagmites had turned to stone, and the stone had been sculptured and painted by fairy artists. The combined beauty of Bryce is incomparable to any other park. The coloring is similar to Zion but the delicate sculpturing of the sandstone is found in none but Bryce.

Bryce Canyon National Monument was created in 1923 and administered under the Department of Agriculture. Later it was elevated to the position of a National Park and placed under the Department of Interior as Utah National Park. In February 1928 the name was changed to Bryce Canyon National Park.

CUR NATIONAL PARKS Yeager

It is strange that the Government waited until 1919 to establish Grand Canyon National Park. It, as the Sequoias, is inconceivable. Aweful in its mighty depths, yet tender and whimsical as a child in its ever changing color of the walls, this great product of water erosion, a mile deep and 4 to 18 miles across, stands as the mightiest canyon the world has ever seen. Writes Charles Dudley Warner "To the eye educated to any other it may be shocking, grotesque, incomprehensible; but those who have long studied the Grand Canyon do not hesitate to pronounce it by far the most sublime of all earthly spectacles."

There are those who take a look at the Canyon and go away. There are always those persons who are unable to appreciate even the greatest of Nature's handiwork. There are others who stand on the rim of the Canyon and their "heart is moved with a feeling that it is far too great for words." The Grand Canyon is one of those great phenomena of Nature that are never the same. Turning away from the scene for five minutes and then looking again, one recognizes nothing of the original. It is an ever changing panorama, a ceaseless study in light and shadow.

Although reported by Spanish explorers as early as 1540, the Canyon was never thoroughly explored until 1869, when Major Powell, afterward Chief of the U. S. Geological Survey, made his way with eight companions in four small boats down the river. This trip is one of the most romantic exploits in all American history of exploration.

Turning our faces northeast and traveling a distance of some three or four hundred miles, we arrived at Mesa Verde, unique among the national parks of America. Though small in extent, containing about 77 square miles, this park is one of the most important and interesting in the series.

Standing on the right bank of the Mancos River, threaded with small, rough canyons, this park contains the most wonderful and best preserved cliff dwellings in the Western Hemisphere, if not in the world.

The Mesa Verde tribes had, with the exception of those of South America and Mexico, the highest culture and the most advanced civilization of any in the Americas, They were farmers, cultivating the dry mesas and eking out a scant existence with the agriculture. They fished, hunted, made pottery and lived a happy, prosperous life. Their artistic sense was keen, as judged by the designs on their fabrics and pottery.

The dwellings are located in the walls of canyons several hundred feet in height. They are well-built structures of stone and clay, often ornamented with designs. That their masonry was lasting is attested by the fact that the construction of these buildings dates back to the beginning, or may antedate the Christian Era. They are still in a good state of preservation, having withstood the winds and snows of centuries.

OUR NATIONAL PARKS Yeager

In December 1888, two brothers came unexpectedly upon the ruins while hunting lost cattle on the mesa. This was the first time that the eyes of white man had ever gazed on this once thriving village. They promptly explored the place to which they gave the name "Cliff Palace". It is a misleading name, however, as the towers and walls were not those of a palace "but a village with 200 rooms for family living and 22 kivas, or sacred rooms, for worship. Later on they found another similar community dwelling, which once sheltered 350 inhabitants. This they called Spruce Tree House, because a large spruce tree grew near it. These names have remained." In later years others came and many new ruins were unearthed. We are apt to think of those who have gone before us as savages, but when we realize that "here may be seen the oldest and most fully realized civic center in America" we begin to see that we are only copying the ideas of ages long since extinct.

As we stand here, beneath the cliffs of Mesa Verde, we feel that we are in the bosom of antiquity. Could these ruins tell all they know, all that has transpired within them, one of the greatest riddles in science would be solved. Could the ruins but speak, they might tell us more of these early people. Whence they came and whither they traveled. Like so many other races, they appeared, lived, their civilization flourished for centuries, and then they disappeared, where they went no one knows.

Seventy miles directly northwest of Denver lies the last major park in the chain. Crowning the summit of the range, with Long's Peak rearing its majestic head 14,255 feet into the air, Rocky Mountain National (Estes) Park embraces 400 square miles of as fine scenery as may be found in the Western Hemisphere or in the world.

I have said that no two parks can be compared. Were any two compared, I would say that Glacier and Rocky Mountain are the most similar. Massive peaks; delicate solitary lakes, lost in a wilderness of conifers; valleys through which rush sparkling mountain streams filled with fighting trout.

Long's Peak itself is worthy of having the area consecrated as a national park. A great mass of glacial carved granite, rearing its box-like head far above all neighboring peaks, this mountain is one of the sentinals of the Rockies. For many years it was considered inaccessible, but finally a route was made through the famous Keyhole and along the "narrows", where a false step means a drop of 2,000 feet into oblivion. Higher than Pike's, and one of the four most difficult mountains in America to climb, Long's Peak will ever stand a memorial to Nature's modeling of granite with ice.

To those who love the country at timberline, no more fascinating place can be found than Rocky Mountain. Leave the valleys behind and mount ever upward on the splendid forest trails until you reach the land of your heart's desire. There you will find forest giants gnarled and twisted by the winds that never cease their warfare with timberline.

OUR NATIONAL PARKS Yeager

There in the rock slides of timberline the cony will whistle at you from the talus slope, the rosy finch will soar heavenward from the rocks and the venturesome jays will quarrel with you over your noonday lunch. If you would break away from the roads, if you would leave the crowds far behind and seek the rugged freshness of timberline, then go to Rocky Mountain and match your strength against that of the mountains themselves.

Cozy inns and chalets nestle at the foot of the peaks; good auto roads thread the valleys and splendid horseback trails penetrate the wilderness. Regular bus service is available from Denver or at any of the small towns bordering the park, such as Boulder, Loveland or Lyons.

On February 26, 1929, President Coolidge signed the act establishing the Grand Teton National Park, thereby ending a 31-year struggle to give this area the title which it rightfully deserves.

Twenty-five miles south of the Yellowstone, this area of about 150 square miles contains some of the most majestic scenery in the whole of the Rocky Mountain system.

The Teton mountains have been landmarks from the earliest days. They are mentioned in Irving's "Astoria" and in a book on the travels of Captain Bonneville. They are constantly referred to in the early literature of the section and always referred to as among the most stately and beautiful peaks in existence. The most impressive peak in the park is the Grand Teton, 13,747 feet in altitude, which was successfully scaled for the first time by W. O. Owen and three companions in August 1898.

Excellent highways lead from the Southern (Snake River) Entrance of Yellowstone Park into its small neighbor, the Grand Teton National Park. Here in the heart of world famous scenery one enjoys the wilderness, either at one of the numerous "dude ranches" or by pitching camp in any of the thousand entrancing spots within the boundaries. Gamey, fighting trout abound in the cold mountain streams and here under the shadow of the majestic Tetons one finds quiet and relaxation in a newly made park to which the masses of American tourists have not yet begun to swarm.

Taking a long jump from the Grand Teton National Park across country to a spot on the coast of Maine, we find ourselves at Acadia National Park with an area of about 12 square miles.

This park, until 1929 known as Lafayette National Park, is situated partly on Mount Desert Island, Maine, and partly on the mainland across Frenchman's Bay. It comprises some of the finest scenery on the Atlantic Coast. Acadia National Park includes a group of low granite mountains abutting the sea. It has been said, and well, that Acadia National Park is the land "where sea and mountain meet". Granite mountains, forest covered, run down to the sea where the pounding of the surf upon the "rock-bound" coast calls the tourist to visit this popular eastern park.

OUR NATIONAL PARKS Yeager

In our journey through the playgrounds of America we touched all of the larger parks. There are several, however, smaller in extent, though no less wonderful in their own way.

Hot Springs National Park is one of the best known summer resorts in the United States. Forty six hot springs are found here. Splendid golf courses and the town of Hot Springs, Arkansas, give this a high place among the minor parks.

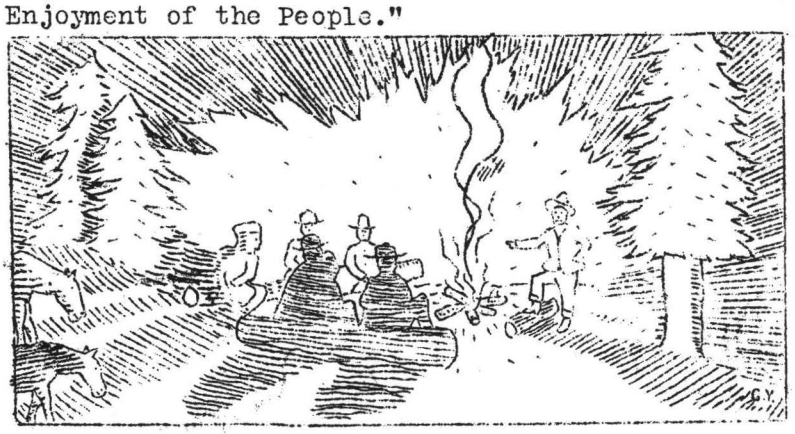
The Black Hills of southwestern South Dakota, scene of Custer's first stand, famous for many years for Indian fights and frontier lawlessness, contain a limestone cave of large size and interesting decoration. It is called Wind Cave because of the strong currents of air which alternate in and out of its mouth.

The walls and ceilings of the various passages and chambers which constitute the cave are covered with the formations common to most caves. The park is also a game preserve.

In speaking of the next minor park the National Parks Portfolio says: "Southern Oklahoma's medicinal springs were conserved for public use in 1906 by the creation of Platt National Park. Sulphur springs predominate, but there are bromide and other springs of medicinal value, besides several fine springs of nonmineral character. Altogether they have an approximate discharge of nearly five million gallons of water daily."

Sully's Hill National Park is situated in a rugged and picturesque forested tract bordering a lake in North Dakota. It is a wild animal preserve and has historical connections of interest.

And so we end our journey through America's playgrounds, through those beauty spots of the world that have been set aside, ever to remain inviolate for the coming generations. And as we think back over the scenes through which we have passed, the geysers of Yellowstone, the peaks of Glacier, the giants of Sequoia, and the falls of Yosemite, we cannot help breathing a prayer of gratitude to those men who, sixty years ago, sat around the campfire at the junction of the Gibbon and Firehole Rivers and formulated the idea of these playgrounds "For the Benefit and Enjoyment of the People."



BOILING POINT PHENOMENA

Dr. G. C. Ruhle, Ex-Park Ranger.

Approved by:
Dr. A. L. Day, Director, Geophysical Laboratory.

A minister of the gospel generally prefaces a sermon with a text, and while this is not going to be a sermon in any sense of the word, it might be provided with a text taken from one of the explanatory signs which are placed beside the geysers and hot springs of the Upper Basin. The particular sign bearing the words of the text is placed beside Scalloped Spring, just across the bridge over the Firehole below Castle Geyser. It reads as follows:

> "Temperature 201° F. This spring, like several others in the Basin, has a temperature several degrees higher than the normal boiling point at this elevation (197°). In spite of this superheat, the boiling is very gentle. The reason for this condition is unknown as yet."

It is this last statement that has prompted the writing of this article, for a thorough acquaintance with boiling point phenomena is necessary to understand the nature of superheating.

THE CONCEPTION OF VAPOR PRESSURE AND THE DEFINITION OF BOILING POINT.

It will first be necessary to consider what is meant by vapor pressure. If a given liquid is placed in an evacuated, closed container fitted with a piston - so that the volume may be altered at will - and the state of the contents are carefully examined, it will be found that not only is liquid present but that a portion of the liquid has passed into the gaseous state (vapor), and the vapor thus present exerts a very definite pressure which depends upon the liquid used and the temperature only. For the liquid, water, this pressure at average summer temperature of Old Faithful region is approximately equal to one-half inch of mercury (one quarter pound per square inch). If the volume of the chamber be increased by pulling out on the piston, the pressure of the contained gas drops, since it is inversely proportional to the volume, but at the same time more liquid begins to evaporate (changes into vapor) until after a very short while the pressure has again been restored to the first value. For the reverse process, if the volume be decreased by pushing in on the piston, the pressure of the gas is increased for the moment, but simultaneously vapor condenses in sufficient amount to maintain the first value. If the piston is pushed in so far that all of the vapor changes to liquid, the pressure can be increased as much as one wishes to, or, conversely, if the piston has been pulled out so far that all of the liquid has evaporated, the pressure on the vapor can be decreased as much as one wishes. But as long as the temperature remains unchanged, only at the one very definite pressure can the liquid and vapor exist together in stable equilibrium.



FIGURE 1-

BOILING POINT PHENOMENA Ruhle.

It will next be necessary to consider what will happen if the temperature is changed while the volume of the containing vessel is fixed. As heat is applied, it will be noticed that some of the liquid disappears to form gas with each rise in temperature and that for every temperature the pressure of the vapor is a definite quantity, characteristic of the liquid used. Moreover, for water it would be found that pressure rises to one atmosphere (30 inches mercury pressure or 14.7 pounds per square inch), when the temperature reaches 100° C. or 212° F. If water were placed in the chamber fitted with a piston and heated to 100° C., the pressure of the vapor would itself be sufficient to push back the piston against the pressure of the air, and, by supplying enough heat to keep the temperature at 100°, all of the liquid would be transformed into steam. Boiling Point may now be defined as the temperature at which the vapor pressure of a liquid becomes equal to the pressure upon it (the atmosphere). Water boils, therefore, at a different temperature at sea level where atmospheric pressure is equal to 30 inches, than at Old Faithful at an elevation of 7367 feet, where atmospheric pressure is only 23 inches, the two boiling points being 212 and 197 degrees F., respectively.

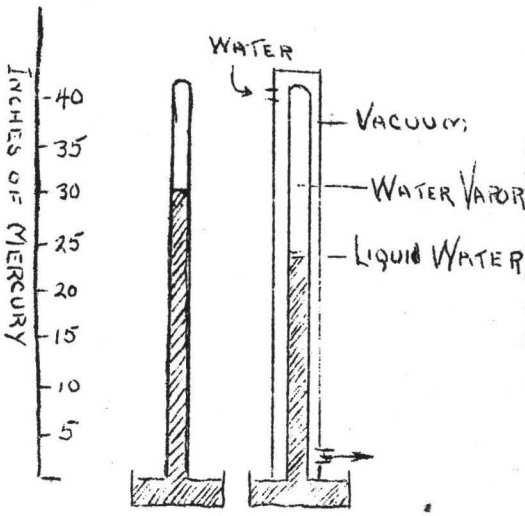


FIGURE 2. Showing fall of mercury in a barometer tube due to the presence of water vapor. The second barometer is fitted with a water jacket to permit heating the tube and contents. The level of the mercury in the second tube drops with a rise in temperature.

This phenomenon of vapor pressure may be demonstrated by admitting water into the vacuum above the mercury of a barometer fitted with a jacket for heating or cooling. In the illustration, a simple barometer is shown on the left, while the tube on the right shows the result of adding water. The black substance is mercury, which is lower in the right tube because the pressure of the atmosphere which is supporting it is partly balanced by the pressure of the water vapor above. By measuring the difference in level of the mercury columns in the two tubes, the vapor pressure might be determined directly. If the temperature of the water in the right tube be raised by admitting warm water into the jacket, the mercury column will be lowered still further. If boiling water be placed in the jacket, the vapor pressure will just counterbalance the pressure of the atmosphere, and the level of the mercury inside and outside the barometer tube will be the same.

BOILING POINT PHENOMENA Ruhle.

Summary: To summarize what has been said above, it can be said that a liquid passes rapidly into the gaseous state ("boils") at the boiling point only but it does the same thing ("evaporates") at lower temperatures, in fact, even when in the solid state ("frozen"), but much more slowly and from the surface only. Gaseous water is most commonly spoken of as steam. Steam is colorless and invisible, but on escaping from hot water into cooler air, a portion condenses into minute drops of water which are visible as a cloud of fog because they have surfaces which reflect light.

DYNAMIC EQUILIBRIUM: UNSTABLE EQUILIBRIUM: SUPERHEATING.

Statis equilibrium has already been considered. It was said that the proportion of water distributed between the gaseous and liquid states existing together was predetermined by the volume and temperature, and this was true after no more change or adjustment after change could be detected in the system. It is possible, however, by keeping pure water vapor, (i.e., vapor containing no liquid or suspended particles) very quiet, to increase its pressure beyond the atmospheric pressure at the boiling point, but the slightest disturbance will then cause condensation. Such a vapor is supersaturated, and unstable.

Any liquid upon changing into vapor absorbs heat. Thus it takes five and one half times as much heat to convert a given quantity of liquid water at the boiling point into steam at the same temperature as it did to raise the temperature of the liquid from its freezing point (32° F.) to its boiling point (212° F.). A liquid can change into vapor only when a sufficient amount of heat is forthcoming.

Boiling water, therefore, continually absorbs heat. In a geyser or hot spring this heat is supplied by superheated steam from below to the surface water and the heated water is raised by the same agency. There are two counterbalancing tendencies at the surface, the removal of heat by boiling away the surface water and the supplying of heat from uncooled volcanic rock below through the agency of rising gases, the chief of which is again superheated steam. If the vapor were confined and no additional heat supplied, static equilibrium conditions would exist, and for an elevation equal to that of Old Faithful, the temperature of the water would have to be 197° if the pressure of the steam were equal to the pressure of the atmosphere. In nature, we do not always find such normal conditions. In the superheated pools and hot springs the ascending hotter water supplies heat more rapidly than the steam removes it and the temperature under favorable conditions passes above the boiling point. Thus we sometimes have a dynamic equilibrium different from the static equilibrium and a supernormal boiling temperature. This is undoubtedly assisted by many factors of which we have no accurate knowledge, such as the configuration of the enclosing walls, the convection currents, the distribution of temperatures, etc. It will also be noticed that the dynamic equilibrium and consequently the boiling temperature is sometimes affected by such factors as wind velocity or surface disturbance of any kind.

BOILING POINT PHENOMENA Ruhle.

Vapor is formed on the surface of a liquid only, and vapor pressure may rightly be considered as a measure of the tendency of a liquid to pass into the vapor state. At increasing depths below the surface this pressure increases with the increasing temperature. Ebullition is therefore fostered by stirring or throwing gravel into such superheated pools as Teakettle, Punchbowl, Purple Springs, Lioness Geyser or Surprise Pool. The rate of change has been increased so much by such means that geyser action has sometimes resulted. Thus the only recorded eruption of Chinaman Pool by Arnold Hague came after stirring it vigorously for one half hour.

OTHER FACTORS INFLUENCING THE BOILING POINT OF A LIQUID.

In general we know that the boiling point of a liquid is raised or lowered by the solution of other substances, either solid or gaseous, therein, but in none of the well-known pools whose temperature is above the boiling point is there enough dissolved material to raise the boiling temperature noticeably. Superheating is consequently due to other factors, among which, especially in alkaline waters, may be mentioned surface tension.



NOTES ON THE ROCKS OF YELLOWSTONE NATIONAL PARK

By D. A. Holm, Ex-Ranger Naturalist

Approved by:
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J. E. Haynes, Former Acting Director of Yellowstone Park Museum

A rock is a mineral or aggregate of minerals occurring in nature as an essential part of the earth. Rocks may be classified on the basis of

1. Mineral composition
2. Chemical composition
3. Texture
4. Origin

It is common procedure to classify rocks according to their mode of origin and on the basis of such a classification, we may divide rocks into three major groups:

I. Igneous rocks, which crystallize from molten magmas.
II. Sedimentary Rocks, which form by the deposition of sediments as either:
    1. Mechanically transported and deposited materials, or
    2. Chemically transported and deposited materials, and
III. Metamorphic rocks, which are formed from igneous or sedimentary rocks by the agencies of heat and pressure. The process may be:
    1. Mineral rearrangement, resulting in the ordering of crystals in linear or banded order, or
    2. Recrystallization, occurring as in the metamorphism of the sedimentary rock limestone, into marble.

All three groups of rocks are abundant in Yellowstone Park, but the most commonly met are the extrusive igneous rocks known as rhyolites, which occur on the central plateau; and the chemically deposited sedimentary rocks known as travertine and geyserite, which are most abundant where hot springs and geysers are found. These will be treated later. Each group will be considered in detail.

IGNEOUS ROCKS:

It is apparent even to the casual observer that the surface rocks of the Park present evidence of a vast amount of volcanic activity during past geological time. Eruptions of lavas have occurred all through Tertiary time, beginning with Eocene dacites and Andesites, followed by basic extrusives during Miocene time, and ended by rhyolitic and basaltic flows during late Tertiary time. The lavas are found in the mountain ranges which border the Park and all over its central plateau.

NOTES ON THE ROCKS OF YELLOWSTONE NATIONAL PARK Holm

Processes of erosion have removed vast portions of the older lavas but the more recent are left much as they were solidified, save where deep canyons have conveniently laid open to our eyes enormous exposures many hundreds of feet thick. In a few areas, the action of hot waters and vapors has altered the rocks to soft clays which are easily eroded, as in the Grand Canyon, but in other areas the rocks are almost as fresh as on the day they were cooled.

Igneous rocks are regarded as the primary rocks of the earth, from which both sedimentary and metamorphic rocks are derived. The genesis and manner of occurrence of igneous rocks are exceedingly diverse. Inasmuch as the igneous rocks in the Park exemplify many forms of occurrence and genesis, it might be well to give a brief scheme of classification according to these characteristics.

Molten magmas from interior reservoirs may solidify within the earth and form Intrusive rocks, or they may solidify at, or near the surface and form Extrusive rocks.

Intrusive igneous rocks are formed from the solidification of molten magmas deep within the earth. The rate of cooling is necessarily slow and allows, in general, the slow growth of crystals from few centers of crystallization, with the result that the rock is usually coarse grained or coarsely crystalline.

Intrusive rocks may be grouped according to the mode of occurrence:

1. Dike rocks are formed in fissures or cracks in the earth, which have been filled with ascending igneous material. The presence of quantities of mineralizers, i.e., gases, in the molten lavas, favors the growth of well developed and large crystals. Dike rocks are often a locus of deposition of valuable ores and minerals. Dikes generally cut through sedimentary, igneous or metamorphic rocks at an angle to the bedding planes. Many dikes are found in the Absaroka Mountains near the eastern boundary of the Park and on the flanks of Electric Peak.

2. Intrusive sheets or sills are usually horizontal masses of igneous material which have been intruded between beds of sedimentary rock or between flows of igneous rock. Contact metamorphism may occur in the rocks immediately above and below sheets or sills. This type of intrusive is found in the Gallatin Mountains and on Electric Peak.

3. Laccolith or"lake-rock", is a lens-shaped mass of igneous material intruded into sedimentary rocks, which has the upper surface dome-shaped and the lower surface flat, and is usually round or oval in general plan. The rocks into which a laccolith has been intruded may be folded or distorted.

4. Volcanic neck or plug is the term used to describe the solidified material in the vent feeding a volcano. The material forming the slopes of the crater may be of softer rocks, which are eroded away, exposing the hard neck, which resists erosion and may stand up as a prominent feature of the landscape. Bunsen Peak may be in part, a plug of dacite.

5. Batholith is a very large mass of igneous material many miles in diameter and of undetermined depth, which has been intruded into the crustal rocks. Batholiths generally underlie mountain ranges. Such is the case in the northern Rockies of Idaho and Montana. No batholith as such has been recognized in Yellowstone Park, unless it be the crystalline rocks extending into the Park from the Snowy Range to the north.

Extrusive igneous rocks are formed from the solidification of molten lavas at or near the surface of the earth. Cooling is necessarily rapid, with the formation of numerous centers of crystallization, with the result that the rock forms a fine-grained (occasionally a rather coarse-grained) crystalline mass. Sometimes the cooling occurs under such conditions that the rock does not crystallize at all but becomes a glass. Extrusive rocks may occur either in quiet flows of fluid or viscous lavas from fissures or cones, or may be ejected in explosive eruptions, in which the material is erupted violently in the fragmental condition. The rhyolites of the central plateau are believed to have extruded in generally quiet flows from fissures and from the crater of the volcano Mount Sheridan. The breccias and beds of volcanic ash of Mt. Washburn and the Lamar Valley are the result of explosive eruptions from craters and fissures, probably in part from Sherman Volcano.

Textures. Igneous rocks are characterized by a wide variety of textures. Numerous examples occur among the rocks of Yellowstone Park.

1. Glassy or vitreous texture needs no explanation. One of the best known rocks of the Park is the glassy extrusive known as obsidian which is exposed on the Grand Loop Road at Obsidian Cliff. Obsidian is a natural glass, amorphous in structure, usually dark-colored and opaque. It breaks with a conchoidal fracture and sharp edges like flint or quartz and was used by the Indians for arrowheads and knives because of this property of fracture. Obsidian occurs at numerous places in the Park, usually intimately associated with rhyolites. The chemical composition of both is about the same. It is often found with rhyolite in thin alternating layers showing flow structure. The old erroneous theory of the formation of obsidian, "that it cooled so quickly that no crystals could form", will not hold in this case; nor does it in the case of thick flows of obsidian, such as at Obsidian Cliff, where it is more than fifty feet thick. The obsidian shows its glassy texture from top to bottom without great change and shows no gradation from glass into rhyolite at the bottom. It is suggested that rhyolite forms because of the presence of gases in the magma acting as mineralizers, while obsidian or glass forms because these mineralizers have escaped from the lava at an early stage.

NOTES ON THE ROCKS OF YELLOWSTONE NATIONAL PARK Holm

Closely related to Obsidian is another glassy rock containing a higher percentage of water than obsidian. This is called pitchstone. It contains 5 to 10 per cent of water, is usually brown in color and has a resinous luster.

Another glass (a variety of obsidian) is perlite, gray in color, and containing about 2 to 4 per cent of water. Perlite sometimes has an oolitic (like fish eggs) structure.

Obsidian often contains spherulites, small spherical bodies in the glass having the same chemical composition as the rest of the rock, but showing a microscopic crystalline form. Under the lens these spherulites are seen to be radial in structure. Some rather large spherulites are found near Old Faithful, just a few hundred yards upstream in the Firehole River canyon, by the side of the trail leading up the canyon toward Keplar Cascade. They occur here in a broken mass of obsidian, perlite and rhyolite, some of them as large as one's fist, generally broken in pieces. The broken spherulites show radiating needles and hollow centers. Spherulites may be found also at Obsidian Cliff, along the new road in the Lower Firehole Canyon, at Pumice Point on Yellowstone Lake and at other places.

Lithophysae or "stone bubbles" often occur associated with spherulites in obsidian. They look like deflated bubbles, with a concentric growth of rings, usually of grayish material, and range in size from very small to several inches in diameter. Pirsson describes lithophysae as "a series of concentric shells of crystalline material, resembling somewhat nested watchglasses, which surround a central cavity, and are more or less separated from each other. They consist of adherent crystals and are very fragile. When exposed by the breaking of the rock they appear much like flowers with concentric layers of petals." In the Park the lithophysae are more usually of nearly spherical form.

Pumice is a glassy rock which has been puffed out like a sponge by the presence of numerous small bubbles of gas or steam during the viscous stage of the lava. It is very light in weight due to the large proportion of air space. It is the same material as pumice used commercially as an abrasive or in small blocks for scouring purposes. Its structure is cellular or vesicular. Other rocks, such as rhyolite and basalt, often occur with more coarsely vesicular structure.

Scoria is the slag-like or cinder-like rock which forms on the surface of many extrusive flows. It is common in recently active volcanic regions, such as the Craters of the Moon National Monument in eastern Idaho and on the slopes of modern Hawaiian volcanoes. It is found here and there on the top of Obsidian Cliff.

Obsidian occurs in abundance in the Park. Besides the large flow of the glass at Obsidian Cliff, it recurs in the upper reaches of the Little Firehole River, on the Madison Plateau, in ridges west of the geyser basins and in the canyon walls of the Firehole River above the

Upper Geyser Basin. It probably occurs in numerous less frequented localities. Good specimens are on exhibition at the headquarters Museum and at the Old Faithful Museum.

2. Felsitic texture. Extrusive rocks which have a uniformly fine-grained crystalline texture are called felsites. Such rocks usually occur in surface sheets or flows. The abundant rhyolites of the central plateau possess such a variety of felsitic forms that one could scarcely ask for better opportunity to observe them. Cooling has taken place under conditions that allowed the uniform growth of crystals about a myriad of centers of crystallization, usually attended by rapid solidification. Thus, the crystals are small in size and are often too small to be recognized without the aid of a lens. The color of felsitic rocks may vary from white to reddish-brown, depending on the chemical composition. In the Park, the felsites appear in many colors, even when the general composition shows no variation. The rhyolites show the greatest range of color variation and may often be mistaken for andesites or dacites, which are more basic rocks and generally darker in color. There is no need for making such a mistake in the Park, for one may identify the rhyolites by location as well as by character. Over the greater part of the central plateau rhyolites are the predominant extrusive rocks. Even at depths of 1200 feet, where exposed in canyons, this is true. In the Gallatin Mountains, on Mount Washburn, on Electric Peak and on Sepulcher Mountain we find andesites. Dacite is found on Bunsen Peak. The more basic rocks, known as basalts, occur near Willow Park, at Osprey Falls and at many other places. In the southwest part of the Park they form extensions of the late Tertiary flows that covered the greater part of the Snake River Valley. Basalts are usually grouped separately from the felsites, although they possess the same textural characters. The columnar structure sometimes characterizing extrusive sheets of lava is beautifully shown in the obsidian of Obsidian Cliff and in the rhyolite that caps the sediments of Mt. Everts, and again at the Overhanging Cliff on the road between Tower Falls and Mammoth, and in the two basaltic sheets on the opposite side of the Canyon at the last-named locality.

3. Fragmental texture. Wherever volcanic action has been accompanied by explosive activity, the rock materials thrown out will be of a fragmental nature. The rock fragments thrown out of a crater fall on the slopes of its cone and form pyroclastic rocks. The fragments may or may not be cemented together. If the pieces are larger than peas and have jagged edges, with little or no rounding off due to the action of water transportation, we call the resulting rock a breccia. The mass of Mount Washburn, which is part of the old Sherman Volcano, is composed largely of andesitic breccias. If the fragments are smaller, grading down to dust-like particles, we may call the rock a volcanic ash. Seen under the lens, many of the particles of ash look like pieces of broken glass, very sharp and jagged, often with many small crystals interspersed. The Fossil Forest at Specimen Ridge is buried under beds of ash and breccia some 2000 feet thick. The settling down of the ash over the succession of giant Tertiary forests in the Lamar valley region, with the resultant burial and silicification of the wood, has preserved for us the forms of thousands of magnificent trees, in the petrifactions.

4. Granular texture. As the name suggests, a rock having a granular texture is comprised of grains or crystals averaging 1/8 inch in diameter. The grains may vary in size from the smallest visible to the size of a pea or larger. Granite, the common building stone, takes its name from the granular texture of its constituent minerals. A similar rock is granodiorite or quartz-diorite, of very common occurrence throughout the Rocky Mountains. A large body of it is found at Electric Peak. It is composed of the minerals plagioclase, quartz, hornblende, micas and some orthoclase. It is an intrusive rock, and in this last case it is believed to have formed the stock or chamber of a volcano.

5. Porphyritic texture. This is seen often in dikes and laccoliths, and is described as having large crystals fastened in a groundmass or matrix of finer-grained crystals. Porphyries may occur either in extrusive or intrusive rocks. The less geologically inclined members of the Ranger Naturalist Division last year kept bringing up the phrase "andesitic porphyry with spherulitic inclusions" and wanted to know what it was. The phrase is hardly worse than the botanist's linguistic meanderings. One can hardly walk ten steps on the central plateau without stubbing a toe on a piece of porphyritic rhyolite and should one go far enough, his toe would surely connect with a beautiful specimen showing spherulitic inclusions. Although scientific names tend to confuse the layman, the latter has the privilege of using these convenient long words as handles for the objects of his dislike. The names are descriptive, however, and should be used wherever possible, instead of loose terms, though one should make some reservations when dealing with the average audience of tourists. In the porphyritic rhyolites the large crystals, which are known as phenocrysts, are generally of quartz, sometimes of the feldspars. Sanidine, a feldspar, is very common in rhyolite.

Rhyolite is undoubtedly the most common rock along the main routes of tourist travel through the Park. From Mammoth to West Thumb and from Lake to Canyon there is little but rhyolite to be seen close to the road. From West Yellowstone across the central plateau the roads follow canyons cut through the rhyolite. Some flows of the rock are exposed along the road to the South Entrance, extending into the Jackson Hole region. Obsidian and its varieties are associated with rhyolites, the best locality being at Obsidian Cliff. Andesites and the basic intrusive equivalent, diorite, occur in the Gallatin Mountains, and may be seen along the Gallatin road. Andesitic breccias make up a large part of the lavas of the Absaroka Mountains, and those of Mt. Washburn. The road over Dunraven Pass is cut through some of this breccia. Bunsen Peak is composed of Eocene dacite. Tourists entering by way of Livingston and Gardiner will see numerous pyroclastics in the west banks of the Yellowstone River, especially in the vertical slide about five miles north of Gardiner. This slide presents a rather interesting example of a sheet or sill which has been partly altered by the decay of the contained minerals, and has been upturned or tilted from a horizontal position by some subsequent orogenic movement. The

NOTES ON THE ROCKS OF YELLOWSTONE NATIONAL PARK Holm

succession of rocks exposed on the east side of the Yellowstone Canyon between Tower Falls and Mammoth, near Overhanging Cliff, is worth calling to the attention of tourists. At the bottom are deposits of basic breccia and ash similar to those that form the beds of the fossil forest and the Sherman Volcano. They have been eroded into extraordinary forms: the "Needles" - tower-like erosion remnants carved out of the heterogeneous breccias. Above the "Needles" are two separate layers of harder rock showing a succession of vertical columns, like fence posts. These are basaltic flows, separated by beds of gravel. Above their upper sheet of basalt is a surface layer of glacial gravels.

SEDIMENTARY ROCKS:

Rocks that are elevated above sea level are subjected to the breaking-down processes of weathering and disintegration. The materials or debris resulting are carried away by the fluid mediums of the atmosphere and water and deposited at some other place, where in time, pressure and the action of ground waters, carrying minerals in solution, may cement the particles together form a hard sedimentary rock. Mechanical sediments are deposited by wind, ice or water, having been carried from the place of disintegration to the place of deposition, in suspension. Deposition occurs wherever this suspension of materials is disturbed. Chemical sediments are deposited or precipitated out of solution, usually by some change in chemical or physical conditions, or perhaps by the actions of minute living organisms, such as algae, bacteria, or sea animals.

Mechanical sediments. The sedimentary rocks exposed in the Park are mostly too far from the beaten path to be of much interest to the average tourist. A good section, however, is exposed just east of Mammoth Hot Springs in the cliff of Mt. Everts. Here are shown in perfectly aligned strata, limestones, shales and sandstones of Cretaceous age. Numerous sections of sedimentary rocks are to be found elsewhere in the mountains if one is sufficiently interested to make a rough excursion to find them. Rocks ranging in age from Pre-Cambrian to Recent are found in the Gallatins and Absarokas. Permian and Triassic rocks occur in the Tetons. On the west side of the Gallatins, a phosphate-bearing rock, named the Phosphoria formation, of Permian age, is exposed. This, with other exposures in Montana, Idaho and Wyoming, is an important source of phosphates. The Jurassic rocks contain a large number of limestones, some of which supply the lime for the travertines of the Hot Spring Terraces. Glacial deposits are fairly common in the Park. The little knoll called Capitol Hill, which is in front of the Mammoth Hotel, is of glacial origin. Around Yellowstone Lake and in Hayden Valley gravels and sands of glacial deposition are abundant. Drift covers part of the floor of the Lower Geyser Basin and is found in evidence around Canyon. A most perplexing bit of sedimentary rock is the series of strata that form Twin Buttes, on the western border of the Lower Geyser Basin. They are composed of smoothly rounded boulders and pebbles of rhyolite in a matrix of fine sands and gravels. Hague has mapped this deposit as Pleistocene glacial gravels. Some question as to this interpretation has been raised

recently but no one has offered a better explanation. Hague's explanation is probably essentially correct, but does not tell the whole story. The history of this prominent topographical feature is made all the more perplexing by the presence of seven small lakes lying near the base of the buttes. The geological importance of Twin Buttes may be all the more emphasized since the New Geyser appeared at its base, and tourist travel was directed to it.

Chemically deposited sediments. There are two rocks of this type that are of importance in the Park. The tourist will wear out his shoe soles on them wherever there are hot springs or geysers. One is travertine, a calcium carbonate deposited by the hot springs at Mammoth, and the other is geyserite, a hydrous silicon dioxide, deposited wherever there are geysers.

1. Travertine. The terraces of Mammoth Hot Springs are composed of travertine, which is a limestone formed by the precipitation of calcium carbonate from hot spring waters. The hot waters moving from the lower strata towards the surface pass through layers of limestone and dissolve the lime, carrying it in solution to the surface. Carbon dioxide dissolved in the water aids materially in the process of solution. As the hot water reaches the surface the carbon dioxide escapes and the calcium carbonate in solution is precipitated as travertine, building up at a rapid rate the extraordinary terraced deposits that make Mammoth Hot Springs extraordinary among thermal springs of the world. Terrace Mountain is composed mainly of travertine. Glacial erratics rest upon its top, and a floor of travertine under Capitol Hill is taken as evidence of the pre-glacial origin of the thermal activity of these hot springs.

2. Geyserite. All over the central plateau, wherever ground water is heated by gases and condensing steam from the underlying igneous intrusives, solution of the silica contained in the rhyolite occurs. As the hot water escapes to the surface, release of pressure and gases allows the precipitation of this silica in a hydrated form. We know this silicious deposit as geyserite or siliceous sinter. It is a white or gray mineral, very hard when fresh but rather easily broken up when subjected to the disintegrating action of the elements. It floors the geyser basins to considerable depths. The rims and cones of geysers and hot springs in the silicious area are built out of geyserite. Gorgeous colorations, so common in the edges of the larger pools and overflow channels, are not due to mineral impurities but to the presence of algae - minute plant organisms. Geyserite is found in a wide variety of depositional forms, varying almost from one geyser to another. The exhibit of thermally deposited minerals shown in the new Museum at Old Faithful should be studied, in order to facilitate a moderate appreciation of the artistic splurges Nature has indulged in. The average tourist may not notice the extraordinarily beautiful configurations of the geyserite formations unless his attention is called to them. One in particular may often be found where algae has dried up, with the formation of minute towers and needles of geyserite in patterns that would make a cathedral architect green with desperation. The

numbers of geyserite forms that are to be found are myriad. One only needs to keep his eyes open to be rewarded with unusual beauties.

METAMORPHIC ROCKS:

Metamorphic means change of form. Wherever rocks have been changed by the action of heat and pressure, generally through chemical processes, metamorphic rocks are present. "Metamorphism" in its most general sense, includes such processes of hydrothermal alteration, but more commonly it implies increase in crystallinity, hardness, etc. as in the formation of schists and gneisses. The rhyolites of the upper end of the Grand Canyon of the Yellowstone have been completely altered to clays, kaolin and oxides of the various basic minerals. Being naturally softer than the fresh rock, these altered rhyolites have been eroded rapidly by the torrents of water escaping from Yellowstone Lake, cutting the deep gorge that gives tourists such unadulterated pleasure to contemplate. The colors in the canyon walls come from the alteration of the basic minerals of the fresh rhyolite. The yellow color that predominates in the Canyon is responsible for the name Yellowstone.

Other metamorphic rocks may be found in the mountain areas of the Park. At Tower Falls, one with a sharp eye for rocks can find many altered dikes, with such alteration products as garnets, micas and other semi-precious stones. Metamorphism in the older rocks has produced gneisses, schists and slates, which are so far from the beaten path that no further mention need be made of them.

The rather sketchy material on the rocks of the Park given here needs to be expanded by the individual himself, and reference to the publications given below may be of considerable help:

Hague, Arnold, Geology of Yellowstone Park, USGS Mono 32, Pt 2. 1904 and Atlas of Areal Maps.

Hague, Arnold, Geological History of Yellowstone Park, Bulletin of the National Park Service, 1921.

Weed, W. H., Geysers of Yellowstone Park, Bulletin of the National Park Service.

Pirsson, L. V., Rocks and Rock Minerals.

USGS, Folio #30, Yellowstone Park.



THE NEW GEYSER

By Dorr G. Yeager, Park Naturalist

Approved by:
Dr. Arthur L. Day, Director, Geophysical Laboratory
J. E. Haynes, former Acting Director of Yellowstone Park Museum

About the middle of July 1928 reports began coming into Mammoth of a great geyser which had broken out in the Fairy Creek District. The reports were at first vague and we could get very little information upon this new giant. No press reports were issued until August, however, as there was much speculation as to whether or not a geyser of such magnitude could long endure. The eruptions continued, and beginning August 11th the Park Naturalist spent four days at the geyser, gathering data for a report to the superintendent. A portion of the report submitted August 15, 1928 is as follows:

"History of the Geyser:

"On July 10th Rangers Woerner and Dale of the Fountain Ranger Station observed a large amount of steam rising from the valley between Fairy Falls and Twin Buttes. The steam continued to rise at intervals and four days later, on the 14th of July, Ranger Dale went to the region and observed the geyser for the first time. The following day Ranger Woerner observed the geyser. They reported that at that time the interval was regularly $7\frac{1}{2}$ hours and that the period averaged $3\frac{1}{2}$ hours, the shortest observed period being $3\frac{1}{4}$ hours.

"Mrs. Arnold (Park Ranger) and Tom Astle (Park Publicity Man) were the next two persons to view the geyser, making the trip from Mammoth and returning the same day.

"A short time later, Ranger Woerner conducted three persons (a Mr. Edward and two sons) to the spot. Following these Drs. Allen and Fenner, of the Geophysical Laboratory, and Messrs. Albright, Woodring, Goodwin, Demaray, Haynes, Wagstaff, Ruhle and Yeager all witnessed eruptions.

"Ranger Woerner has been observing the steam from Fountain Ranger Station each day. He reports the longest interval which he has seen to be $14\frac{1}{2}$ hours and the longest period $5\frac{1}{2}$ hours. This, however, is simply from an observation of the steam at a distance of several miles. The belief at Fountain, however, is that both the interval and period is increasing which confirms and strengthens the conclusions drawn by the Park Naturalist during the past few days.

"Structure and Location of the Geyser:

"The new geyser is located between Fairy Falls and Twin Buttes, approximately 200 yards west of Spray Geyser. It may be reached from Old Faithful by following the Madison Junction road

to the point where the Fountain Freight Road branches to the left. Following the freight road 3/8 mile beyond Goose Lake there is, on the left of the road a large tree with a National Park Service blaze. Tracks turn to the left here and into a meadow. Following these tracks in the general direction of Twin Buttes one fords Fairy Creek twice, drives to the edge of the timber and there parks the car, as it is dangerous to go further because of the swampy condition of the ground. A good trail begins 100 feet southwest of this point which leads to the geyser.

"The geyser is located in a small valley which shows much evidence of thermal activity at an earlier date. Round water-worn pebbles show that it was, in all probability, a stream bed at one time.

"The vent is an opening approximately 2½ feet wide and 9½ feet long. Erosion and the force of the eruptions have worn a large crater about it 130 x 90 feet in size. The walls of this crater suggest that thermal waters were once very active in this region, as a ledge of silicious sinter fully two feet in thickness is visible on the south side. Under this is black dirt and clay showing that probably this activity was not of long duration in early times. Dr. Allen reports having seen a small geyser playing from this same crater in the summer of 1927. The large crater is surrounded by bubbling springs and no less than 10 steam vents are found within the crater basin, surrounding the vent from which the present eruptions take place.

"Investigations by the Geophysical Laboratory of the Carnegie Institution, which were recently made, show that the conduit of this geyser is one of the deepest in the Park. A depth of 74 feet was reached before the narrow rift forming the throat below, refused to admit a small plumb-bob. This depth is equal to that of the Lion and is one foot deeper than the conduit of Giantess Geyser, heretofore commonly considered the deepest in the Park. Temperatures near the bottom give readings of 120 degrees C. The rate of overflow was also measured and it shows that over one million gallons of water are thrown out at each eruption."

A detailed hourly report followed. The summary of detailed observations read:

"From the above observations and the earlier reports of Ranger Woerner it will be seen that both the interval and the period of the geyser are increasing. Nothing definite on the time of eruption can be said. The interval at present varies from 8 to 13 hours. The average is around 11 or 12 hours. The geyser at present is playing from 4 to 5½ hours.

THE NEW GEYSER Yeager

"The water fills the crater and recedes several times before the eruption takes place. It is evident that the water must flow over the outlet and into the creek for at least 15 minutes before the eruption begins.

"One observation of especial interest is that the pools near the geyser boil most vigorously directly after an eruption. The water in these pools changes color during the playing of the geyser itself.

"A peculiar 'pop' or 'thud' is heard with each spurt of water. This is probably caused by the sudden release of steam below and is not unlike the pounding of a teakettle in violent ebullition.

"Another interesting observation reveals an apparent connection with Spray Geyser. During an interval of the new geyser the Spray plays to a height of 12 or 15 feet. During eruption of the new geyser the Spray erupts only about 3 feet.

"Several names have been proposed for this geyser. The name "Twin Buttes Geyser" was suggested. Mr. Woodring suggests "Geyser of the Woods". I am impressed with Mr. Woodring's suggestion and offer "Valley Geyser" as another possibility."

The eruption is of the spreading jet type, resembling closely the famous Excelsior* which ceased playing in 1890; although not as great as the Excelsior, the new geyser plays in a series of spurts to an average height of 75 feet, shafts often reaching 100 feet or more.

Whatever may be said about the other geysers in the Park, certainly none will dispute that the sheer strength of this giant, set as it is in an isolated wilderness valley, goes far toward placing it well to the front among the others in the Park.

Since the report on detailed observations of the new geyser was submitted on August 15th several interesting happenings might be noted.

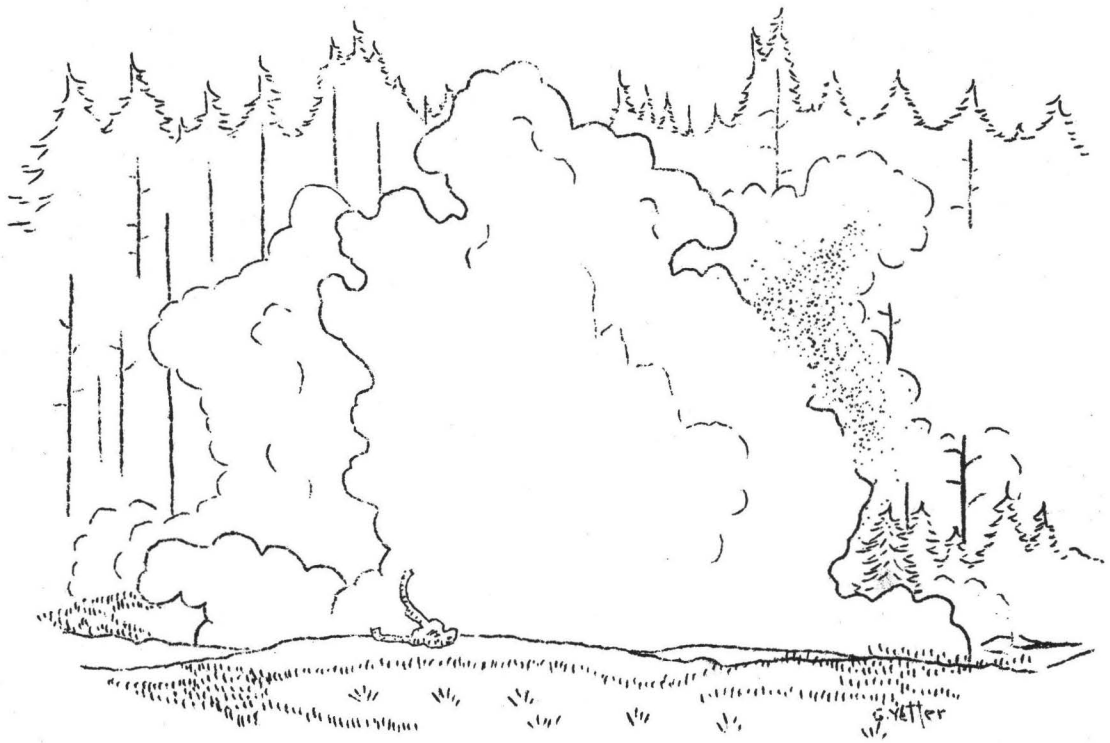
For at least two months after the geyser began its eruption, rounded pebbles and pieces of sinter were thrown out by the eruption and accumulated to a depth of several inches about the crater. The water was muddy and the whole eruption gave evidence of the youthful stage of this new phenomenon. In a few months, however, the water cleared and rocks ceased to be thrown out. This seemed to point to the fact that the tube was becoming washed out and that the geyser might become a stable affair.

THE NEW GEYSER Yeager

A sign has been placed on the freight road at the point where cars turn off and another sign states where cars should be left. During the latter part of August busses ran from Old Faithful Lodge and Hotel, carrying tourists to see this new wonder.

During the fall the geyser kept up its regular eruptions, with the period slightly on the increase.

*Up to the fall of 1928 it was generally understood that Excelsior Geyser erupted last in 1898. However, we have recently received correspondence and proof relative to the last eruption and find that this really took place in the year 1890.



GEYSER REGIONS OF OTHER LANDS

Prepared by:
Dr. George C. Ruhle, Ex-Ranger.

Approved by:
Dr. E. T. Allen, Geophysical Laboratory, Carnegie Institution.
Dr. C. N. Fenner, Geophysical Laboratory, Carnegie Institution.

The occurrence of geyser phenomena throughout the world is rare in comparison with the occurrence of other volcanic phenomena since proper conditions are seldom encountered. Nevertheless, there is a much wider distribution than is generally supposed, though they are not prevalent in any locality on such a grand scale or wide diversity as in Yellowstone Park. Geysers are found in all quarters of the globe at all elevations from sea-level to 20,000 feet.

ICELAND has always been the classical land of geysers, for it was here that they were discovered and first scientifically investigated, and it was for centuries the only locality in which they were known to exist. They were first mentioned by the great Scandinavian historian Saxo-Grammaticus (1150-1206) in the preface to his "History of Denmark". As is shown by published writings, public interest in Iceland geysers grew to considerable proportions towards the end of the eighteenth century, and reached a climax eight decades ago. Since that time it has shifted to the Yellowstone and New Zealand fields, and Iceland again seems to be merely that distant outpost of Europe on the periphery of the Arctic Circle.

The mighty volcanic forces that have given the island its geysers have not yet ceased. A score of active volcanoes still unfurl their fiery banners of smoke, lava, and ashes across Icelandic heavens. Mightiest of these is Hecla, the Hooded (el. 5,100 feet), located twenty miles from the southwest coast. No less than twenty-six times has it disturbed the composure of the neighboring countryside with eruptions that have been remarkable both for their violence and endurance. One of the latest, beginning in September, 1845, lasted for over a year and scattered dust as far as the Orkney's, five hundred miles distant. In contrast to the grotesque lava slopes of volcanoes streaked with brilliant metallic oxides or clad with mighty jokulls, or glaciers, luxuriant carpets of green grasslands, or Hudsonian birch "forests" of elfin stature stretch over valley and lowland.

Thermal activity is widely distributed over 5000 square miles of Iceland terrain, but geysers are found in three localities only. Prevailing igneous rocks are rhyolite, phonolite, and palagonite. Mounds of siliceous sinter occur, but the absence of chimneys or cones such as are found in the Yellowstone betokens the youthful age as distinctly as the glowing hearts of living volcanoes.

GEYSER REGIONS OF OTHER LANDS Ruhle

Forty miles northwest of Hecla, the broad, desolate, marshy Valley of the Hawks (Haukadalr) nestles at the foot of a range of hills, three or four hundred feet high, whose volcanic needle spires are gaudily smeared with reds, browns, yellows, and grays. The plain is crossed by the Hvita (White), one of the largest Iceland rivers. Here, at an elevation of 360 feet above sea-level, a hundred or more hot springs of varying dimensions and character are found within a circuit of two miles. At its northern edge rises the Laugarfjall, Hot Spring Mountain, devoid of every trace of vegetation, pocked with small geyser mounds, discolored with clays of many hues, and punctured by a myriad of fumaroles, hot springs, and spurting jets. At its base sleeps the mighty Great Geyser, dreaming perhaps of the days when it was the most famous in the world, when it attracted to these wild and dreary wastes master-minds of the nineteenth century. Calm and limpic appears the circular pool of sea-green water, sixty feet in diameter and four feet deep, which fills the saucer-like depression on the summit of a gently terraced mound of cauliflower-like geyserite. In the center of the basin is a cylindrical shaft ten feet in diameter and one hundred feet deep (Keilhack, 1883). Water spills over the eastern rim in little runnels.

Since Great Geyser was first mentioned in 1647, its eruptions have varied greatly in nature and frequency. The highest recorded eruption is 360 feet (Olafsen and Povelson, 1770) and the longest duration is twenty minutes (Symington, 1859). The period between eruptions has been gradually increasing. The big earthquake of 1896 was followed by accelerated activity, which was of short duration only. The following indicate the extent of variation: 1775, period $\frac{1}{2}$ hour; 1805, 6 hours; 1860, 4-5 days; 1883, 20 days; 1896, 1 day; 1905, 3-8 days.

Great Geyser, or The Geyser, has given its name to all hot springs which have intermittent eruptions. The word is derived from an old Icelandic verb, geysa, to rush forth furiously, to burst forth with violence.

One hundred twenty yards south of Great Geyser is the crater of Strokkr, the Churn. Before 1789 it was an insignificant spring to be metamorphosed into a mighty geyser by the earthquake of that year. Its powerful eruptions to heights of 150 feet or more occurred several times a day, but visitors accelerated these by throwing pieces of turf or sod into the vent, a procedure which probably resulted in the cessation of natural displays and ultimate death. It is told by W. S. C. Russell that a Frenchman desirous of getting an exceptionally powerful eruption dumped in many stones, after first casting in quantities of turf; since that time Strokkr has not spouted again, regardless of

what artificial urge has been tried. Spontaneous eruptions ceased in the middle of the past century. Strokkr has a tunnel-shaped crater ten feet in diameter at the top and narrowing to ten inches at a depth of forty feet. During quiescence the level of the water was ten or fifteen feet below the rim. It was in constant ebullition. The earthquake of 1896 had no effect on Strokkr such as it had on Great Geyser.

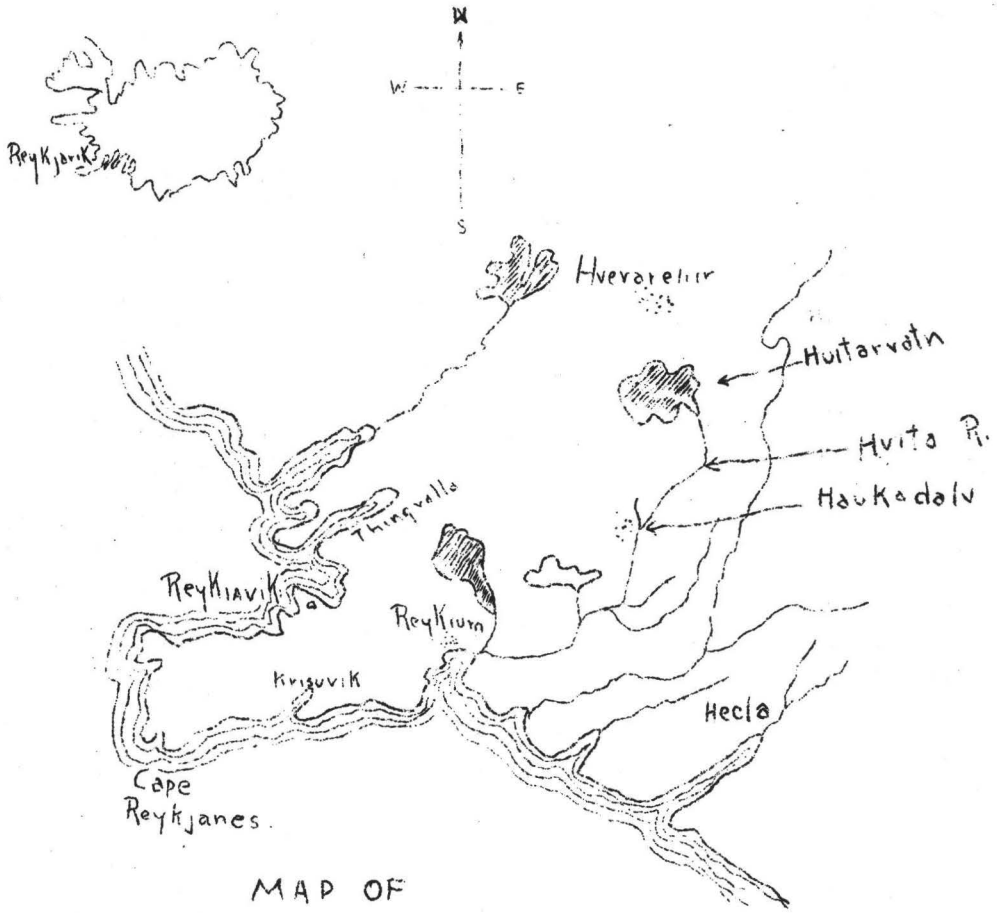
Two hundred twenty yards southwest of Great Geyser is a small geyser, Oderis holla, which became active in 1905. It plays frequently to a height of fifteen or twenty feet.

Konungsvher was an active geyser near the Great Geyser which played as late as 1877. Near it was old Strokkr, also called Bleri, the Roarer. It once rivalled Great Geyser in the magnificence of its displays but since the earthquake of 1789, its activity waned until it ceased altogether. It had previously played thirty or forty feet high every four or five minutes. Little Geyser formerly played ten or twenty feet high every two hours. It has been inactive for many decades. Smidur, the Blacksmith, is a small geyser that plays fifteen feet high after excessive soaping.

On the southern coast of the northwestern peninsula of Iceland the geyser Krablanda plays four or five feet high every four minutes from a crater two feet in diameter. In northern Iceland half way between the village of Husavik and Myvatn (Gnat Lake) the intermittent geyser Uxavhorr plays every five or six minutes to a height of three feet.

In addition to the above, the following thermal regions bear mention: Hveravellir (plains of the hot springs) situated between two glaciers, Hofsjokull and Langjokull, and celebrated for the great beauty of its springs; Reykolt thermal area, north of Reykjavik, with its vigorously boiling hot springs - "geyser springs"; the very active regions around Reykir on Skagafjord in the north and around Myvatn with mud-pots, solfataras, and fumaroles; the areas around Thingvallavatn and Reykium which were formerly very famous for geysers and hot springs, but which suffered from the 1789 earthquake and have since greatly diminished; the solfatara fields around Krusavik and Cape Reykjanes. (Note: The Thingvallavatn and Reykolt thermal fields are now visited by tourists on the Raymond-Whitcomb "North Cape Cruises" as well as the Hamburg-American Line's annual S. S. Reliance tour.)

Perhaps the thermal regions of the NORTH ISLAND OF NEW ZEALAND have had the most varied and colorful history of all. They are spread over 2500 square miles in or near the headwaters of the Waikato River northeast of Lake Taupo.



MAP OF

MAIN GEYSER AREAS

OF ICELAND

Scale of Miles

10 20 50

(Page 304 Hayden 1878 Report)

GEYSER REGIONS OF OTHER LANDS Ruhle

When Hayden wrote his report on the survey of the Yellowstone Region in 1878, the center of interest was around Rotomahana, Warm Lake, thirty-five miles northeast of Lake Taupo. Here were the world-famous Pink and White Terraces and TeTarata (Tattooed Stone) Geyser, about which we read the following:

"'About 80 feet above the lake, on the fern-clad slope of a hill, from which in various places hot vapors are escaping, there lies the immense boiling caldron in a crater-like excavation, with steep reddish sides 30 to 40 feet high, and open only on the lake side to the west. The basin of the spring is about 80 feet long and 60 wide, and filled to the brim with perfectly clear, transparent water, which in the snow-white incrusted basin appears of a beautiful color like the blue turquoise ..... Immense clouds of steam, reflecting the beautiful blue of the basin, curl up, generally obstructing the view of the whole surface of water; but the noise of boiling and seething is always distinctly audible..... The deposit of the water is like that of the Iceland springs, siliceous, not calcareous, and the siliceous deposits and the incrustations of the constantly overflowing water have formed on the slope of the hill a system of terraces, which, as white as if cut from marble, present an aspect which no description or illustration is able to represent. It has the appearance of a cataract plunging over natural shelves, which, as it falls, is suddenly turned into stone.

"'The flat spreading foot of the terraces extends far out into the lake. There the terraces commence with low shelves containing shallow water-basins. The farther up, the higher grow the terraces; two, three, also some four and six feet high. They are formed by a number of semicircular stages, of which, however, not two are of the same height. Each of these stages has a small raised margin, from which slender stalactites are hanging down upon the lower stage; and encircles on its platform one or more basins resplendent with the most beautiful blue water. These small water-basins represent as many natural bathing-basins, which the most refined luxury could not have prepared in a more splendid and commodious style. The basins can be chosen shallow or deep, large or small, and of every variety of temperature, as the basins upon the higher stages, nearer to the main basin, contain warmer water than those upon the lower ones. Some of the basins are so large and so deep that one can easily swim about in them. In ascending the steps, it is, of course, necessary to wade in the tepid water, which spreads beside the lower basins upon the platform of the stages, but rarely reaching above the ankle. During violent water-eruptions from the main basin, steaming cascades may occur; at ordinary times but very

little water ripples over the terraces; and only the principal discharge on the south side forms a hot, steaming fall. After reaching the highest terrace there is an extensive platform, with a number of basins, 5 to 6 feet deep, their water showing a temperature of 90° F. to 110° F. In the middle of this platform there arises, close to the brink of the main basin, a kind of rock island, about twelve feet high, decked with manuka, mosses, lycopodium, and fern. It may be visited without danger, and from it the curious traveler has a fair and full view into the blue, boiling, and steaming caldron. Such is the famous Te Tarata.'

"This geyser usually boils to a height of 10 or 15 feet. When there is a south wind, according to Mair (New Zealand Institute Transactions, Vol, IX, 1876), the water recedes, and when the wind changes the basin refills at the rate of three or four feet per hour, boiling and roaring like an engine, and when almost full sends up a column of water 20 feet in diameter to a height of 60 feet.

"OTAKAPUARANGI (cloudy atmosphere) or the PINK TERRACE is on the opposite side of the lake from Te Tarata, which it much resembles, except that its 50 terraces are tinged with pink, which is most marked in the upper portions of the deposit. The rocks on the hill surrounding the siliceous mass are harder than those around Te Tarata. The main plat form upon which the basin of the geyser is situated is 60 feet above the lake and measures 100 yards by 100 yards. The geyser is smaller than that of Te Tarata, measuring about 50 feet diameter, and is very deep, filled with azure-tinted water which is generally boiling, and has a temperature of 204° to 208° F. At times the geyser quiets and the overflow ceases, but the times of these cessations have never been determined. The pink color is due to iron oxide, traces of which are found upon analysis of the water. Unlike Te Tarata, the deposits are narrower at the bottom near the lake, on account of being incloses in a horseshoe curve of the hill."

By 1880 most of the phenomena about which Hayden tells were no longer active, a condition prevailing until a surprising eruption of the bordering "dead" volcano Tarawera altered the whole face of the country and plunged the New Zealanders into deepest gloom by robbing them of their celebrated terraces. At this time the mountain was a flattened dome rising abruptly from the slightly elevated plateau and undoubtedly of volcanic origin although it had suffered much from denudation and was without the remnant of crater. The highest point, Ruawahia, was 3609 feet above sea-level, flanked on either side by the false summits Tarawera on the south and Wahanga on the north. Soon after midnight on June 10, 1886, a series of earthquakes and a great rift extending along the whole mountain occurred from which issued a series of terrific eruptions that covered the whole countryside first with hot mud and later with white ash. The existing Lake Rotomahana was replaced by enlarged basin with precipitous walls and mud-covered bottom honeycombed with vents. The terraces were destroyed and the topography of the area completely altered.

GEYSER REGIONS OF OTHER LANDS Ruhle

Fourteen years later the islanders were compensated for their great loss by the addition of a new but temporary wonder, Waimangu (Black Water), the mightiest geyser of all history, whose action more near resembled that of a volcano. Previously it had been inconspicuous but in January, 1900, it suddenly broke forth without warning in spectacular display, projecting heavenwards mighty fluted shafts of steaming black water that broke into cauliflower-like masses a thousand feet above the vent and showered boulders, mud, and sand back into the crater or over the surrounding slopes. Highest eruptions measured 1500 feet (457 meters) and it is estimated that the geyser column contained more than 800 tons of water.

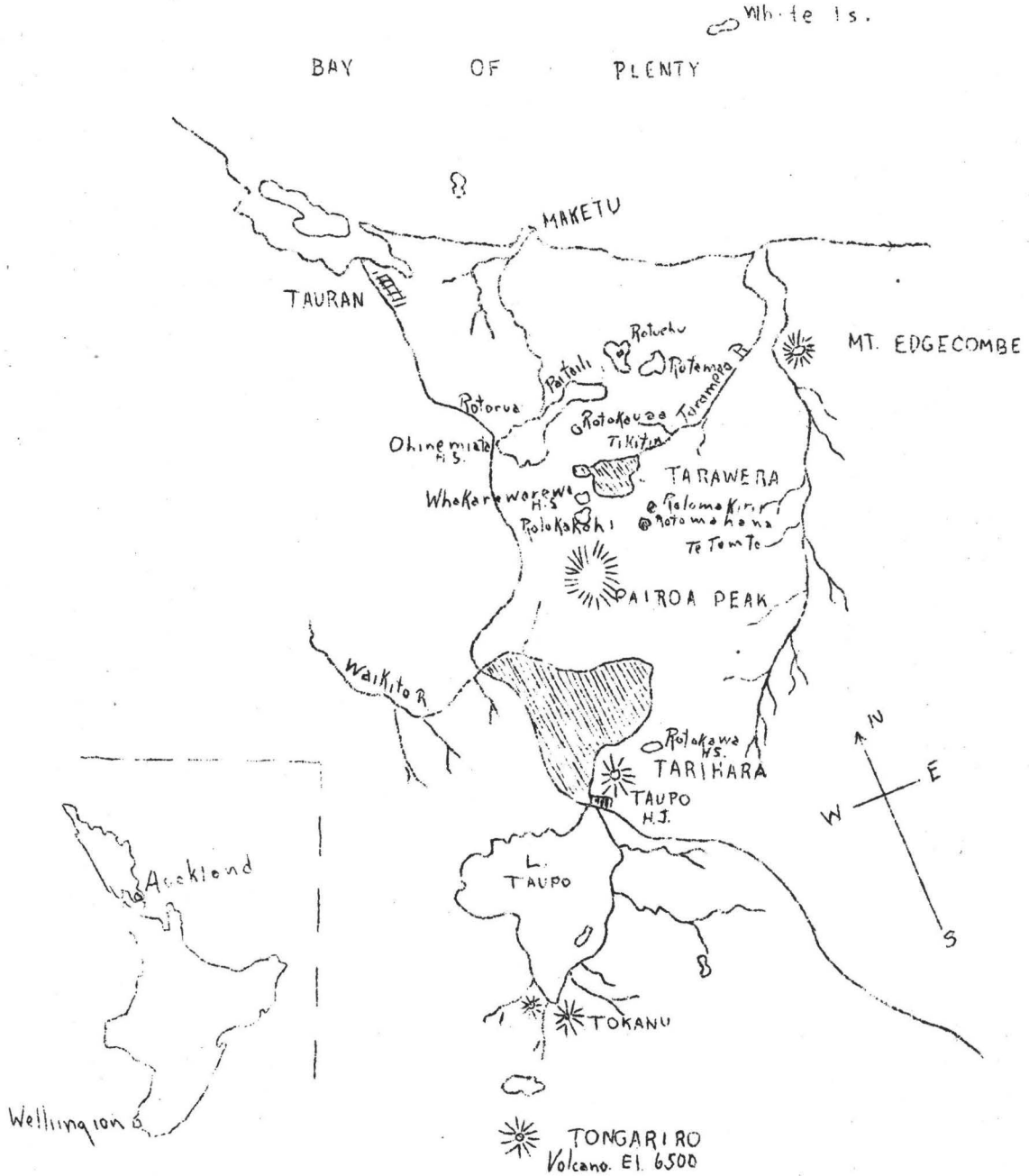
For a time Waimangu continued to erupt with erratic periods of five to thirty hours, averaging once a day. Their instantaneity endangered the life of any one bold enough to approach the crater. (Drew, National Geographic Magazine, 1926). In 1904, the geyser failed to erupt in July and August, and ceased playing altogether in October. Five years ago it again resumed temporary activity though not on its former grand scale. The geyser basin is a two-and-a-half acre hollow with steep slanting walls at the base of Tarawera. The crater is a cauldron, 130 by 75 feet, filled with quiet muddy water. Tarawera is passive and smokeless now, and Waimangu's crater is reported to be gradually drying up. (Setchell, communication).

The New Zealand thermal regions are celebrated for their intense activity. The earth gapes with steaming cracks; a cane thrust a few inches into the soil releases a jet of steam or spout of hot water. Each is an inferno of boiling mud-pots, bubbling, vaporous lakes of hideous colors, blasts of steam on plain and hillside.

The guide book of New Zealand issued by the Thomas Cook and Son in November 1902 at the height of Waimangu's activity describes the eruptions as follows:

> "The eruptions of Waimangu are of four kinds: (1) Wave-like upheaval, attended by the escape of low pressure steam; (2) geyser displays of beautiful black feathery fountains, averaging about one hundred feet in height, projected in an endless variety of form, above billowy clouds of purest white; (3) eruptions - paroxysmal outburts of tremendous energy, throwing up to a height of 100 to 500 feet magnificent cathedral-like masses of black ash, which are instantly wreathed in steam escaping from the ejected material. These astonishing exhibitions of hydro-thermal activity are followed immediately by a wondrously beautiful pillar of cloud which rapidly ascends, sometimes to a height of 5000 feet; (4) volcanic explosions, which discharge enormous quantities of earth and stones, often to several hundred feet in height, and in various directions, from the crater basin. The projectiles, in falling, leave a trail of misty steam, like comet tails; sometimes they explode in mid-air, and fall like the shower from a rocket, which the rapidly rising steam cloud soon envelopes. These displays are the greatest hydro-thermal phenomena in the world...."

MAP OF THE GEYSER AREA OF NORTH ISLAND NEW ZEALAND, IN 1880
FROM HADYENS REPORT



GEYSER REGIONS OF OTHER LANDS Ruhle

Likened unto small Norris Geyser basins, many of the New Zealand thermal regions are celebrated for their intense activity. The earth gapes with steaming cracks; a cane thrust a few inches into the soil releases a jet of steam or a spout of hot water. Each is an inferno of boiling mud-pots, bubbling and vaporous lakes of hideous colors, blasts of steam on plain or hillside. The tourist usually enters the thermal areas from the village of Rotorua (pop. 4,000), 171 miles by rail from Auckland. It is in the very midst of the active regions that stretch 150 miles from Wha-ka-a-ri (White Island) in the Bay of Plenty to Lake Taupo. Their average width is twenty miles; the elevation of the geyser districts is 1000 to 1500 feet. Some hot springs are located within the village, but the larger and more famous of these have been enclosed and are used as baths.

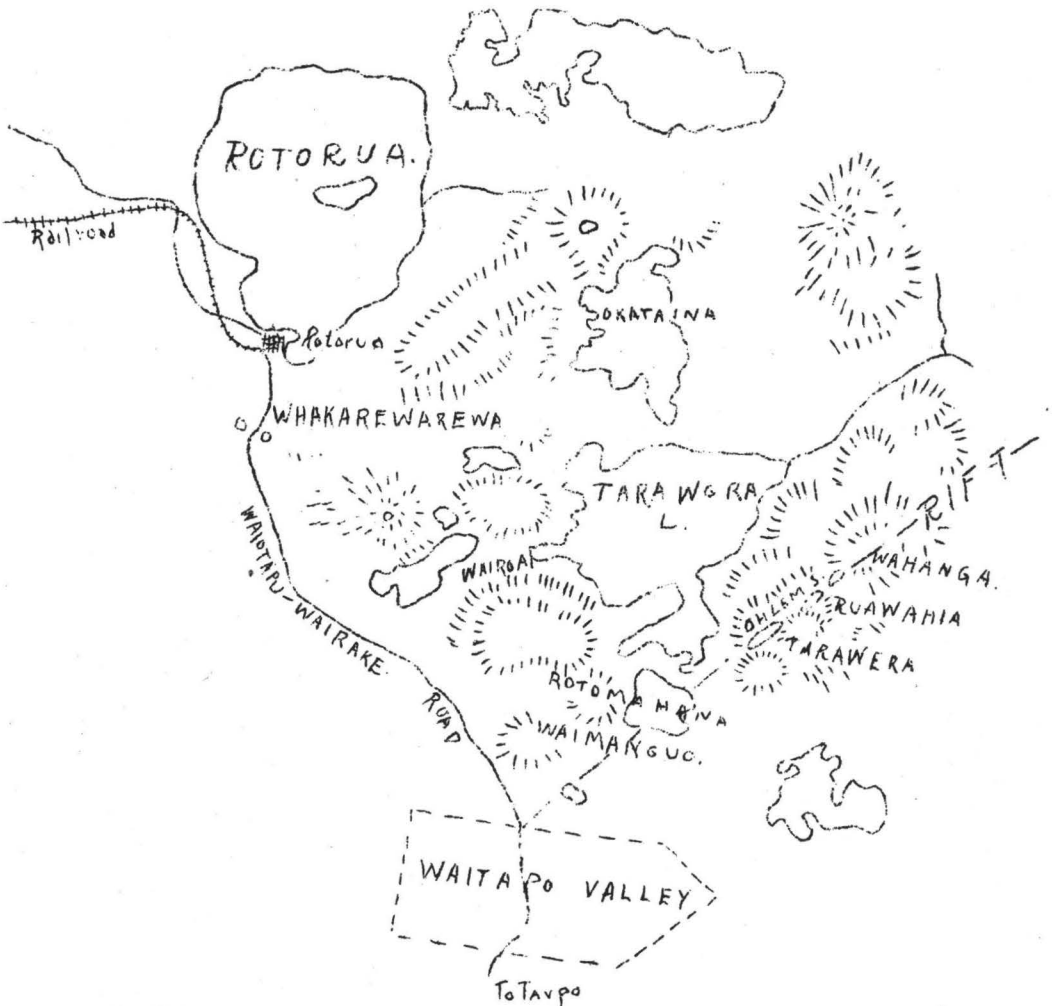
Two miles from Rotorua lies Wha-ka-rē-wa-rē-wa (to set afloat and keep floating) in the heart of which lies a picturesque aboriginal Maori village. Here are ten or twelve active geysers or puias. These play at intervals of two to ten hours, and are of the "splasher (fountain) type". Most famous of these was Waikite, located high on a terraced mound of glistening white silica like coral. It played regularly every eight minutes to a height of ten feet or more, but in the summer months (January and February) these eruptions often reached one hundred feet. It ceased playing in 1896, but resumed activity in 1927 with eruptions fifty feet high (Communication from New Zealand government).

In the overflow from Waikite is Wairoa, formerly a mighty geyser playing 130 feet high, but now inactive unless copiously soaped. The vent is protected by a padlocked wooden cover that can be removed for soaping, a rare indulgence for the entertainment of most distinguished visitors only. This geyser is one of the very few New Zealand geysers of the spouter (Old Faithful) type.

The geyser, Pohutu, is supplied with water from the open reservoir TeHoru, a great cauldron of boiling water, fifteen or twenty feet in diameter, which constantly rises and falls. As it rises it boils furiously giving off dense clouds of steam. When nearly full, large sparkling bubbles dance over its surface and, breaking, throw up sparkling columns two to twenty feet high. At this instant, Pohutu, with tremendous overwhelming rush, projects a tall steaming column reputed to be sometimes one hundred feet high and lasting two or even three hours. Papakura (Giant's Cauldron) is a smaller geyser that spouts several times a day from its sintered well on the Puarenga River. Keruru is another small geyser emptying directly into a nearby creek.

The basin is to be compared to Norris Basin but is smaller and less striking. The water for the most part is dull, lacking transparency or pleasing colors.

Tikitiri is a desolate valley of furiously active solfateras, mud volcanoes, and dirty-colored hot springs filled with ill-smelling waters. Its entrance, Gates of Hades, is steam-blanketed by two boiling mud pots, one thick, the other thin. The Inferno is a precipitous yawning black pit filled with boiling mud.



SKETCH MAP SHOWING EXTENT AND LOCATION OF TARAWERA VOLCANO RIFT

GEYSER REGIONS OF OTHER LANDS Ruhle

Waiotapu Valley, twenty miles from Rotorua, is situated at the base of Kakaramea, Painted Mountain, a scarred and steaming volcanic cone. In it, Northland geyser plays 15 or 20 feet high from an artificial cone made of triangular stones cemented together (W. A. Setchell). Waikite Valley, nearby, is celebrated for its "Boiling River" with its "Boiling Cascades." The stream is fair-sized and is fed with hot water from numerous springs.

Fifty miles from Rotorua is the Wairakai Geyser Valley with a great gathering of thermal phenomena, far less active than formerly. The Basin is crossed by Te Wairakei, a hot stream that rushes over broken rocks. Champagne Cauldron (Tuhuatahi) is an enormous cauldron of boiling water, seventy feet in diameter. Pack-horse Mud Geyser is a deep crater of lead-colored mud which was excited into activity by the frantic lunges of an unfortunate pack-horse that fell into it.

The Great Wairakei Geyser is the largest and most interesting geyser which has built up a considerable mound of sinter at the base of a steep cliff of black rock with white incrustations. Its narrow opening is lined with light brown spongy sinter. The geyser is very energetic, but irregular in period, force, and volume. It plays at average intervals of eight minutes to heights of four to fifteen feet for four minutes. In its overflow are found the best display of algae and sequence of algous colors in New Zealand, but this does not approach the fine displays so common in Yellowstone.

The Dragon's Mouth is a small, deep, bright-red opening filled with boiling water that is thrown out in feathery streams ten feet high. Lightning Pool is a small circular basin of boiling water in whose depths "bubbles of fire" grow as they ascend. It recalls Firehole Pool in Yellowstone. Black Geyser is a small basin in jet black sinter. Within it are smooth, lustrous, black, incrusted stones. The geyser plays regularly to a small height. The Eagle's Nest is a geyserite cone surmounted by huge, nest-like pile of sticks incrusted and cemented together with snowy white sinter. It is an intermittent, irregular "splasher". The Funnel is a steam vent in a large triangular fissure in black rock, with occasional roaring geyser displays. The "Boilers" is a rock-rimmed pool with a black ground of dark red rock covered with green, slimy algae. It is in constant agitation and occasionally sends up spasmodic columns six or eight feet high. The Whistler (Ko-ro-whi-ti) spouts occasionally from a cavernous opening two feet in diameter, and is accompanied by a smaller water-spout ten feet to the west. The Prince of Wales Feathers gives an extraordinary display of plume-like discharges with a maximum height of twenty five feet and a lateral spread of forty or fifty feet. A small geyserite bridge spans the opening, twelve inches in diameter. A small geyser a few feet away serves as an "indicator" for eruptions. Nea Mahanga (The Twins) geyser plays from a pear-shaped opening formerly spanned by a geyserite bridge which divided the display. Petrifying Geyser, located forty feet above Te Wairakei, covers everything within its reach with a marvelous filigree incrustation resembling red coral in color and appearance. Te Re-ke-re-ke plays five or ten feet high at irregular intervals from its dark cavernous opening.

GEYSER REGIONS OF OTHER LANDS Ruhle

Karapiti (the Great Steam Hole) or Devil's Trumpet is a famous gigantic fumarole three miles from Wairekei in the midst of manuka scrub (Leptospermum). Steam escapes almost horizontally with a great roar. A fire of brush wood ignited near the orifice causes the steam to become very white and apparently increase in volume.

Orakei-Korako is sixteen miles from Wairakei on the Waikato River. Here are found extensive geyserite deposits but no active thermal phenomena that are striking. The principal geyser, Koro-Koro is in red sinter. White Terrace is a very imposing deposit which looks like a petrified water fall, ten feet high. The Red Terraces are of a deep red color.

Crow's Nest Geyser is on Lake Taupo close to the Waikato River. It possesses a low, bluntly conical mound something like a nest. The eruptions were of the spouter type, but the geyser is now reputed to be inactive (W. A. Setchell).

At O-ne-ke-ne-ke, the "Terraces" possess the finest display of algae and algous sinter to be found in New Zealand. These terraces are formed in the runways of numerous springs. The Black Terrace is a curious deposit of bronze, green, and black, streaked with white and brown, and is covered with dark purplish or brown algous "jellies".

In reading about New Zealand geysers one is impressed by great inconstancy of display. Geysers, many of major dimensions, break forth or die very suddenly. Interest in the region has decreased in the last two decades.

Local names notwithstanding and despite firm assertions of Californians to the contrary, there are no existing natural geysers known within the state of California. Steamboat Geyser near Geyserville is an active steam vent. The geysers of Calistoga resulted from well-drilling. Three of these, in 1924, played through an iron pipe quite regularly once or twice an hour to a height of perhaps 75 feet.

At Steamboat Springs, twelve miles south of Reno, Nevada, are several geysers and geyser cones. One of these erupts 30 or 40 feet high (Communication of Dr. E. T. Allen and Carl P. Russell). Dr. C. N. Fenner has described a new geyser in the crater of Katmai Volcano, Alaska, which threw muddy water 200 feet high.

According to Dr. A. L. Day (Communication) there was only one real geyser recently active in Japan. (Reference: Mineral Springs of Japan, R. Ishizu, Tokio, 1915). It occurred in the midst of a town, and was walled up since it was regarded as dangerous. It played 15 feet high.

In NEW BRITAIN (New Pommerania) and NEW IRELAND (New Mecklenburg) single geysers have been reported. At sea level on the former, a geyser was reported to be playing every two hours to a height of 35 feet. Its location is on Hannam Harbor, on Villaumez Peninsula. Nearby a smaller geyser with a similar period played three feet high. On Ambitle Island of New Ireland, the great geyser called Balmusson plays every 5 to 6 hours to a height of forty feet.

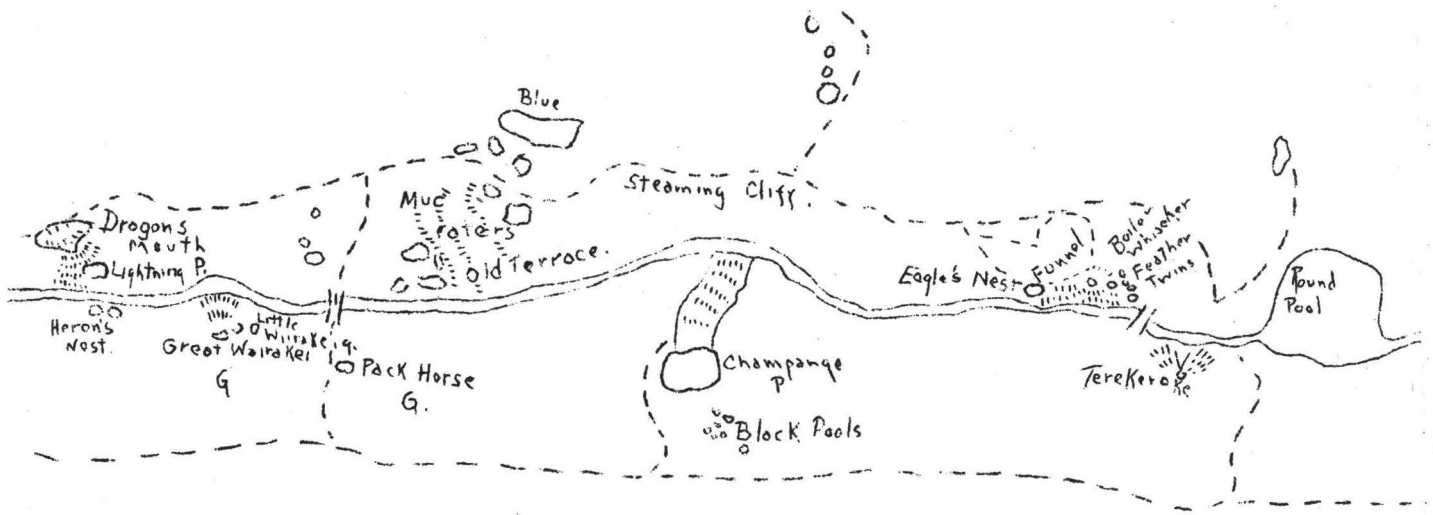
GEYSER REGIONS OF OTHER LANDS Ruhle

Geysers have been reported to exist in Val de Furnas on San Miguel of the AZORES, near the volcano Viejo near Chillan in CHILE, and in Poas, COSTA RICA. Of great interest is the geyser reported by Reichert, 1905, to be playing in the snow-field filling the recently shattered crater of Socompa in Puna de Atacama, CHILE, 20,000 feet above sea-level. The geyser Chang is located at an elevation of 15,000 feet on the shores of Lake Tengri Nur, north of Lhasa in THIBET. The height of its eruptions is reputed to be forty or fifty feet. There have been one or more geysers in Tuscany, ITALY, but these have been wiped out by drilling (Communication of Dr. E. T. Allen).

It is seen from the above that geysers are rare and scattered, and no region enjoys the variety or number that are found in Yellowstone Park.

Reference and Bibliography

(1) F. V. Wolff, Der Vukanismus, p. 635-638, Stuttgart, 1913.
(2) F. V. Hayden, Twelfth Annual Report of the U. S. Geological Survey, Part II, p. 432-448, Washington, 1883.



SKETCH MAP WAIRACEI GEYSER VALLEY
1904.

THE BIRDS OF THE LAKE YELLOWSTONE REGION

By Dr. Harry M. Kelly, Ranger Naturalist

Approved by:
Dorr G. Yeager, Park Naturalist.

There are two factors which noticeably modify the bird life of the region about Yellowstone Lake, in comparison with other parts of the Park: first, the elevation, which distinctly limits certain species to lower altitudes, and second, the large and varied bodies of water hereabouts, which make possible more generous representation of water fowl than elsewhere in the Park. The crow, the magpie, the bobolink and the yellow-headed blackbird frequent lower altitudes only, and are not ordinarily found at the Lake. The western meadowlark, and the red-winged blackbird barely reach this elevation, and in very limited numbers. But gulls, ducks, geese, pelicans, the osprey, the various sandpipers, and other aquatic birds find such abundant and appropriate nesting and feeding facilities, that the Lake offers the most ideal conditions for their study of any place in the Park.

Slightly less than one hundred species of birds are listed as occurring about the Lake, and approximately seventy five kinds should ordinarily be seen in one season spent thereabouts, a characteristic few in large numbers, most of them regularly but rather sparingly, and others only by good fortune, and then only occasionally.

The auto tourist in the Yellowstone promptly grows familiar in the several camp sites with the three species of jays or "camp robbers"; most frequently with the Clarke's Nutcracker, with contrasting black and white back, its strident, everlasting scolding voice, and its undue familiarity, not to say intrusion, at the camper's dinner table; next commonly perhaps with the Rocky Mountain Jay, of similar unpleasant note and habits of familiarity, but with a plumage of generally dirty grey; less frequently with the Black Crested Jay, whose shining dark blue plumage and natty black top-knot mark it as somewhat of an aristocrat. The Northern Raven will quickly be recognized as an enlarged edition of the crow, but with a shorter, more metallic, raucous "honk", a coarser, heavier head, and generally unkempt, dirty black plumage, always keeping away at a very respectful distance. Brewer's Blackbird will be everywhere under foot in the auto camp, the tourist's most intimate neighbor, not unlike the rusty blackbird of other localities, and perhaps building its nest in the shelter of an adjoining meadow or willow thicket. The Western Robin, hardly distinguishable from the familiar eastern form, but rather more shy, is less abundant than the blackbird, but usually in evidence in small numbers in every camp. And along every roadside, here as well as elsewhere in the Park, the glorious blue of the Mountain Bluebird wins the unstinted admiration of every one.

Of the diminutive birds of the camp site, sparrows are most numerous and conspicuous. Gambel's Sparrow, a variety of the White Crowned, is very abundant, noticeably by reason of the crown of

contrasting black and white stripes, its spick and span, well groomed appearance, and its pleasant, most musical song. The sociable and trustful Western Chipping Sparrow, with familiar chestnut crown, hops about the tables, picking up stray crumbs; and Cassin's Purple Finch, whose males display a most flaming scarlet crest, neck and breast, may swarm about the tourist, or gorge themselves with near-by grass seeds. This latter habit is shared by the shyer, delicate Pine Siskin, distinguished by its modest striped coat of black or grey and yellow. Juncoes, most commonly the Pink-Sided, with their white edged tails, will flit about, active and restless, and the Nuthatches, both the White- and Red-Breasted, will clamber over the tree trunks, their short, plump, grey bodies disposed in all positions, utterly disregarding customary adjustments to gravity, and uttering their complaining "yank, yank", as they carry on their untiring microscopic search in bark crevices for their insect food. Associated with the nuthatches in working tree trunks for their food, though contrasted with them in its meticulous observance of keeping always right side up, and pursuing its search only in the upward direction, is the slender, obscurely striped Rocky Mountain Brown Creeper.

The rich color note in the trees of the camp, may be the Louisiana or Western Tanager, brilliantly black, and scarlet, and yellow; less frequently it may be the deep red of the big Pine Grossbeak; or infrequently, the black and red of the smaller Crossbill, easily recognized at close range, by its wry bill , used to twist the seeds from the pine cones. Occasionally the plump and dapper Bohemian Waxwing may be seen, always attractive in its warm grey plumage, with sporty crest, and often its red "wax"-tipped wings and tail.

The bird lover will miss about Yellowstone Lake the numbers and varieties of Warblers characteristic of lower altitudes, but will enjoy in or along the edge of the evergreen forest, the sudden, erratic dashes of our brilliant yellow and black Audubon's Warbler. Along roadside bushes and willow thickets the Yellow Warbler, so common everywhere in such environment, will be both seen and heard. Perhaps also in the late summer, the Pileolated Warbler, yellow with jet black skull cap, will peek inquiringly from a low bush on the road side.

Flycatchers are not infrequent, though generally unobtrusive. Say's Phoebe, the Western Wood Pewee, and the smaller, slightly yellowish Western Flycatcher, each resembling their common eastern relatives, may be observed perched on watch on some outstanding, isolated branch, or making their sudden dashes into the open for their flying insect prey. Occasionally, the Olive-Sided Flycatcher, or more rarely the common eastern Kingbird, will be seen in similar attitude and situation.

More often heard than seen, - for it is one of the smallest, and certainly the noisiest of our little birds, - is the Ruby-Crowned Kinglet, not much bigger than the end of one's thumb, unobtrusively

olive green in color, so that except for its active, nervous movements and its noisy song, it would ordinarily pass unsuspected in its usual location, high up among the top branches of the pines.

Humming Birds, common enough at lower altitudes, are very rare at the Lake; only an occasional Rufus or Broad-Tail favors the leafy thistle with a brief visit of inspection.

About the hotel and other buildings, two species of swallow are common. The Cliff Swallow, much like the familiar barn swallow in general coloration, but lacking the latter's deep forked tail, construct their interesting, fragile gourd-shaped nests of mud under cornices, eaves and other projecting building surfaces. The beautiful Violet Green Swallow, with back of magnificent metallic sheen, and under parts of pure white, often nest with the cliff swallow, though utilizing holes in trees and buildings, and lining these with feathers. Along with these, skimming everywhere over the Lake, are the Bank Swallow and the Rough-Winged Swallow, both of somber brown backs and light under parts, and both excavating their homes in the vertical faces of the lake shore banks.

Should one wander out over the open meadows about the Lake, especially along the edge of a patch of sage brush, several kinds of sparrows will reward a cautious, slow approach. There may be seen the Western Vesper Sparrow, pale striped gray, with narrow white edge on the tail; or the Western Savanna Sparrow, alert and restless, with conspicuously striped back and sides; or the Mountain Song Sparrow, with slightly erectile crest of black and brown stripes, and splashes of rich brown upon its grey breast; and even occasionally the larger Western Lark Sparrow, conspicuously striped upon the crown with black and white and brown, with a single spot upon its otherwise white breast, and a tail white-edged all around.

Woodpeckers are noticeably scarce about the Lake, unless the Red-Shafted Flicker be excepted, though occasionally the familiar Red-Headed, the Northern Hairy, or the less well-known yellow-crowned Three Toed may be met, busied at their characteristic drumming or chiselling upon a tree trunk.

Of the birds of prey, the most conspicuous at the Lake is the Osprey or Fish Hawk. Practically at all times it may be seen, slowly winging its way over the Lake, or soaring high above it, periodically executing its spectacular dives from astounding heights, or bearing away in its talons a good sized trout. At some points along the shore, their conspicuous nests, a great mass of sticks at the top of a lofty and often dead spruce or pine, can easily be recognized. The osprey's white under parts, as well as its manner of fishing, are sufficient to distinguish it from other hawks and eagles. Both the Golden and the Bald Eagle occur, though rather rarely, and may be seen soaring without wing-beat at great heights over the Lake, or perched on lookout on some tall lakeside tree. Over the open meadows, skimming along just over the vegetation, Marsh Hawks are common, easily identified by their conspicuous white rump spot, as well as by their low flying habit. Western Red Tailed and Swainson's Hawks, difficult of differentiation at their great distances, soar widely, far overhead. And the little

Desert Sparrow Hawk, occupying quietly its customary perch on some roadside telephone wire or pole, will easily be recognized by its likeness in habit and plumage to its common eastern relative.

Judging from the familiar hoot, not uncommonly heard about the Lake after nightfall, the Western Horned Owl must be present, though not often seen. Just at dusk, along roads in the forest, the erratic flight of the Pacific Night Hawk easily leads to its proper identification. The little Gambel's Sparrow entertains the evening strollers, sometimes to a quite late hour, by an elusive, though very musical song.

Sharing with the Osprey the attention of the visitor along the lake shore, are the numerous and most interesting water fowl. The Belted Kingfisher, though not abundant, may frequently be observed, perched as usual upon some dead snag overlooking the water, waiting the approach of some luckless fish. The Great Blue Heron, common only towards the last of the summer, stands sentinal like, stiffly on watch along the water's edge. Numerous Sandpipers, the common Spotted Western Solitary, the Killdeer, and less frequently Wilson's Snipe, or the larger Western Willet, assiduously pursue, just out of reach of the waves, their everlasting quest for wave-swept food.

On the waters of the Lake, along the Yellowstone River toward the Falls, and all about the numberless tributary smaller streams, ducks of many kinds, and often in great numbers, may be seen. Taking the season through, Barrow's Golden-Eye are by far the most common, black with white under parts, white wing coverts, and with a triangular white spot at the base of the bill. They are good divers, entirely submerging when after food, and their flight is rapid and accompanied with a distinct whistling sound. The plump little Buffle-Head, with white conspicuous on breast and sides, and white patch on the cheek, extending to the crown, against a general background of black and grey, is not infrequent in rather small flocks. Mallards, counterparts of the common domestic breed, with irridescent green head in the male, and the female with variously mottled and spotted brown, is abundant, especially after the breeding season, when great numbers gather in the estuaries along the river, mixed with similar multitudes of the various trim little Teal-Green-Winged, Blue-Winged, and Cinnamon, and with Pintail and Scaup. Keeping at safe distance from the traveled road, are the Mergansers, crested with black, neck and belly white, white wing patches, easily recognized by their rushing over the water, with scattering spray, like miniature speed boats, and diving repeatedly, and to good distances, if too closely pursued. Even occasional Wood Ducks delight the sight of the cautious observer, of whom Bailey says "If the end of a rainbow had touched a marsh, and dabbled its colors over a plain brown duck, it could never have produced anything half so brilliant as one of these old male Wood Ducks in full breeding plumage". A pair of these, for several seasons, has flown out of the forest each morning shortly after sun up, perched for a moment on the chimney of the Lake Ranger Station, greeted the world with their cheery quacking, then set out for their foraging over the Lake.

THE BIRDS OF THE LAKE YELLOWSTONE REGION Kelly

Everywhere and at all times about the Lake, sailing in the air, swooping down to retrieve from the water's surface some choice morsel of food, or riding the waves like a fleet of yachts, even in the fiercest storms, or lazily parked by the hundreds on every headland and sand bar, are the California Gulls, most conspicuous of all the aquatic birds of the Lake region. This is the only species of "sea gull" which visits Yellowstone, except for a few of the Delaware or Ring-Billed Gull, which may occasionally be seen in the latter part of the summer. As the general coloration of many gulls is quite similar, specific determination is difficult, but no confusion will result in the Yellowstone, as these are practically the only ones present. Sometimes the novice will declare that a certain flock of gulls must contain several species, from the variety of coloration, but it will be remembered that the juvenile members of the colony assume several diverse patterns, before the typical grey mantle, white under parts, and black wing tips of the adult are finally donned.

But it is the American White Pelican which most excites the wonder and admiration of both the greenest tenderfoot and the oldest inhabitant. Yellowstone's largest bird - measuring from four and a half to six feet in length, and with the magnificent wing spread of nearly ten feet - at times one may observe them swimming majestically in military formation, like a fleet of ships in manoeuver, sometimes awkwardly perched in lines along the shore, or flying high, in long lines, with slow wing beat, - once, twice, thrice - then with a period of sailing, before the cadence is resumed. Should it be possible to visit the Molly Islands, far towards the south end of the Lake, the nesting sites of more than a hundred pairs of pelicans may be seen, odorous but extremely fascinating, as disclosing their meager housekeeping arrangements. One of these islands is occupied almost exclusively by the pelicans; the other, an eighth of a mile distant, is shared by a very few pelicans, thousands of the California Gulls, hundreds of the Caspian Terns, a few Black Terns, and last season a single pair of Cormorants or "Nigger Geese".

A boat trip on the Lake may treat one to the sight of numerous Canada Geese, with their families of young in the proper season, for they nest in the willows of the islands and shore of the Lake. Numbers of Grebes, both Eared and Pied-Billed, half submerged, will hurry both by swimming and good, long dives, to keep well out of reach, and possibly also an occasional Loon. About the Molly Islands, along with the sandpipers, infrequently Phaleropes are met, both the Northern and Wilson's. Some appreciation of the water fowl may also be had in the drive along the Yellowstone River from the Lake to the Canyon, for numberless gulls and ducks, some of the Canada geese, usually fair numbers of the pelicans, and on rare occasions a single swan, may be seen upon the water or near by, and sailing overhead are one or more ospreys, ready to pounce down upon any trout within its sight.

THE REPTILES OF YELLOWSTONE PARK WITH NOTES ON THE AMPHIBIANS

By Dorr G. Yeager, Park Naturalist

Approved by:
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One of the many interesting fields of research in Yellowstone National Park is that pertaining to the reptiles and amphibians. Very little systematic work has been done along this line and should an organized search be made for new forms it would doubtless result in a doubling of the recorded number of species.

Practically the only published record of observed forms is found in "The Yellowstone Nature Book" by former Park Naturalist M. P. Skinner. This record must be very incomplete, valuable though it is, as only last summer (1928) not only a new species but a new genus was discovered at Old Faithful.

Before entering into a discussion of the forms found within the boundaries of Yellowstone Park, let us go back some ninety millions of years to when these types first began to appear on the earth.

The forerunners of nearly all the great groups of animals are poorly preserved. Were it not for this fact, we would know considerably more about the early life of this planet. But they were poorly formed, delicate creatures at best, and the early members of each group are far less adequately preserved as fossils than are their better formed, larger boned posterity. For this reason we know very little concerning the origin and rise of amphibians and scarcely more about reptiles. There is no doubt that the amphibians sprang from the fish in the scale of evolution and that the Reptilia evolved from the Amphibia. There is little evidence of this when one tries to connect reptiles with fish through any of the present amphibian forms. However, the evidence is indisputable when one deals with the ancient order of Stegocephalia. This group contained large, partially armored, short-legged lizard-like creatures, no survivors of which remain, as they appeared in the Carboniferous and were extinct by the end of the Upper Triassic.

Then came the rise of the great reptiles. If you have ever seen "The Lost World" you have seen representatives of these groups. Tyrannosaurus, Ornithomimus, Ichthyosaurus, flying reptiles, toothed birds and others. They dominated earth, water and air. They reigned supreme until their over-specialized bodies and under-developed mentality spelled their downfall and ultimate extinction by the end of the Mesozoic.

The Age of Reptiles is long past, the days of Ichthyosaurus and the flying reptiles are gone. They belong to the past and to a study of the past and as the study of Palaeontology does not come within the scope of an article on "the reptiles and amphibians of Yellowstone Park" we will proceed at once to a discussion of the modern forms of these prehistoric monsters.

THE REPTILES OF YELLOWSTONE PARK WITH NOTES ON THE AMPHIBIANS Yeager

Unfortunately, in practically every tropical and temperate section of the world snakes are feared and shunned. Stories are current, of snakes waiting beside a trail to inject poisonous venom into the flesh of humans. From childhood we have been taught to fear snakes as dangerous and malicious things. Amphibians have suffered no less at the hands of ignorance and superstition. The old story of a toad transferring warts to those who handle him, ranks in the same category with witches and ghosts. It is unfortunate indeed that witches have always been pictured surrounded with snakes and toads. The rattlesnake is about as misunderstood as any living thing. Were all the facts known, we would find that far more people are killed in one year from auto accidents than have ever died from the venom of the rattlesnake.

Now a word to the Ranger Naturalist who is fortunate enough to guide on the nature or formation trails in the Yellowstone. Be above superstition and fear in regard to the reptiles and amphibians. They are but a part of the fauna of the park, and a very interesting part, I can assure you. If a snake is encountered on the trail there is one thing to be done first. Keep any thoughtless member of your party from killing it. There will always be someone ready with a club or stone. I have encountered a great many snakes while conducting parties afield and never has it been my experience to find a party in which there was not one or more that desired to kill the snake at once. After you have stayed the intended slaughter and given the party a short talk on snakes you will invariably find that those who were most timid at the first encounter will be handling the creature and admiring the delicate colorings and scale design. A snake can be made just as interesting to the tourist as a squirrel or a marmot.

A check list of reptiles and amphibians found within the park gives four species of snakes, one species of swift, one species of turtle, three species of frogs, one species of toad and an unidentified species of salamander. As I have said, probably this list could be doubled were a systematic search undertaken.

REPTILES

1. Bull Snake or Gopher Snake (Pituophis sayi)

Any boy who has wandered the fields of the middle west knows the bull snake. Who has not caught one of these reptiles as it was entering a burrow and attempted to pull him out again? If you have not, I advise that you do so at once, for nothing else can as well demonstrate the strength of the bull snake. They are often taken for rattlesnakes because of the similarity in the markings. Concerning this snake in the Park Mr. Skinner says "The dull yellow, or slightly reddish-yellow, ground color of this snake has a row of large, square blotches of brown or black on the back - different individuals vary a bit - and smaller spots on the sides; ..... This snake with its heavy, stout body, five, six or seven feet in length, is our only large one; and is generally confined to the Gardiner flat and along the river to Mammoth, possibly reaching up as high as the Silver Gate, but does not occur on

the Park Plateau". In recent years I have noticed an increasing number of these snakes at Mammoth, where they lie on the dead formation sunning themselves during the warm days of July and August. Notwithstanding the many killings by tourists during the summer months, these snakes seem to have established themselves on the formations. On one trip over the trail I counted five bull snakes sunning themselves on unshaded formation prominences. They were loathe to move, even when prodded with a stick.

Those of the Educational Division who served at Mammoth during the summer of 1926 will remember "Bozo", a pet bull snake that was brought in one day by a formation guide. Bozo immediately made friends with the entire division and any tourist who was brave enough to stroke his throat. He was given the freedom of the space behind the Information Office, where he glided through the books and maps, exploring every niche and cranny of his new home. He delighted to curl up on the I nformation Desk and would lie there as long as he could find someone to stroke his back. I well remember once when Bozo crawled inside my shirt and went to sleep wrapped around my body. It was necessary for me to get up to answer a question and Bozo, rudely awakened, poked his head out from my shirt to see what the disturbance was. I still remember the expression on the face of that tourist. Each night we would deposit Bozo outside the museum in the stack of antlers and each morning he would be waiting in that vicinity to be picked up and taken inside.

Bozo was the source of much interest for several weeks. Many of the tourists who shrieked at their first sight of him, left the park with a picture of Bozo draped unceremoniously around their neck or arm.

Unfortunately, a few of the more timid souls lodged complaints about the snake and we were forced to return him to the formations. I have never seen a more beautiful bull snake than Bozo. His case was merely one of the many which goes to prove that bull snakes are easily tamed and make excellent pets.

Garter Snakes - Thamnophis

Probably the genus Thamnophis, with its twenty one species and sub-species, is the best known of the snakes in this country. Garter snakes are known to every boy and it is this species that usually finds its way into a drawer of the teacher's desk or unexpectedly appears from the pocket of some mischievous schoolboy.

2. Wandering or Green Garter Snake (Thamnophis ordinoides vagrans)

This snake is the most common and widely distributed of any snake in the park. I have had no personal experience with this snake but have seen it both at Mammoth and at Old Faithful. The one which I observed at Mammoth was swimming leisurely down the ditch that runs past Hymen Terrace. Upon catching sight of me he scurried toward the bank and disappeared amidst the vegetation.

The ground color of this snake on its upper surface is olive or greenish yellow, which leads to the name "Green Garter Snake". A yellow line runs down the middle of the back and a similar line down each side of the body. On each side of the back are two series of alternating black spots which occasionally unite to form a zigzag band along each side. The top of the head is usually a light brown and the chin and throat are normally white.

This little snake, seldom over 20 inches long, is a great lover of water and swampy lands. He feeds largely on aquatic life. Insect larva, fish, tadpoles and small frogs all fall before his swift rush through the water. Ruthven and Gaige, in speaking of the feeding habits of this snake, say that "The stomach of one individual contained eight large tadpoles; that of another, five fish, and one had eaten a fish 141 mm. in length, besides a smaller one."

Of three pregnant females which were brought to the California Academy of Sciences, one gave birth to eight young on August 25th, one to ten on September 2nd and the third to twelve young on September 10th. A single female has been known to give birth to as many as 78 - 80 young or as few as four at a time. Mating occurs in the spring but as is shown above, the young are not born until July, August or September.

3. Red-barred or Prairie Garter Snake (T. sirtalis parietalis).

Although, strictly speaking, this snake belongs to the region east of the Rocky Mountains (type locality, Missouri) it is found as far west as Idaho and Nevada. We occasionally find them in the Park along water courses or in meadows, especially along the Gardiner River below Mammoth. They are rare, however, and one may count himself extremely fortunate if he finds one.

This species is slightly darker than the green garter. The ground color above is "olive or olive brown, varying shades of brown or blackish usually with more or less red on the sides, chiefly on the skin between the scales---". The belly is lighter in color, being usually bluish, yellowish or grayish white - rarely some shade of red. The dorsal stripe is usually bluish, but may be yellow. The length of these snakes seems to vary considerably, running from 10 inches up to as high as 30. The red stripings mark it from the green garter.

I have seen this snake only once in the Park, on the Gardiner River below Mammoth Hot Springs. The species is, as I have said, extremely rare and, unless you are sure of the red markings and the darker ground color, it would be well to call it the green garter.

4. Rubber-snake, Ball-snake (Charina bottae).

During the summer of 1928 Miss Herma Albertson caused considerable commotion in the offices of the Educational Division by reporting a Rubber Snake at Old Faithful. We were at first rather doubtful as to whether to accept this as an actual observation, inasmuch as we did not obtain the specimen and it was unknown to the Park up to that time.

However, Miss Albertson's description was so accurate that it could have been nothing but this species.

I believe I can safely say that this is the most fascinating and friendly of all the snakes with which I have come in contact. He is gentle and will make friends with anyone. I well remember one specimen which we had in Yosemite Park during the summer of 1927. He was the favorite among all the snakes at the museum and was by far the most popular with the tourists. He liked to be handled and stroked and would lie motionless in one's arms while the process was going on. As soon as the stroking ceased, however, he would contentedly wrap himself around one's arm and go to sleep. Never have I seen him attempt to bite or make any vicious move. In fact, I never heard of any specimen becoming angry, no matter how much he was handled.

There are several peculiar habits which might be noted in connection with the rubber snake. In the first place, the head and tail are so similar in appearance that only by sharp observation can they be distinguished from one another. This has led to a popular name "two-headed snake". It is a common thing to see this species coil up with his tail elevated as if it were his head while the head is safely concealed beneath the coils of his body. The name "ball-snake" is derived, no doubt, from the fact that often while he is being handled, the snake ties himself in a peculiar ball-like knot where he remains motionless. I have noticed that this species, when in captivity and when the bottom of the case is lined with sand, will bury itself and it is only when the sand is combed carefully that its ball-like form will be revealed. I remember one morning I went to the cage in Yosemite and, not finding the snake, thought he had escaped during the night. However, he was later discovered buried beneath several inches of sand.

These snakes are lovers of moist coniferous forest and shady trails. The specimen at Old Faithful was reported from the Nature Trail. They never attain any great size, even though they are related to the great boas of the tropics. Specimens vary in length from eight inches to slightly over two feet. Their general appearance is that of rubber, hence the name "rubber snake". This color, however, varies from pale gray to yellowish brown or olive. The lower surfaces are lighter. The color is solid and lacks the usual lighter or darker markings of other snakes. The tail is blunt, and as before stated, bears a remarkable resemblance to the head itself. The snake never seems to be in a hurry and the movements are usually slow and rather sluggish.

Little seems to be known concerning the feeding habits of these snakes. I do not remember that I have ever seen them feed, either in the field or in captivity. A specimen from Carmel, California was reported as having eaten four mice while Cope and Slevin both report having found blue-bellied lizards in stomachs of captured specimens.

5. Rattlesnake (Crotalus sp.)

Although no specimens have been obtained from within the park boundary and despite the repeated assertions that "There are no rattlesnakes within the park", there seems to be no doubt that they are found at one or two places within the boundary. M. P. Skinner makes the statement that there have "been reports of them inside the field, inside the entrance arch, but these were never confirmed." Although I have never seen a rattlesnake in the Yellowstone, I am certain that they are here. They are reported just outside the park, and the telephone crew, when building the line to Crevice Station along the north boundary, reported seeing several. Chief Ranger Woodring tells me that he has often seen them inside the north line, especially at two places, namely at Rattlesnake Point near the entrance of Turkey Pen Trail and in the rock slides near Crevice. This seems indisputable proof and I feel that we may safely list the rattler among our reptiles. Inasmuch as no specimens have been taken it is impossible to accurately name the species, although in all probability it is the Prairie Rattler (C. confluentus).

And now a word concerning the broadcasting of the information that rattlesnakes occur in the park. I once attended a lecture given by a Ranger Naturalist, who was (unfortunately) poorly informed on the subject of snakes. He gave the impression that the vicinity of Mammoth was swarming with rattlers. Naturally, such information discourages the most timid tourist from venturing out upon the trails, even though the remark be followed with a discussion of the erroneous ideas concerning the death-dealing qualities of these snakes.

Because of the widespread misinformation concerning the species it is always well to explain, when mentioning the occurrence of this snake in the Park, that it is not abundant and that no tourist is ever likely to encounter one unless he makes a special trip into the mountainous regions of Crevice district. Even then, the chances are that he will not find them.

It may be well, at this point, to clear up a few ideas that seem prevalent in regard to these snakes. The fatal results of bites have been greatly overestimated, although it must be remembered that a rattlesnake is probably the most poisonous snake in the United States. First, let us discuss briefly the poison mechanism of a rattler. Snake venom is a yellowish or colorless fluid containing a number of toxic substances of a proteid nature. In the rattlesnake this fluid is secreted in a gland located against the side of the skull below the eye. The capacity of this gland varies with the size of the snake. In some large specimens its capacity may be 10 or 15 drops. This gland is connected with the fangs, located on either side of the upper jaw and rooted in the maxillary bones. When the snake strikes, its mouth is open and as soon as contact is made the mouth closes, thus sinking the fangs into the flesh of the victim. Instantaneously the venom is ejected through the hollow portion of the fangs. The snake thus makes two irregular punctures in the skin of the victim. Should a snake miss

its mark, as is often the case, the venom may be shot to a distance as great as four feet.

Venom, as in the case of most proteid poisons, has a direct action on the nerve centers, heart and respiratory organs. Usually great pain and swelling in the region of the bite is noted, along with a discoloration of the skin in the region of the wound. The discoloration is due to small hemorrhages. Death may result from paralysis of the respiratory organs, paralysis of the heart, or small hemorrhages into important parts of the brain and other organs.

The death rate has been greatly overestimated in connection with those bitten by rattlesnakes. A bare 10% of all bites are fatal and most of the fatalities occur among children. As I remember it, only two persons died of rattlesnake bites in California in 1926. Both of these were children and in neither case were proper curative measures taken. California, I believe, has about as large a rattlesnake population as any state in the Union. Her mountains and valleys are the haunts of nature lovers as well as rattlers. Surely if fatality from snake bites was the rule in a rattler-infested country there would have been more than two deaths in 1926. The treatment for snakebites in the days of '49, and which is still all too prevalent today, was to "fill 'em up with whisky". The benefits of alcohol for snake bites has long been a disputed question. Laboratory experiments, however, have definitely proven that when taken in large doses, it does more harm than good. Brandy given in teaspoonful doses at half hour or hour intervals may not be harmful, but in larger doses, while tiding the patient over the critical period, leaves his heart in a weakened condition which is a mark for the small amount of poison left in the blood. It has been thought that more victims have been killed by the whisky administered than by the poison itself.

Putting aside now the more unpleasant features of the rattler, let us look at some of the more interesting characteristics of his genus. Probably the most characteristic feature of the rattler is the series of horny rattles at the end of the tail. These are formed by portions of skin cast off during the process of shedding. A rattle is formed each time the skin is shed, which may be several times a year. This corrects an erroneous impression that the age of a rattler can be determined by the number of rattles. These rattles fit loosely together and when the tail vibrates rapidly a half metallic, half insect-like sound results. The tip, or last rattle, is smaller than the rest and is known as the button. The snake usually rattles before striking but this is not always the case. In striking, the rattler coils with the tail elevated. Contrary to popular opinion, the distance covered when striking is always less than the length of the body; some authorities estimate it as about a third that distance. It is made with lightning-like speed, although the recoil is slow and it takes several seconds before the snake is in a suitable position to strike again.

The hypnotic power of reptiles has long been known. In the case of the rattler it seems rather awesome. I have seen rattlers so frighten mice that the little creatures were absolutely helpless and would allow the snake to approach within a few inches. The mouse was unable to move a muscle during the snake's approach. A friend of mine told me an interesting story of a rattler "charming" a small rabbit. He stated that while he was fishing one day he discovered a small cottontail sitting motionless among the sagebrush. All attempts to frighten the animal failed. He prodded it with a fishing pole but the rabbit remained still and rigid. Finally he threw his hat at the animal and instantly a rattler, which had been lying concealed in the grass, buried his fangs in the hat. This seemed to break the hypnotic spell and the rabbit was away in a fraction of a second.

The ability of a rattler (and most snakes) to swallow extremely large objects is well known. In the case of the rattler the upper and lower jaws are constructed so that they may be dislocated when the swallowing process begins. The open mouth of a rattler, with its jaws dislocated, is a horrible thing to look upon, reminding us of the pictures of dragons in storybooks. The story that a rattler will eat nothing that was not killed by himself seems unfounded, at least in the captive state. Many times I have seen a rattler in captivity eat dead mice and pieces of beef that were thrown to it. In swallowing a mouse or ground squirrel the head usually disappears first, thus lessening the danger of the feet, hair, etc. sticking on the way down. One case, however, has been reported where a rattler swallowed a chipmunk tail first.

Whatever may be the status of the rattlesnake throughout the West in the minds of the layman, it certainly is an absorbing study from the standpoint of the naturalist and interesting things may be added to our knowledge of herpetology by watching, instead of killing the snake.

6. Western Painted Turtle (Chrysemys marginata bellii - Gray).

Although by no means common in the Yellowstone, this turtle is occasionally found in the ponds and marshes. It is a variety of the common painted or pond turtle found so extensively throughout the country.

Hurter, in his Herpetology of Missouri says concerning the coloration: "..... greenish olive with narrow yellowish lines following the sutures. Some of the shields are traversed by vein-like lines of the same color. .... The plastron is red with a central region occupied by a large, blackish lyriform blotch, which is marbled with pale yellow and sends rays out along the sutures. Head and legs are striped with red. A yellowish stripe from below the nostril in front to the end of the jaw ..... two other yellowish-red stripes, one starting at near the corner of the mouth, the other through the tympanum ..., on the front of the forelegs are four reddish stripes, one on each side and two in the middle, which reach to the end of the fingers. Webs largely pale yellow. On the posterior side of the hind legs are two reddish yellow bands, which start from the body, running nearly parallel and converge

at the tail from where they run out to a single stripe on the lower end of the tail to its tip .... On each side of the upper side of the tail are also two of these stripes, which join and run out to the end of this member."

The size of this turtle is given as follows:

Length of carapace	160-250 mm.
Length of plastron	150-232 mm.
Width of carapace	116-175 mm.
Width of plastron	139 mm.
Length of tail	32 mm.

There is no particular necessity to go into a detailed discussion of the habits of turtles at this time. Suffice it to say, they are oviparous reptiles, great lovers of water and marshy places. They are easily tamed and when treated kindly are usually gentle and easily managed. Turtles, especially the larger forms, grow to a very old age. No data are available as to the age of the Western Painted Turtle, but the larger forms sometimes attain an age of 75 to 100 years.

7. Striped Swift (Sceloporus consobrinus, Baird and Girard)

Skinner describes what he terms the "yellow-striped swift, (Sceloporus undulatus, variety consobrinus, Baird and Girard)" as the species which we have in the Yellowstone. The species to which he refers is probably Sceloporus undulatus consobrinus, Cope, which appears in the Check List of North American Amphibians and Reptiles as Sceloporus consobrinus consobrinus, Baird and Girard. Until we find that we are mistaken we will assume that this is the species found in the Park, as I have never identified it and as far as I know no specimens have been sent out for identification.

The majority of tourists would term this little creature a lizard but Skinner tells of an amusing report by one of the truck drivers who stated that "a little alligator ran across the road in front of me at Norris". These swifts are great lovers of warm situations and are often to be seen sunning themselves on the hot spring or geyser formations. The color above is generally olive, yellowish or bluish with a lighter stripe along each side of the back from the neck to the base of the tail. They are little fellows, seldom measuring over six or seven inches in length, but they are extremely active and unless they are caught on a long flat stretch of formation they are a difficult creature to capture.

They are usually ground dwellers, seeking refuge in holes or between the cracks and crannies of rocks and old formation. They have been known, however, to take to trees, although this is not at all usual. Their food consists largely of insects. One specimen from New Mexico "had eaten ants, beetles, and a robber fly".

So far as is known the only other form of life in Yellowstone which might be confused with this lizard is the salamander or mud puppy, which, of course, is an amphibian and is usually found in or near water while the swift is a lover of warm dry rocks and formations.

AMPHIBIANS

If our knowledge of reptiles of Yellowstone is scant, our knowledge of the amphibian life is even more so. The portion of this article which deals with the amphibians must necessarily, therefore, resolve itself into simply "notes".

1. Toad (Bufo boreas). As far as I know, this single species of toad is found only about the formations at Mammoth, living in niches in the old travertine deposits. It seems impervious to the gas of the formations and enjoys the warmth of the sun and steam. The adults are about five inches in length, with markings and habits similar to those of other toads. The eggs are hatched under water and the tadpole stage is spent in the same place. It eventually takes to the air, however, and seeks out the hot spring formations and environs for its home. The life cycle is about the same as that of the common Eastern Toad. The food, as with other toads, consists largely of insects caught with its tongue, which is hinged in front.

2. Swamp Tree Frog (Pseudacris triseriata). About the middle of May the swamps and ponds along the northern boundary of the Park resound with the music of these "peepers". They are especially plentiful about Mammoth and Tower Falls. About a month later, those on the upper plateau of the Park awaken and give forth the welcome news that spring has at last come. Their singing, however, is unfortunately limited to one month during the breeding season, after which they are quiet until the next spring.

They are small dark-colored frogs. The mature adult measures no more than an inch in length, although their shrill notes would mark them as considerably larger. It is not uncommon to find a gray frog of the same size. It is the same frog, however, which has simply changed color to harmonize with its environment. This chameleon-like power vested in this frog is common also in certain species of lizards. The "peepers" are found in marshy places and always on the ground. The name "tree frog" is confusing, as they are seldom, if ever, found off the ground. M. P. Skinner relates the following interesting incident concerning these little amphibians: ".... one glorious day in June ... I found these frogs migrating literally in millions across the road near Pelican Creek Bridge. The whole length of the built-up causeway was alive with them, every square foot having from one to three tiny frogs on it, and more continually coming from the marsh."

3. Western Frog (Rana pretiosa). This species seems to be limited in Yellowstone Park to the low altitudes along the northern boundary, being reported only from "below Mammoth" and in the vicinity of Tower Falls. They are not at all common and I have never seen one, although they are reported by Skinner.

4. Mink Frog, Big Green Northern Frog (Rana septentrionalis). This frog is rather widely distributed throughout the park. It seems to have a greater sense of the "esthetic" than its brothers, being found along running streams rather than in stagnant pools. It is light olive in color, with coarse darker markings. The belly is unspotted and light yellow.

This frog, in contrast to the tiny Swamp Tree Frog, is quiet and even during the mating season does not give forth a song. He seems to be a lover of water and is not found even in meadows unless while migrating.

The name "Mink Frog", common in several localities, arises from a disagreeable odor which is given off when teased - an odor not unlike that of a mink.

5. Salamander, Mudpuppy. Concerning this amphibian, Skinner says "there is also a salamander or mud-puppy, about five inches long and very dark in color, found in muddy streams in Hayden Valley and about Yellowstone Lake, particularly abundant in Indian Pond. Not having been studied much, little is known of it or its habits." I have never seen this in the locality mentioned by Mr. Skinner, although I have found a single specimen of salamander answering closely the above description in one of the ditches running through the Mammoth Auto Camp. I am not prepared to state, however, that it is the same species mentioned by Skinner.



PREDATORY ANIMALS

Prepared by:
Sam T. Woodring, former Chief Ranger of Yellowstone National Park,
now Superintendent, Grand Teton National Park.

There are several generally recognized species of predatory animals in Yellowstone National Park, among which are the mountain lion or cougar, the wolf, the coyote, the lynx, the bobcat, the otter and marten. However, the National Park Service officials, in conference assembled in San Francisco, California on February 21, 1928 went on record as considering only the mountain lion, wolf, coyote and bobcat predatory in the national parks.

Predatory birds consist of the bald and golden eagles, the osprey or fish hawk, the horned owl and the pelican, although the National Park Service has not as yet gone on record as considering them predatory.

Mountain Lion. The lion or cougar is our most destructive predatory animal but is, fortunately, very scarce in Yellowstone Park. The last known kill by a lion occurred the day preceding Thanksgiving, 1924. The killer was treed and slain the following day. One lion has been reported seen since that time. These animals do not travel in groups, with the exception of mothers with cubs. The cubs are trained by their mothers in the art of killing, and raids of this kind, where game is plentiful, often result in the killing of a half dozen animals within a period of 24 hours. When the kill exceeds their immediate food requirements the remains of their victims are dragged off and buried (covered with rubbish, leaves, dirt, etc.).

Wolf. The wolf, grey, timber, or lobo, is another destructive animal in the game fields. They have apparently migrated from Yellowstone Park, as the last of which we have any authentic reports were seen during the spring of 1923. This pack, consisting of a mother and seven pups, were located and captured in their den on Antelope Creek near Tower Falls by Park Ranger James Dupuis. The old trappers contend that these animals migrate to new fields at intervals of every few years, which, if true, may account for the reported losses by sheepmen in states bordering the park during a period when there were no signs of their presence within the park limits.

Certainly, if the wolves were as plentiful as coyotes, we would have no deer, sheep, or antelopes in the park today. These animals travel in packs and there is usually a fresh kill for each meal.

They have been known to pull down young buffalo calves, although the resourcefulness of the adults, North America's largest game animal, ordinarily protects their off-spring.

Coyote. The coyote destroys more game animals than any other in the park at the present time. He is our most difficult animal to control on account of his cunning and the rate at which he breeds. Breeding occurs annually and the litters average about seven, as compared with about five for the wolf, and from two to three for the

mountain lion. This animal, also known as the prairie wolf, was originally a plains animal and subsisted very largely on rodents and other small forms of wild life.

The deer and antelopes sought a refuge in the remote mountain districts, because the inroads of the settlers forced them back to the remote and sparsely settled districts in the mountainous areas of the west, but this refuge from hunters exposed them to new hazards from predatory animals. The coyote took quick advantage of his enlarged opportunities and has since become one of our most cunning destroyers of big game animals. I have counted fragments of deer carcasses totaling 50 or more during the course of a winter season's patrols that were the unmistakable victims of coyotes. These animals destroyed more than a hundred and fifty antelopes along the north boundary of the park during the spring of 1922. I accounted for a total of 19 deer killed by coyotes during a March, 1929, patrol.

We have shot and trapped an average of 250 coyotes annually during the past eight years, but it appears that the annual increase probably exceeds the annual kill, as I am confident that we have as many in the park at the present time as during any spring season of recent years. A lone coyote has been seen to run down a full grown, well conditioned deer. There are many known instances of their adopting wolf tactics of working in packs. There are also signs that they engage in this practice extensively, such as the multiplicity of tracks in the vicinity of kills and the speed with which they devour whole carcasses of full grown antelopes and deer. There is seldom anything left, with the exception of the skull and pelvic bone, a few hours after a kill; all bones containing marrow are completely destroyed.

Two coyotes were seen to run down a full grown antelope at the buffalo ranch early last fall. This was done by the relay method, such as they practice when pursuing jackrabbits. The pursuit in this case was directly across a plowed field and was witnessed by a man plowing at the time; they passed within 100 feet of the observer. One of the coyotes was in close pursuit and the other followed in the rear of the leader at a distance of from 50 to 75 yards, apparently waiting for the antelope to change its course when he could benefit by a short cut and take the lead. They alternated in these tactics until the victim was finally run down about 300 yards beyond the plowed field. The soft bearing surface was a serious disadvantage to the pursued on account of its sharp hoofs and superior weight.

The otter apparently feeds entirely on fish. They destroy very greatly in excess of their food requirements, particularly during the winter season when they raid the water holes along the small streams and destroy all the fish in sight. Their activities also deplete the annual egg take, particularly at Fish Lake. The otter are increasing in the park and, in my judgment, destroy more fish than the pelicans.

PREDATORY ANIMALS Woodring

The marten subsists principally on birds, chipmunks and pine squirrels.

The lynx and bobcat prey on rodents and birds; also the young of the antelopes and deer.

Predatory Birds. The golden eagle has been known to swoop down and pick up the young of the Bighorn sheep and the antelopes. I have seen as many as five golden eagles and four bald eagles feeding on a carcass at one time. Last fall a golden eagle was seen to swoop down on a seven months old elk calf, striking at it repeatedly with the butts of its wings while the animal ran for cover. This continued for a run of approximately 100 yards, when the calf reached safety in a belt of timber.

Assistant Chief Ranger Douglas reported witnessing a bald eagle dive into the water of the Madison River and ascend with a live fish; he also observed a golden eagle on the same date as the above feeding on the warm carcass of a Canada Goose.

The osprey or fish hawk is a natural fish eater and they are often seen in flight capturing and carrying fish to their young. The pelican also subsists on fish. The horned owl feeds principally on mice, rabbits and birds.

YELLOWSTONE NATIONAL PARK TRAVEL
1872 TO 1928, INCLUSIVE

J. E. Haynes, Former Acting Director, Yellowstone Park Museum

(Compilation from Reports of the Park Superintendents)

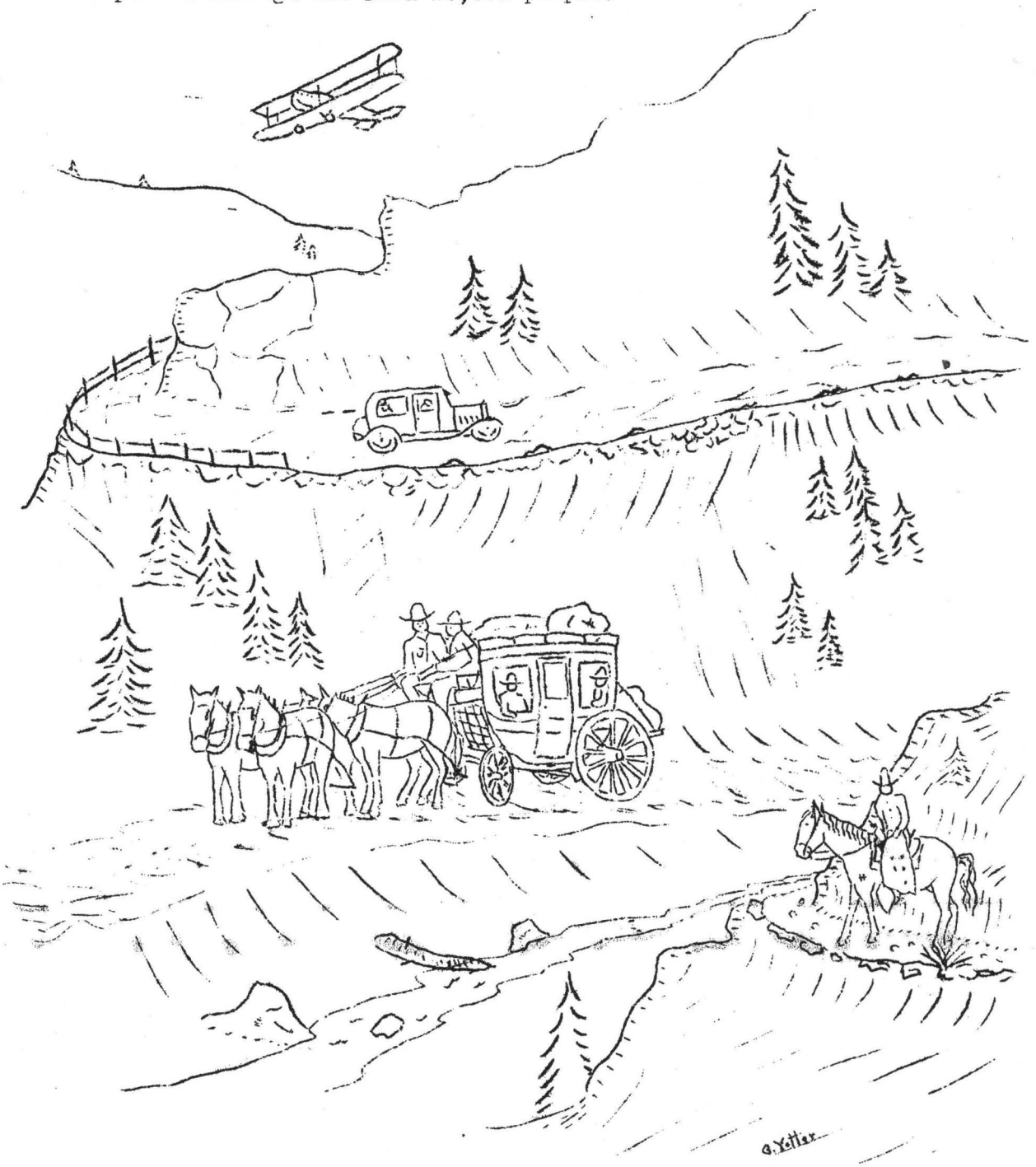
No accurate records were kept for the years 1872 to 1894, inclusive, but estimates average 2,000 each year during that 23 year period.

YEARS	NO. OF VISITORS	
1872 to 1894.....	46,000	
1895.....	5,438	
1896.....	4,659	
1897.....	10,680	Year of the railroad strike
1898.....	6,534	
1899.....	9,579	
1900.....	8,928	
1901.....	10,769	
1902.....	13,433	
1903.....	13,165	
1904.....	13,727	
1905.....	26,188	Lewis and Clark Exposition, Portland, Ore.
1906.....	17,172	
1907.....	16,414	Railroad completed to Western Entrance
1908.....	18,748	
1909.....	32,545	Alaska-Yukon-Pacific Exposition, Seattle, Washington.
1910.....	19,575	
1911.....	23,054	
1912.....	22,970	First tourists entered via Eastern Entrance.
1913.....	24,929	
1914.....	20,250	July 28, 1914, Beginning of World War.
1915.....	51,895	Panama-Pacific Exposition, San Francisco, California.
1916.....	35,849	Motorization of Yellowstone Park began.
1917.....	35,400	April 6, 1917, United States entered World War.
1918.....	21,275	Nov. 11, 1918, End of World War.
1919.....	62,261	
1920.....	79,777	
1921.....	81,651	
1922.....	98,223	
1923.....	138,352	
1924.....	144,158	
1925.....	154,282	
1926.....	187,807	Sesqui-Centennial Exposition, Philadelphia.
1927.....	200,825	
1928.....	230,984	
	1,887,496	TOTAL VISITORS

YELLOWSTONE NATIONAL PARK TRAVEL Haynes

Note:- The stage company organized by F. J. Haynes began carrying passengers to and through the Park via the western entrance in 1898. The railroad to the western entrance of the park was completed in 1907. Visitors began coming into the Park via the eastern entrance in 1912. The southern entrance was dedicated in 1921.

The record year for any horse-drawn stage line was established in 1915 by the Yellowstone-Western Stage Line, which during that season transported through the Park 20,151 people.



THE HISTORY OF COOKE, MONTANA

By Dorr G. Yeager, Park Naturalist

Approved:
Horace M. Albright, Director, National Park Service
J. E. Haynes, Former Acting Director, Yellowstone Park Museum

The majority of persons are divided into two classes, those who have never heard of Cooke and those who know only that it is the point from which the trips start for Grasshopper Glacier and who have heard rumors that gold was once mined in the hills nearby. The great majority, in fact very few persons know anything of the true history of the little clump of buildings nestled at the foot of Republic Mountain. I must admit that I was one of the majority until a trip was made in company with Park Naturalist Carl Russell of Yosemite National Park to the place for the expressed purpose of gathering historical relics and data.

Cooke, commonly known as Cooke City, is only one of the hundreds of ghost towns scattered over the mountainous regions of America's West. But Cooke differs from most of the others in that its spirit lives, though its body is smashed and wrecked. I say its body is smashed, yet there are a few sparks of life in its store, post office and dilapidated hotels. Its spirit lives in those hardy old timers who through the long winter months sit around the stove in Judge Allen's Hotel and Harry Stinson's workshop, looking forward with inspiring confidence to the time when the Republic and the Daisy and the War Eagle and a hundred other mines shall once more open and Cooke will come into its own as the foremost mining district of the world. They are all sure that it will come sometime and the men hang on, valiantly fighting the passing years, doing only sufficient work on the claims to hold them - ever waiting. Many have been laid to rest in the little graveyard during the long wait but the rest turn their faces brightly from the graves of their friends and look forward once more to the time when the whistle of ore trains and the muffled sounds of blasting shall bring Cooke again to the head among the mining communities of the country.

Cooke is a town wrapped in rich memories of the gold rush. A halo of historic interest and pathos surrounds the little town just outside the northeast boundary of Yellowstone National Park. True, its saloons and gambling halls are wrecked, their plate glass mirrors smashed and their bars and tables are thrown into one corner of the room. (I well remember being taken into the old bar formerly owned by the present Judge Allen and being told "it was the finest bar in the northwest in its day." I have a picture of the bar which substantiates this statement.) True the great crushers and smelters are still and the town has fallen into decay but the ghost of the old days of '80 and '81 walks through the streets. The ghost of brilliantly lighted dance halls, of saloons "with their gramaphones all ablair" and of the rush and bustle and prosperity of days in an early mining camp. It is the ghost of two gun men, of whisky and dancehall girls. But ghosts are dead and these memories live only in the minds of those who are still able to remember.

THE HISTORY OF COOKE, MONTANA Yeager

The history of Cooke begins with two men, Jack Crandall and his partner, a man named Daugherty. In the fall of 1869 they arrived in Bozeman with samples of rich placer gold and richer tales of valleys full of the mineral in the region of Clark's Fork. These tales reached the ears of four men, "Horn" Miller, Bart Henderson, Ed Hibbard and James Courley, who immediately decided to try their luck with pan and pick in this new region. They accordingly outfitted at the old Crow agency on Mission Creek, near the present site of Livingston, Montana, and, after arranging to meet Crandall and Daugherty on July first at the present site of the "Jim Smith Ranch", they set out the following spring for the new Bonanza. They followed up the Yellowstone River to Bear Gulch where they did some prospecting. They pushed on, however, and the end of June found them in the region of Soda Butte. They arrived at the appointed spot on time but Crandall and Daugherty had not yet arrived. Thinking that they had been delayed they camped and spent several days repairing their packs and resting. After nearly a week they despaired of meeting the two men, as they were not the type who would fail to keep a promise, were it possible. They began to see Indian signs and so breaking camp and driving a great herd of elk back over their tracks to erase all signs from the eyes of wandering bands of Indians, they started up what is now called Pilot Creek. They climbed Index and Pilot Peaks and dropped down into the basin of a creek which is now known as Cache Creek, a name which has survived from this party who cached their supplies when Indians surprised them. (The statement appears in literature that they climbed these two peaks although this is rather doubtful. Mr. J. E. Haynes says "From my own personal knowledge, up until a year or two ago, nobody had ever scaled either one of these peaks. The famous mountain climber of the Sierra Club, who climbed all the mountains in Glacier Park and the Grand Teton and Mount Moran and a few others, at my suggestion, tackled Pilot Knob and Index Peak and reported later that he had failed in the attempt and that in his opinion nobody could possibly climb either one without putting iron pegs in the perpendicular granite walls, and that he is confident nobody has ever climbed it.") At the time of the attack only Miller and Courley were in camp, the others having gone into the hills in search of mountain sheep. The two men stood off the Indians until their companions returned. With these reinforcements the Indians retreated and the little party slipped quietly under cover of night down Cache Creek to the Lamar. From there they made their way up the Lamar to a point about opposite the Buffalo Ranch where they forded and made camp just before coming to Slough Creek. The remainder of their journey is obscure. It is evident, however, that they followed up Soda Butte Creek to its head waters and eventually arrived at the present site of Cooke. They were, therefore, the first men to take gold from that point, as Crandall and Daugherty did all their prospecting in the region of Clark's Fork. The honor for discovery of the gold at the present site of Cooke should be credited to the other four men. After spending some time in the region they returned to the Crow agency where they learned of the fate of Crandall and Daugherty. The Crow Indians reported the killing, stating that it had been done by the Sioux, although this seemed unwarranted as the Indians who attacked "Horn" Miller and his companions on Cache Creek were Crow.

THE HISTORY OF COOKE, MONTANA Yeager

The next year the bodies of the two miners were found by a prospector named "Hank" Bottler. Mr. Harry Stinson, a resident of Cooke and a personal friend of "Horn" Miller has told me, and his words are substantiated by other reports that "their heads had been cut from their bodies and stuck on the point of their picks, the other point in the ground. Their tin cups had been placed in front of them telling other Indians that the men had been surprised while eating."

If one cares to make the tedious journey over to Crandall Creek he will see two graves. No headstone marks the spot and no epitaph informs the traveler of the tragedy which occurred there. Only two piles of stones keep the coyotes from digging up the remains of the bones of the men who are buried below - the one Daugherty, and the other Crandall, whose name has been given to the creek upon whose bank he was murdered.

When the four men returned to civilization the story of the rich finds spread and the next few years saw many prospectors on the ground, among these such characters as Sam Shively, Pat O'Hara, "Dutch Bill" and others. The extensive work, however, did not begin until 1877 when a number of men from Bozeman became interested in the prospect and formed the "Eastern Montana Mining Company". They erected a small smelter, the first to be erected in the district and work was begun in earnest. In the same year, however, the Nez Perce Indians, under Chief Joseph, crossed the northeastern portion of Yellowstone Park and raided the little settlement, forcing the miners to flee to the hills. The Indians destroyed several buildings and carried away considerable bullion which they later molded into bullets. The following year the Bannocks went on the warpath and the town was again endangered.

From this time on, the history of Cooke is a history of success and failure. The first blow fell when the Government ordered a cessation of operations due to the fact that the claims were on a portion of the Crow Reservation. This difficulty was overcome by a one-sided treaty with the Crow Chieftains giving up their rights to the Cooke area in 1881. The great boom occurred in the years of 1881 and 1882 following the bonding of the Republic Mine by eastern interests. It looked as if the region, known as the New World District, was to become a second Leadville or Cripple Creek. Excitement was at fever pitch the following spring when word came that a party of eastern financiers were to arrive for the purpose of looking over the situation with a view of investment. The party, headed by Jay Cooke, Jr. arrived in June when the snow still lay on the hills, The little mining community welcomed the party with open arms as they might have welcomed a savior. They explained to him the riches which lay hidden beneath the surface. They told him of the difficulties in transporting the ore to the railway. When Cooke suggested that he might build a railway to the community himself, their enthusiasm knew no bounds, and they straightway rechristened the town from Clark's Fork City, as it had been hitherto known, to Cooke in honor of their guardian angel.

THE HISTORY OF COOKE, MONTANA Yeager

The promise of a railroad continued to boom the little town. Its work continued with renewed vigor, its population increased, and for the next few years it seemed that the dream was to be realized. In 1883 "there were 135 dirt covered log shacks and 227 votes were cast at an election that year."

About that time, however, things began to happen which were to spell the ultimate downfall of the promising future. The bonding of the Republic mines in 1882 by Jay Cooke, Jr. and his eastern associates was panning out financially better than they had at first realized. The returns were so great that they found little need of putting in a railroad. In fact, the returns from the bonding was more profitable than work at the mines, and very humanly, he promptly forgot the promise to his namesake. This roused public indignation in Cooke and there was even a movement to wipe out the name "Cooke" and substitute "Edelweiss". However, the name "Cooke" had become so deep-rooted by that time that nothing came of the movement.

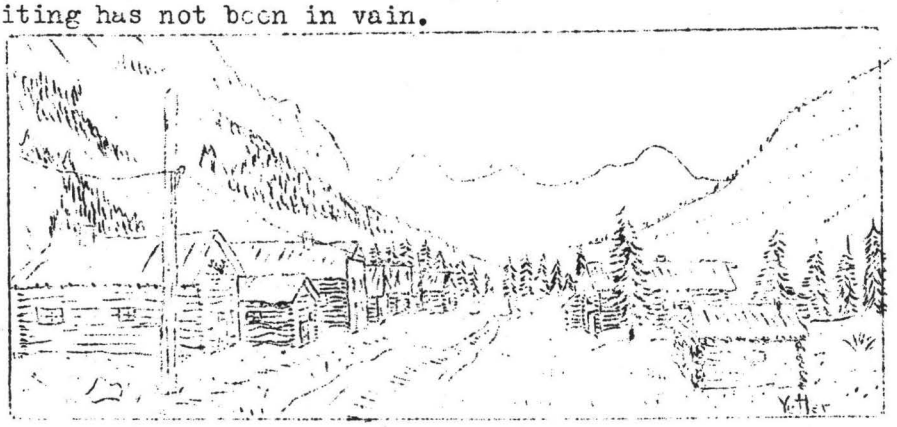
In addition to the bad memory of Jay Cooke, Jr. the possibility of possessing a railroad was pushed further and further back by a decision from Congress that no railroad should go through Yellowstone National Park. The Congressional documents of those years are full of arguments both pro and con concerning the railroad. The pros argued that the New World District possessed untold mineral wealth but that due to a lack of transportation facilities they were unable to continue the workings. In 1883 their claim was that it cost two cents a pound in summer and 4 cents in winter to haul the ore to the nearest railroad at Cinnabar, 5 miles from Gardiner. They argued that it cost as much to ship ore from Cinnabar to New York City as it did to get the ore from the mines to Cinnabar. They cited the shipment of ores from Black Warrior and Elk Horn to Omaha, when ores yielding $112.50 per ton after transportation and reducing charges were paid, left $4.50 for the miner for expenses at the mines. They pointed out that a road along the northern boundary of the park would in no way harm the park, that there were no phenomena in that district and that the scenery was poor at best. They even drew maps showing the distances to Old Faithful, Norris, Shoshone Lake, Canyon and Yellowstone to prove that a railroad at that distance from the natural phenomena could not in the least detract from them. (I have noticed on these maps, however, that no line was drawn to the Mammoth Terraces a few miles away). The pros maintained that this route, down the Yellowstone was the only possible route for a railroad to Cooke and that unless it was put through the world would lose a great abundance of minerals. The fight waged back and forth for months. The miners and Livingston business men raised $1,500 to send a committee to Washington, but ". . . the first night in Washington - staged a wine party to further the cause and the next morning wired for more funds. But the lobby sponsers were unable to keep up the delegation's pace and they came home without the railroad." The cons defied the pros to make good any of their statements. They maintained that the ores bringing $112.50 per ton were picked ores and that the average ores would bring on an average of but

$50.00. They maintained that there were two other routes equally advantageous for a railroad. One from Stillwater on the Union Pacific up the Stillwater River to the Clark's Fork District. The other from Billings up the Clark's Fork. They were strongly adverse to running a railroad into or through a National Park, saying that (and their foresight should be congratulated) it would be a strict violation of all National Park policies. The pros laughed, saying that the American people would never let a playground interfere with the mineral resources of the country. At last the question was settled and the decision of Congress barred forever a road through any section of the park.

With the passing of the railroad project, the inhabitants of Cooke sat down to wait, and they are still waiting. Most of the miners left for more productive fields, but a few remained in hopes that some interested corporation would again take hold of the situation and bring the "steel horse" to the town. The remnant of population which is left in Cooke, still insists that some day, not so very far in the future, their isolation will be overcome and the mines and smelters will once more become active. They look upon every stranger in the town as a possible savior and who knows - perhaps steel rails will some day be pushed from Billings or Stillwater and their dream come true.

I am not qualified to make statements concerning the possibilities of the Cooke District. Many of the early reports speak very favorably of the amount of minerals to be found there. Prominent among these reports is the one of Professor C. C. Swallow, Inspector of Mines for the State of Montana, who spent some time in the region and submitted a detailed report, a copy of which I have in my files. Whether or not the ore sent to Omaha, worth $112.50 per ton was hand picked ore will probably never be known. Those who were opposed to a railroad claimed that it was hand picked and that the average ore is worth about $50 per ton. These statements were stoutly denied by the miners. This we know, that it is possible to go to Cooke and pick up gold bearing ore. We also know that the future of the place depends not upon a road through the park, as that is impossible, but a road from either Billings or Stillwater.

In the meantime, the old timers of the locality will continue their waiting, ever hoping, ever confident, that some day news will come that their waiting has not been in vain.



SOME MEMORABLE DATES IN YELLOWSTONE HISTORY

By: Newell F. Joyner, Ranger Naturalist
J.E.Haynes, Authorized Park Photographer

Approved by: Horace M. Albright, Director, National Park Service

. . . . . .

1803 Our Government effected the Louisiana Purchase, thereby doubling the size of the United States and adding the territory which was later to be famed as containing among other features the region of geysers ---- Yellowstone National Park.

1807 John Colter, who left the Lewis and Clark Expedition near the mouth of the Yellowstone River, was the first known white man to set foot in this region. He saw the Lake and falls, but not the geysers.

1827 Jedediah Smith, a trapper, accompanied by some others of his kind, visited the Yellowstone region. His letter of that year, telling of the hot springs, geysers, etc. that he had seen, and the location of them leaves no doubt in our minds as to the authenticity of the description. (This letter was published a few years after it was written, then seemingly forgotten for a long time. However, as early as 1880, Supt. Norris attempted to locate it after having heard rumors of its existance. It did not finally come to light until less than ten years ago.)

1830 Jas. ("Jim) Bridger, a trader and trapper who was afterwards laughed at for his stories of the geysers and various wonders to be seen in this region, saw these phenomena for the first time.

1834 Warren Angus Ferris, a fur-trader, prepared the first known written account of the Yellowstone Wonders.

1859-60 A party composed of Capt. W.F.Reynolds, Prof. F.V.Hayden, Jas. Bridger, and others, and known as the Reynolds Expedition, attempted to reach the region from the south and east sides but were blocked by the snow-covered mountain ranges.

1860-68 Prospectors worked around the forks of the Yellowstone -- C.J.Baronett, Geo. Houstin, Bart Henderson (the two former men were afterwards associated with the development of the Park, and acted in the capacity of scouts and assistant superintendents.)

H. Sprague and Frederick Bottler prospected from Henry's Lake to the Forks of the Firehole.

SOME MEMORABLE DATES IN YELLOWSTONE HISTORY Joyner and Haynes

1863 Capt. W.W.DeLacy, in command of an unsuccessful prospecting expedition, discovered Lewis and Shoshone Lakes and the Shoshone and Lower Geyser Basins.

1869 Chas. W. Cook, David Folsom, and Wm. Peterson traversed the Yellowstone Region. The diaries of Mr. Cook and Mr. Folsom give a full account of the wonders seen.

1870 The Washburn-Langford-Doane Expedition made a several weeks exploration of the Yellowstone Region, and through the members of the party, Congress was urged to establish the Park in 1872.

1871 Dr. F.V.Hayden headed the work of making official explorations and surveys of the region, which work was continued in 1872 and completed in 1878.

William H. Jackson, photographer of the Hayden surveys, secured the first photographs of the region to be published. They undoubtedly helped in the creation of the Park.

Thos. Moran, the artist, painted pictures of the Canyon and of other features of the region. He accompanied the Hayden Survey Party.

Settlements were made near Mammoth by Mathew McGuirk and J.C.McCartney and a bridge was built over the east fork of the Yellowstone by C.J.Baronett.

Capts. J.W.Barlow and D.P.Heaps of the U.S.Army made explorations of the region.

1872 March 1st -- Pres. U.S.Grant signed an act of Congress setting aside Yellowstone National Park for the benefit and enjoyment of the people.

May 10th -- Nathaniel Pitt Langford became the first superintendent of Yellowstone National Park, which office he held until April 18, 1877, serving without remuneration.

Discovery of the Gibbon (Norris) Geyser Basin by E.S.Topping and Dwight Woodruff.

Discovery of Heart Lake Geyser Basin by a party of Hayden's Geol. Survey, under the leadership of Mr. Stevenson.

A thorough exploration of the Yellowstone Lake was accomplished by members of the Hayden Survey. They built a boat called the "Anna" for this purpose. It was the first boat,

of which we have any record, being sailed on the Lake by white men.

1873 Capt. W.A.Jones, U.S.A., and Prof. Thoe. Comstock headed exploring party through the region.

1874 The Scottish Earl of Dunraven cade a tour of the Park -- his account of it has been published in a book called "The Great Divide".

Rev. E.I.Stanley visited the Park and wrote "Rambles in Wonderland".

1875 "The Topping" -- built by Capt. E.S.Topping at Topping's Point on Lake Yellowstone. This was the second boat built by white men to navigate the Lake. Capt, Topping was afterwards identified with the development of the Park in various capacities.

Visit of the Secretary of War Belknap.

Capt. W. Ludlow made an interesting military reconnaissance of the region.

Geo. Bird Grinnell, naturalist, prepared first list of fauna of the Park,

P.W.Norris explored the Park for the first time.

1877 April 18 -- Philetus W. Norris was made the second superintendent of Yellowstone Park, succeeding N.P.Langford, and serving until February 2, 1882.

The summer of the Nez Perce Indian troubles, resulting in the pursuit of these Indians, under Chief Joseph, through the Park, by Gen. O.O.Howard.

J.C.McCartney was appointed resident assistant to the Superintendent by Supt. Norris.

Gen. Wm. T. Sherman visited the Park with an escort of five men.

1878 Supt. Norris constructed the famous Norris Road, a wagon-trail which led from Mammoth up over the formations, past Obsidian Cliff, which was first described by Supt. Norris subsequent to the surveying for the road, and on past the Norris Geyser Basin to the Lower Basin. Monument Geyser Basin was also discovered by this same party.

SOME MEMORABLE DATES IN YELLOWSTONE HISTORY Joyner and Haynes

Gen. Nelson A. Miles toured the Park, accompanied by Supt. Norris.

Other noted visitors were: General Brisbin; Lord Stanley, an Englishman; and the German Colonels, Schultz and Koster.

Liberty Cap, which it was feared would tumble soon, was braced.

The U.S.Geological Survey Party, headed by Dr. F.V.Hayden, spent some time in the Park. This was the third such expedition in this region, the two former ones being in 1871 and 1872.

1879 Headquarters Building on Capitol Hill was constructed by Supt. Norris. It served as a blockhouse, residence, and office.

Norris Pass was opened to saddle horses. It was the route discovered by Supt. Norris from Upper Basin to West Thumb via Shoshone Lake.

Guide boards were placed by Supt. Norris to show names of important phenomena as well as distances.

The first white men to spend the winter in the region --- A.F.Norris, C.M.Stephens, and J.Davis were located in the headquarters building during the winter of 1879-80.

Rustic Falls were discovered and named.

Discovery of sheep-eater haunts near Osprey Falls.

Supt. Norris urged changing the north and west boundaries of the Park to coincide with those of the state of Wyoming.

Montana passed laws protecting the buffalo.

Visitors: Prof. Geikie of Scotland, a noted geologist of his time.

1880 Hofer Brothers built the "Explorer" on Lake Yellowstone that Supt. Norris might explore the lake as well as the tributary streams. One of these brothers, T.E.Hofer, better known as "Billy" later was active in the transportation of tourists, both by means of saddle horse and boat.

Geo. W. Marshall and a partner named Goff built mail stations at Norris and Riverside, and a combined mail station and hotel at the Firehole Forks.

SOME MEMORABLE DATES IN YELLOWSTONE HISTORY Joyner and Haynes

Harry Yount was appointed the first game-keeper of the Park and built a cabin at Soda Butte.

Exploration of Hoodoo Region by Supt. Norris and Photographer H.B. Calfee who took a number of pictures. Supt. Norris recommended that the Hoodoos become a part of Yellowstone Park --- this was finally done in 1929.

Visitors included: Secretary of Interior Carl Schurz and Gen. Crook, U.S.A.

1881 Photographer F. Jay Haynes first visited the Park, taking pictures at Mammoth, Old Faithful, and Grand Canyon.

Devils Thumb was recoated by waters from an upper hot spring - Liberty Cap was to be repaired by the same method.

Visitors: Gen. Sheridan; Senator Benj. Harrison of Indiana; Senator John Sherman of Ohio; Justice W. Strong of Washington, D.C.;Wm. Collins and wife of Glasgow, Scotland; Commodore Bell and Fred de Gamba of Senegambia; and Prof. W.I. Marshall of Fitchburg, Mass. The latter gentleman was a lecturer --- using illustrated slides, and telling of the wonders of Yellowstone and Yosemite.

1882 Patrick H. Conger was made third Superintendent of the Park, succeeding P.W. Norris on February 2nd, and serving until August 4th, 1884

John Yancey was permitted to erect a small mail station in Pleasant Valley ("Yancey's") for the accomodation of teamsters, fishermen, etc.

Geo. L. Henderson of Iowa, brother of Speaker Henderson of the same state, came into the Park as Assistant Supt. He brought his son with him, and by the next June his four daughters were in the Park. One daughter and the son erected the Cottage Hotel. Another of the daughters was postmistress over a long period of time --- from 1883 on. Another of the girls married Mr. Lyall, who with Henderson (the son) operated the Henderson and Lyall post-office store at Mammoth for 10 years or so. Geo. L. Henderson was a partner in the operation of the Old Marshall House at the Lower Basin previous to 1886. One of his partners was a son-in-law, Henry Klamer who later built the store at Upper Basin and whose plant was afterwards bought by C.A. Hamilton.

Visitors: Senator Bayard of Maryland with a distinguished party; General Sheridan; John McCullough the actor; Gen. B. Sackett and others with 150 men and 300 horses and pack animals; "Omaha Board of Trade" party; Earl Hope of Scotland with a large party; A.T. Argens, Copenhagen, envoy of the King of Denmark.

SOME MEMORABLE DATES IN YELLOWSTONE HISTORY Joyner and Haynes

1883 July 28 -- Lieut. Daniel C. Kingman, Engineering Officer of the Department of the Platte, was in charge of improvements in Yellowstone Park.

Pres. Chester A. Arthur visited the Park, accompanied by a large party and an escort of a troop of cavalry. Members of this party included: Gen. Phillip H. Sheridan; Col. Mike Sheridan; Gov. Schuyler Crosby of Montana; Senator George G. Vest; Capt. Philo Clark; Col. J.F. Gregory; Judge Rawlins; Gen. Anson Stager and Secretary of War Robert C. Lincoln. F. Jay Haynes, Photographer accompanied this party. Pres. Arthur was the first president to visit the Park.

Y.P. Improvement Co., headed by Hobart, Douglas and Hatch, partially constructed the Mammoth Hotel and conducted tent-hotels at Norris, Lower Basin, and Upper Basin. The Mammoth Hotel offered accomodations for tourists on August 1st.

Northern Pacific R.R. completed its Yellowstone Park branch to Cinnabar, and began transporting tourists on August 1st, at the same time that the Mammoth Hotel was opened.

Visitors included the above named, as well as Gen. W.T. Sherman; Justice Gray of the same tribunal; Senator George Graham Vest of Missouri; Rosco Conkling of N.Y.; George Boutwell of Mass.; Edward Pierpont of N.Y. and J. Hilton Scribner of N.Y.; Arnold Hague and John Renshaw of the U.S. Geological Survey, entered the Park for the purpose of studying its phenomena. Mr. Renshaw made some paintings which are now in the Mammoth Museum.

J.B. Grinnell of Iowa; U.S. Senator John A. Logan of Illinois; and Prof. Passey of Paris were also guests in the Park.

Pres. Villard of the N.P.R.R. took a distinguished party through the Park. This party included a number of prominent foreigners, especially the German and English Ministers to the U.S.

1884 The first studio of F. Jay Haynes was constructed at Mammoth Hot Springs, in the center of the plateau now known as the Parade Grounds. It was later removed to the base of Capitol Hill, and razed in the fall of 1928.

Aug. 4th -- R.E. Carpenter became the fourth superintendent of the Park. He held office until May 29th of the next year.

Yellowstone Park Improvement Co. was placed in financial difficulties.

SOME MEMORABLE DATES IN YELLOWSTONE HISTORY Joyner and Haynes

John Yancey secured a lease for a hotel at his site in Pleasant Valley (Tower Fall Vicinity).

The Lower Basin Hotel was erected by C.T. Hobart on the lease of the Yellowstone Park Improvement Co. near the present Fountain Ranger Station.

1885 May 29 -- David W. Wear became the fifth superintendent of the Park succeeding R.E. Carpenter, who went into the Hotel business at the Lower and Upper Geyser Basins. Mr. Wear held office until August 1st, 1886.

Hobart and Carpenter erected a two-story frame hotel at the Upper Geyser Basin.

Cottage Hotel was constructed in late summer on ground leased for that purpose by Helen L. and Walter Henderson. This was the second hotel constructed at Mammoth and was later purchased by the Yellowstone Park Association and is now used as a dormitory for Hotel employees.

1886 Aug. 17 -- Capt. Moses Harris became Acting Superintendent of Yellowstone --- the sixth superintendent of the Park and the first military Superintendent. One troop of cavalry was stationed in the Park for the purpose of protection. Camp Sheridan, their headquarters, was located on the south side of Capitol Hill. It was of a temporary nature and was superseded by Fort Yellowstone in 1892.

The Yellowstone Park Association secured the leases of the Yellowstone Park Improvement Co. and completed the Mammoth Hotel and erected a new hotel at Norris. It also conducted tent-hotels at Upper Geyser and Lower Geyser Basins as well as at the Grand Canyon.

1887 Norris Hotel was destroyed by fire on the evening of July 14th. There was no loss of life or tourist's baggage. A Hotel Camp was immediately constructed.

The Yellowstone Park Association constructed a hotel-camp at Lake Outlet.

In late December of the previous year, Photographer F. Jay Haynes and Frederick Schwatka, an explorer of Artic Fame, arrived to visit the Park in the winter time and to secure pictures of the region covered with snow. The illness of Schwatka and the poor condition of the snow was responsible for only partial success of the undertaking. Pictures were secured, however, of the Canyon, Norris and Old Faithful. These were the first known winter pictures of the region.

Capt. Clinton B. Sears, U.S.A. Eng. Corps was in charge of construction work.

SOME MEMORABLE DATES IN YELLOWSTONE HISTORY Joyner and Haynes

1888 Excelsior Geyser, quiescent since 1882, was again active.

Maj. Chas. J. Allen, U.S.A. Eng. Corps, relieved Capt. C.B. Sears in charge of improvements.

There was a bill in Congress for changing and enlarging of the area of Yellowstone Park.

1889 Capt. F.A. Boutelle became acting superintendent of the Park on June 2nd. He was the seventh superintendent and the second military superintendent. He served until Dec. 19, 1890.

Ole Anderson was granted a non-transferable permit to coat certain articles with travertine (hot-springs deposit) and to sell these articles. He erected some tents near the present site of the Park Curio Shop at Mammoth.

Mr. E.C. Waters, previously connected with Y.P.Association, placed boats on Lake for passenger service. This was done under independent lease.

1890 Last recorded eruption of Excelsior Geyser on July 28th.

Visit of the Michigan Press Association party.

Lake House was in the course of construction.

Canyon Hotel was constructed.

It was recommended by the Superintendent and commander of the military force in the Park, that Congress appropriate $50,000 for the erection of a permanent army post in the Park. This was done within the next two years, and called Fort Yellowstone.

The first edition of Haynes Guide Book was published.

Construction on road from Cody, Wyoming to Yellowstone Lake was begun. It was completed in 1903.

1891 Feb. 15th -- Capt. Geo. Anderson became Acting Superintendent of Yellowstone Park. He was the eighth superintendent and the third military superintendent of the region. He served until June 23, 1897.

June 5th -- Lieut. Hiram M. Chittenden, U.S.Eng. Corps, took charge of the improvements in Yellowstone Park and served until April 2, 1893; he returned to duty in the Park March 25, 1899 and served until March 31, 1906, at which time he was Major in the Engineers Corps.

Lower Basin Hotel was abandoned and the new Fountain Hotel opened about ½ mile north of Fountain Paint Pots. Practically all of the buildings in connection with the old hotel were razed and burned soon after the abandonment.

SOME MEMORABLE DATES IN YELLOWSTONE HISTORY Joyner and Haynes

The road from Lone Star Geyser to West Thumb was under construction.

1892 The temporary Hotel at Norris burned in May. A lunch station was then operated at that place under canvas.

Fort Yellowstone was built and occupied about Nov. 1st by one troop of cavalry.

The road from Upper Basin to West Thumb was completed, permitting travel from Norris to the Geyser Basins and via Lake and Canyon to Norris again without duplication of Route of travel. Previously the route had been to Norris to Upper Basin via Lower Basin, then return to the Lower Basin and across Mary's Mountain to Hayden Valley; up the valley to Lake Outlet and Thumb; thence retracing down the valley to Canyon Station and across to Norris.

1894 Travel to date (1872 - 1894) 46,000.
Congress passed an act protecting the birds and animals of Yellowstone Park and provided for the enforcement of that act. Judge John W. Meldrum, associated with the early history of the State of Wyoming, was appointed U.S. Commissioner for Yellowstone Park and has served continuously since that date.

F. Jay Haynes made a second winter photographic expedition through the Park with Capt. Scott, Lieut. Forsythe, Scout Burgess and Robert Burns, and at the same time the famous writer Emerson Hough and Billy Hofer made a ski trip through the region. Both parties were making investigations of the wild animal conditions, and their report, along with their capture of a notorious poacher, Howell, resulted in the above Congressional action.

C.A. Lindsley first came to the Park. At that time he was night clerk for the Mammoth Hotel. He later became clerk in the office of the Acting Supt., and was himself, at a more recent date, Assistant and Acting Superintendent. In 1922 he became Postmaster of Yellowstone Park and still holds that position.

Bill introduced into Congress providing for the establishment of a railroad through the Park. The plans were for it to pass near the Lake. The bill was eventually killed.

1895 Travel 5,438

1896 4,659 Visitors.
W.W. Wylie was granted a permit to conduct tourists through the Park. Later he was succeded by the Wylie Permanent Camping Co. which operated from 1898 to 1917.

SOME MEMORABLE DATES IN YELLOWSTONE HISTORY Joyner and Haynes

1897 10,680 Visitors
Haynes Log Cabin Studio, the second studio in the Park, was built at the Upper Basin, six years before the Old Faithful Inn was built.

June 23 -- Col. S.B.M. Young was appointed as the ninth Acting Supt. of Yellowstone Park. He was the fourth Military Supt. and served until July 12, 1898.

Fort Yellowstone was enlarged to accomodate two troops of cavalry.

Henry Klamer, son-in-law of Geo. L. Henderson and partner with him in the operation of the Firehole Hotel in 1885-6, erected a two-story frame building in the Upper Basin for a store. The Plant was afterwards purchased by C.A.Hamilton.

1898 6,534 Visitors.
July 12 -- Capt. Jas. B. Irwin became Acting Supt. upon the promotion of Col. S.B.M. Young. Capt. Irwin was the fifth military Supt. and the tenth Supt of the Park.

Monida and Yellowstone Stage Co., organized by F. Jay Haynes, began transporting passengers through the Park, with horse-drawn stages. The name of this company was later changed to Yellowstone-Western Stage Co., and under this name operated until 1917, when transportation of the tourists was motorized.

Wylie Camping Co. established permanent Camps at Apollinaris Spring, Upper Basin, Lake Outlet, and Canyon.

1899 9,579 Visitors.
March 15 -- Capt. W.E. Wilder became Acting Superintendent of the Park.

June 23 -- Capt. Oscar Brown succeeded Capt. Wilder, and became the twelfth Supt. of the Park and the seventh military Supt.

March 25 -- Major Hiram M. Chittenden, of the U.S.Army Engineers Corps, took charge of the work of improvements in Yellowstone Park for the second time, serving until March 31st, 1906. His previous assignment to the Park was in 1891, 92, and 93.

1900 8,928 Visitors.
June 23 -- Capt. Geo. W. Goode was appointed Acting Supt. of the Park. He succeeded Capt. Oscar Brown, and served until May 8th of the next year. He was the thirteenth Superintendent of the Park, and the eighth military Supt.

SOME MEMORABLE DATES IN YELLOWSTONE HISTORY Joyner and Haynes

1901 10,769 Visitors.
May 8 --- Capt. John Pitcher was appointed Acting Supt. of Yellowstone Park, succeeding Capt. Geo. W. Goode and serving until 1907. He was the fourteenth supt. of the region, and the ninth Military Supt.

New Norris Hotel opened.

Golden Gate Viaduct was constructed by Maj. Chittenden. Lieut. Dan Kingman had previously constructed a road with a wooden viaduct, but the present structure of concrete was constructed in this year.

Death of Silas S. Huntley, President of the Y.P.Transportation Company.

1902 13,433 Visitors.
The lawn in front of the hotel --- on the plateau known as the parade ground --- was started, and an irrigation system installed by Maj. Chittenden.

An electric power plant was constructed, and Fort Yellowstone supplied with electricity.

The Northern Pacific R.R. completed its tracks to Gardiner, its present terminus.

Pursuant with the policy of re-establishing the Buffalo Herd in Yellowstone Park, "Buffalo " (Wm.) Jones was employed to serve as Buffalo Keeper. He made a trip to Texas to secure some bulls, and the buffalo corrals and buildings near Mammoth were constructed for his use and the care of the animals.

Aug. 1st -- Mr. Lercy Hill first came into the Park. He was Chief Clerk of the Engineering Department of the Army in Yellowstone Park. When the army abandoned the Post, he became Purchasing Agent for the National Park Service in the Park. Later he was Disbursing Agent and Assistant Supt. and at the present time holds the position of Disbursing Clerk.

1903 13,165 Visitors.
Dedication of the North Entrance Arch by President Roosevelt on April 24th. President Roosevelt was the second President of the United States to visit the Park and he made a trip in the northeast portion, accompanied by John Burroughs, the great naturalist.

Old Faithful Inn was under construction.

The road from Cody, Wyo. to the east entrance of the Park was completed. Construction on it had begun in 1890.

SOME MEMORABLE DATES IN YELLOWSTONE HISTORY Joyner and Haynes

The Office of the Engineer for the Park was constructed. With the coming of the N.P.S. it was remodeled to serve as the Administrative Offices for the National Park Service in Yellowstone Park.

The Weather Bureau office and residence was under construction.

The Chittenden Bridge over the Yellowstone River just above the Great Falls was constructed by Engineering Officer, Maj. Hiram M. Chittenden.

1904 13,727 Visitors.
Old Faithful Inn was opened. It was managed by Larry Mathews, the genial Irishman who had at previous times operated Trout Creek and Norris Lunch Stations. This was Mr. Mathew's last season in the Park.

Lake Hotel was enlarged, and was then the largest hotel in the Park.

The long steel bridge over the Gardiner River, two miles from Mammoth was constructed by Maj. Hiram M. Chittenden. Its total length is 410 feet.

1905 26,188 Visitors.
The spiral road and viaduct on the Cody Road were constructed by Maj. H.M. Chittenden.

The Chittenden road over Mt. Washburn and Dunraven Pass (both branches) were completed. This completed the road system that is today known as the "Grand Loop", permitting tourists to make a trip around the Park with but very little repitition in route of travel.

1906 17,172 Visitors.
Lieut. E.D.Peek, U.S. Eng. Corps, succeeded Maj. H.M. Chittenden in charge of improvements in the Park.

Wylie Permanent Camping Co. established a camp at Lost Falls (Roosevelt Lodge).

1907 16,414 Visitors.
U.P. R.R. completed its tracks to the West Entrance of the Park, and was known as the Oregon Short Line.

General S.M.B. Young became Supt. of the Park. He was not in charge of the troops at Fort Yellowstone and held the rating of full superintendent. Gen. Young was the ninth Supt. of the Park, serving as Acting Supt. in 1897 and 98.

T.E. Hofer controlled the Yellowstone Boat Co., succeeding Mr. E.C. Waters in that capacity.

SOME MEMORABLE DATES IN YELLOWSTONE HISTORY Joyner and Haynes

Y.P.Hotel Co. was organized and acquired the franchise of the Yellowstone Park Association.

A somewhat detailed recommendation was made by Supt. Young, pointing out the need for a type of personnel, differing from the regular army man, to protect the Park.

1908 18,748 Visitors.
Oct. 27 -- Maj H.C. Benson became the fifteenth man to serve as Supt. of Yellowstone Park. He was also the tenth military Supt. He served until 1910.

Pryor and Pryor bought out Old Anderson's plant at Mammoth and were granted a permit to sell articles to tourists. Their store became known as the Park Curio Shop.

Garrison was increased to four troops of Cavalry on May 13th, but was later replaced with only three troops.

1909 32,545 Visitors.
Old Headquarters Building on Capitol Hill was torn down.

New stone Buildings erected at Fort Yellowstone --- now able to accomodate four troops of cavalry.

1910 19,575 Visitors.
Sept. 30,-- Colonel Lloyd M. Brett became acting superintendent succeeding Maj. Benson, and serving until 1916. He was the sixteenth man to serve in such a capacity, and was the eleventh and last military superintendent.

President and Mrs. Warren G. Harding were in Yellowstone together for the first time. Mrs. Harding had been here in 1889.

1911 23,054 Visitors.
June 15 -- The remodeled and enlarged Canyon Hotel was opened to the public for the first time.

Gallatin Road from Bozeman, Mont. to the West Entrance was opened.

The Park was protected by four troops of cavalry and a machine-gun platoon.

The main building of the new stone hospital was constructed and used by the Army.

1912 22,970 Visitors.
Passengers began coming in through the east entrance to the Park.

The stone Chapel at Mammoth was under construction.

SOME MEMORABLE DATES IN YELLOWSTONE HISTORY Joyner and Haynes

1913 24,929 Visitors.
The Monida and Yellowstone Stage Co. changed its name to the Yellowstone-Western Stage Co.

Geo. Whittaker, and ex-scout under the army in 1897-8, bought out the Post-Office store at Mammoth belonging to Lyall and Henderson.

Old Faithful Inn was enlarged by the addition of 100 rooms, (south wing).

Shaw and Powell established permanent camps within the Park.

The new wing of the Mammoth Hotel was completed, increasing the guest capacity by 124 rooms.

The Annex to the Stone Hospital at Mammoth was completed.

Franklin K. Lane, Secy. of Interior, visited the Park.

June 2 -- Horace M. Albright became a law clerk in the Department of the Interior at Washington, D.C.; in 1917 he was made Assistant Director of the National Park Service, and in 1919, became Supt. of Yellowstone Park; in 1929 he became Director of the National Park Service, Department of Interior.

1914 20,250 Visitors.
H.P. Brothers was granted a concession to operate a swimming pool at the Upper Basin.

Henry Klamer, owner of the store at Upper Basin, died in August.

Replacement of the troops within the Park under a different system. A single unit was not in the Park, but it was protected by men from various units, who had shown the fitness for such Park duty.

1915 51,895 Visitors.
Jan. 21 -- S.T. Mather became Assistant to the Secy. of Interior.

March 7th -- Brigadier-General (retired) Geo. S. Anderson, former Park Superintendent, died in New York City.

July 4 -- Mr. Mather and Appropriations Committee used autos from East Entrance to Lake Hotel.

Aug. 1 -- First private automobiles permitted in Park. There had been auto travel on the Gallatin road, which is only partially within the Park.

Yellowstone-Western Stage Co. set an all-time record for horse-drawn vehicles, transporting through the Park in 1915 a total of 20,151, thereby testifying to the increasing

popularity of the western entrance.

C.A. Hamilton bought our the Henry Klamer store at the Upper Basin.

1916 35,849 Visitors.
The Cody-Sylvan Pass Motor Co., headed by F. Jay Haynes, operated the first bus-line within the Park. They carried passengers between Cody, Wyo. and Lake Hotel.

Aug.25 -- The National Park Service was created by an Act of Congress signed by President Wilson.

Oct.1 -- Fort Yellowstone was abandoned by the War Department. The troops were soon replaced by N.P.S. Rangers.

Oct. 16 -- Assistant Supt. C.A. Lindsley became acting Supt., succeeding Col. Brett, and serving until June 28th, 1919. He was the seventeenth man to serve in this capacity, and the sixth civilian superintendent.

Nov. 14 -- Brig.-Gen. (retired) Daniel C. Kingman, the first officer in charge of improvements within the Park, died at Atlantic City.

1917 35,400 Visitors.
May 16 -- Hon. Stephen T. Mather became the first Director of the National Park Service, which position he held until Jan. 12, 1929, when on account of ill health he found it necessary to resign.

Oct. 9 -- Gen Hiram M. Chittenden passed away at Seattle, Wash. He was an Engineering Corps officer under whose supervision a great deal of improvement in the Park was accomplished. He was also the author of "The Yellowstone Park", a work on the history and phenomena of the region.

Motorization of Transportation under one company was brought about.

Yellowstone Park Camps Co. was organized by the purchase of the two large camping companies' interests. These companies were the Shaw and Powell and the Wylie Companies. Camps were maintained during the season at Mammoth, Old Faithful, Riverside, Lake, Canyon, and Tower Falls.

Troops returned to the Park on June 26th

1918 21,275 Visitors.
All hotels were closed as a measure of War Economy.

The Camps at Riverside, Tower Falls, and Lake were closed for the same reason.

The addition of the Jackson Lake and Teton region was recommended by the Acting Superintendent.

July 1 -- Army Engineers removed. For the first time civilian engineers were in charge of improvements of the Park, under supervision of the Superintendent.

Oct. 31 -- Complete civilian control restored. The Park was protected by the N.P.S. Rangers.

1919 62,261 Visitors.
June 28th -- Mr. Horace M. Albright began his ten years service as Superintendent of Yellowstone Park. He was the 18th Supt. of the Park and the seventh civilian Supt.

Riverside and Lake Camps were not opened, nor was Lake Hotel. There was a temporary Camp established at Lake Outlet, part of the season.

Park Ranger Milton P. Skinner was engaged in making collections for the Museum which was to be established in the near future.

The Brooklyn "Eagle" Tour -- July 27 to 31 inclusive.

Visitors included: U.S. Chamber of Commerce Party; Ex-Secy. of Interior, Walter L. Fisher and family; Governors of 15 or 20 states in a special party; Dr. Nicholas Murray Butler, Pres. of Columbia University.

1920 79,777 Visitors.
Jan. 1 -- James McBride became the Park's first Chief Ranger.

The office of Park Naturalist was created --- M.P. Skinner was appointed to the office.

The exploration of the Bechlar River Country by Wm. C. Gregg of Hackensack, N.J.

Supt. Albright made a trip of inspection to the Upper Yellowstone and Bechlar River regions.

Isabel Bassett Wassen lectured to the tourists at Mammoth Hot Springs. She was the first lecturer employed by the N.P.S. in Yellowstone Park.

Visitors included : Secy. of Interior, J.B. Payne and Secy. of Navy, Josephus Daniels, in company with Senator T.J. Walsh; Lieut.-Gen. S.M.B. Young, Ex-Superintendent of the Park; Hal G. Evarts, Saturday Evening Post writer, who spent several weeks in the Park during July and August; Admirals Fletcher and C. McR. Winslow; General Liggett and party; Geo. H. Lorimer, Editor of Saturday Evening Post and

Emerson Hough; Col. F. D'Olier, Commander of American Legion.

1921 81,651 Visitors.
March 10 -- F. Jay Haynes passed away, after completing forty consecutive summers in the Park.

Mount Haynes named at the suggestion of Superintendent Horace M. Albright, to perpetuate the name of Frank Jay Haynes, pioneer photographer of the Park. The name was approved by the National Park Service and the U.S. Geographic Board.

Aug. 21 -- At Towgwotee Pass, the Southern Entrance Highway was dedicated.

The Fire-lookout and shelter built on top of Mt. Washburn.

The Gregg-Birdseye Party, and J.E. Haynes, explored and mapped the Beehler Region. Mr. Gregg had previously explored the region, but it had never been thoroughly mapped or photographed.

Miss Mary Rolfe lectured to the tourists at Mammoth.

Visitors included : Secy. of Interior, A.B. Fall; Dr. Henry VanDyke, former minister to Holland; Edmund Heller, famous naturalist; Dan Board, National Scout Commissioner; Geo. B. Grinnell and family; Forty-five members of the General Federation of Women's Clubs; Prof. Keyi Uyehara of Department of Landscape Architecture and Forestry, Tokyo Imperial University, Japan; Emerson Hough, writer and conservationalist; C.C. Adams, Director of Roosevelt Wild Life Forest Experiment Station of Syracuse, N.Y.; Dr. E.R. Warren, mammologist of Colorado.

1922 98,223 Visitors.
Aug. 14 -- The Semi-Centennial Geyser broke out near Norris.

July 14 -- Supt. Horace M. Albright officiated at the Semi-Centennial Ceremonies commemorating the establishment of the Yellowstone National Park in 1872, which were held at the junction of the Firehole and Gibbon Rivers at the foot of National Park Mountain. Supt. Albright was assisted in these ceremonies by the National Editorial Association which was holding its annual convention in the Park at that time.

May 1 -- Joseph Joffe, Assistant to the Superintendent, came into the Park as a clerk.

Sam T. Woodring was appointed Chief Ranger vice James McBride. Mr. Woodring held this position until the spring of 1929, when he was appointed Superintendent of the new Grand Teton National Park.

SOME MEMORABLE DATES IN YELLOWSTONE HISTORY Joyner and Haynes

Mr. Leroy Hill, who had been connected with the engineering department for a period of years, was appointed Assistant Superintendent.

Mr. C.A. Lindsley was appointed Postmaster, succeeding Mr. George Whittaker.

Dr. F.E.A. Thone lectured to the tourists at Mammoth.

Visitors included : Shriner's Party; Massachusetts Forestry Assn.; St. Louis Police and Detective Assn. Party; Putnam's Party of Writers, etc.; National Editorial Assn. Party.; American Bar Assn.; Buick Sales Organization; Admiral Benson, of U.S.Shipping Board; Wm. G. McAdoo.

1923 138,352 Visitors.
Dr. F.E.A. Thone became Acting Park Naturalist, due to the resignation of Park Naturalist M.P. Skinner.

The formal opening at Gardiner. The speaker of the Day was Dr. John Wesley Hill, Chancellor of Lincoln Memorial University of Cumberland Gap, Tenn.

June 30 -- July 1 --President Warren G. Harding and Mrs. Harding visited the Park. They were accompanied by Secy. of Interior, Hubert Work and Secy. of Agriculture Wallace, as well as Speaker Gillett.

July 19 -- The Howard Eaton Trail was dedicated. This name was suggested by Chief Ranger Sam T. Woodring who superintended the planning and the work of the building of the 157 miles of horseback trails. It is so named in commemoration of the Dean of Guides in the Park --- who conducted more than 100 horseback parties through the region, and surrounding country. He was a very close friend of Theo. Roosevelt, being his neighbor in the Dakota Ranch days.

A Congressional Committee, headed by Senator Frances E. Warren of Wyoming, were investigating Governmental Activities in the West. During the tour, they visited Yellowstone Park.

During OctoberSupt. H.M. Albright and Chief Ranger Sam T. Woodring explored the Gallatin Range.

Visitors: Dr. John C. Merriam, President of Carnegie Institution; of Washington, D.C.; Col. Alvin M. Owsley, National Commander of the American Legion; Lieut.-Gen. S.B.M. Young, former Supt. of the Park; Hon. Chas. E. Winter, Congressman from Wyoming.

1924 144,158 Visitors.
In January Edward J. Sawyer was appointed Park Naturalist, filling the position formerly permanently occupied by Milton P. Skinner.

SOME MEMORABLE DATES IN YELLOWSTONE HISTORY Joyner and Haynes

Feb. 12 -- Col. (retired) Frazier Augustus Boutelle, former Park Superintendent, died at Seattle, Washington.

July 10 -- Brig.-Gen. N.A., James Brailsford Erwin (honorable discharge) died at Pasadena California. Mr. Erwin was a former superintendent of the Park.

Sept.21 -- Col. (retired) Harry Coupland Benson, former Supt. of Yellowstone Park, died at the Presidio of San Francisco, Cal.

Sept. 1 -- Former Supt. Samuel Baldwin Marks Young, former Lieutenant-General, Chief of Staff (retired) and Governor of the U.S. Soldier's Home, died at Helena, Montana.

September -- Park Photographer J.E. Haynes, Park Naturalist Ed. J. Sawyer, and G.A. Larkin made a six-day boat trip exploring the shoreline of Yellowstone Lake, and ascended the peak climbed in 1870 by N.P. Langford, who, from that point, drew the first accurate map of Yellowstone Lake.

Supt. H.M. Albright, accompanied by Chief Ranger S.T. Woodring, Photographer J.E. Haynes, and Ranger Ed. Bruce, made a six-day horseback trip, visiting Death Gulch and the Hoodoos, and exploring the Absaroka Mountains.

Cook Peak was named in honor of Chas. W. Cook, pioneer of Montana, and a member of the Cook-Folsom Expedition of 1869.

The West Entrance Checking Station was constructed. A similar station was erected at the East Entrance.

The opening ceremonies were held at the North Gateway. Capt. John R. Quinn, Commander of the American Legion, cut the chain suspended across the gate, thereby admitting traffic. The speakers were Gov. Jos. M. Dixon of Montana, and U.S.Senator T.L. Oddie of Nevada.

1925 154,282 Visitors.
Opening ceremonies were held at the West Entrance. Four Governors of adjacent states were present and assisted in the exercises. Those were: Gov. Nellie T. Ross of Wyoming; J.E. Erickson of Montana; C.C. Moore of Idaho; and Geo. H. Dern of Utah.

Visitors: Dr. Frank Oastler and wife; Dr. H.C. Bumpus; Pres. Carl R. Gray of the Union Pacific Railroad, who with Mrs. Gray accompanied a party of Railroad Officials through the Park in June; Dr. W.T. Hornaday, Naturalist and Directon of the New York Zoological Gardens; Montana Press Assn. Party; W.H. Jackson, Photographer of the Hayden Surveys of 1871,'72, and '78; Maj.-Gen. Hugh L Scott; Omaha Walking Club; Wasatch Mountain Club of Salt Lake City; Gen. Jas. A.Drain, National Commander of the American Legion.

SOME MEMORABLE DATES IN YELLOWSTONE HISTORY Joyner and Haynes

1926 187,807 Visitors.
Oct. 12 -- Lieut.-Col. John Pitcher, former Park Supt., died at Edgewater, Md.

Opening ceremonies were held at North Gate, under the auspices of Rotary International.

Merrill F. Daum was appointed Resident Engineer. He had been previously connected with the Chief Engineer's Headquarters at Portland, Oregon.

Visitors: Secy. of Interior, Hubert Work; Crown Prince and Princess of Sweden and party; Large party of Governors of various states; California Camera Club; Boris V. Morkovin of Prague, Czecho-Slovakia, Ambassador from that country; Mr. John D. Rockefeller, Jr. and family; Princeton Summer School of Geology, under direction of Richard M. Field; Sierra Club of California, part of whom ascended the Grand Tetom; Senator Wm. E. Borah from Idaho, accompanied by a party of irrigationists.

TheGeophysical Laboratory of the Carnegie Institution of Washington, D.C., is working on problems connected with geysers and hot springs.

Ray O. West entered the Park, accompanied by his daughter. (Mr. West was Secy. of Interior from Aug. 1928 to March 4, 1929.

1927 200,825 Visitors.
Opening ceremonies held at the East Entrance on June 19th. The speakers were the Hon. John Q. Tilson, floor leader of the U.S. House of Representatives; Congressman Chas. E. Winter of Wyoming; Gov. Frank C. Emerson of Wyo.; White-Man-Runs-Him ---Last of General Custer's Crow Scouts; Max Big-Man, interpreter for the Scout.

The Formal Opening of the Gallatin Gateway Inn was held on June 17th --- thus routing travel through a new entrance to the Park via Gallatin Gateway and Bozeman.

Old Fountain and Norris Hotels were razed.

Aug. 22-27th -- Pres. Calvin Coolidge visited the Park. He was accompanied by Mrs. Coolidge and their son John.

Sept. 23 --- Former Park Supt. Brig. Gen. Lloyd Milton Brett passed away in Washington, D.C.

Addition of 150 rooms to the Old Faithful Inn (north wing).

Jan. 30 -- Chas. W. Cook, pioneer explorer of the Park, passed away at White Sulpher Springs, Montana.

Merrill F. Daum was appointed Assistant Supt. in October.

SOME MEMORABLE DATES IN YELLOWSTONE HISTORY Joynor and Haynes

The Geophysical Laboratory of the Carnegie Institution of Washington, D.C. made a study of deposition of travertine in Yellowstone Park.

Visitors: Secy. of Commerce, now President, Herbert Hoover; Walter C. White, Head of the White Motors Co.; Modo Winoman, Photographer; Rochester Tour of forty people from Washington D.C.; Roger Babson; California Camera Club of seventy-five members; twenty students from Morningside College in Iowa under Prof. T.C. Stephens; Rear-Admiral Wilson; Iowa State College Party; Sen. Reed Smoot of Utah; New York Evening Graphic Party of 115 people; Gen. Mason Patrick, Chief of Air Corps, U.S.A.; Wm. Jackson, photographer of the Hayden Surveys of 1871, '72, and '78; St. Louis Chamber of Commerce Party; Dwight Morrow, new American Ambassador to Mexico; Wm. Allen White, author and editor of Kansas; Wyoming Press Assn.; Dr. Hubert M. Work and Gov. Fisher of Pennsylvania were in the Park early in August.

1928 230,984 Visitors.
The new Firehole Canyon road completed. It is the most spectacular roadway in the Park.

The House of Horns in front of the Mammoth Museum, was built by Chief Ranger Sam T. Woodring.

July14 -- The new Geyser was first observed in eruption on this date. Park Ranger Roy Dale first saw the steam from Fountain Ranger Station on July 10th.

Dec. 15 -- Haynes Headquarters Building and the new Photo-Finishing laboratory, both at Mammoth, were completed.

Derr G. Yeager became Park Naturalist in March, succeeding Ed. J. Sawyer in that position.

A Duplex Ranger Station was construdted at the South Entrance.

The formal opening of the Park was held at West Yellowstone on June 20th. The Gates were electrically opened by Secy. of Interior, Hubert Work by pressing a button in Washington, D.C. The speakers were Gov. Baldrige of Idaho, Gov. Dern of Utah, Chief Justice Calloway of Montana, T. Joe Cahill of Wyoming, Congressman Addison T. Smith of Idaho, and Chief Tentsy of the Shoshone Indian Reservation of Idaho.

A Committee on Educational Work in the National Parks visited the region. This committee was composed of Dr. John C. Merriam, Dr. Frank R. Castler, Dr. H.C. Bumpus, Dr. Harold C. Bryant, and Chief Park Naturalist Ansel F. Hall.

The Laura Spellman Rockefeller Foundation donated $118,000 for educational work in Yellowstone Park. They started the

erection of a small Museum at Upper Basin, which will be opened June 20th, 1929.

The Park, and especially the Bechler River region, was visited and inspected by a House Public Lands Committee, while a Senate Public Lands Committee made a tour of the Yellowstone and Jackson Hole Country to the south.

Visitors: Mr. Ferruccio Vitale of New York City, a representative of the Fine Arts Commission; Mr. Harvey S. Firestone and three sons; Mr. Blair W. Reed, Director of the New York Zoological Park; Dr. Frank G. Crane, President of Wyoming Univ.; Pres. Carl R. Gray of the Union Pacific Railroad; Chas. P. Donnelly, President of the Northern Pacific R.R. accompanied by Hugh Kennedy, Chief Justice of the Irish Free State; Postmaster-General Harry F. New; Edward E. Spafford, National Commander of the American Legion; Harlan F. Stone, Justice of the United States Supreme Court; Princeton University Geological Summer School under the direction of Richard M. Field; Maj Gen. Has. C. Hurbord, former Chief-of-Staff, U.S.A. with party; Tri-State Medical Convention and a number of prominent Surgeons and Physicians of the country; American Chiropractic Convention; Wm. C. Gregg, friend of the Park, from Hackensack, N.J.; Secy. of Interior Roy C. West; Maj. Gen. Hugh L. Scott; Mary Roberts Rinehart; Montana and Wyoming Banker's Assn.; Western Dude Ranchers Assn.

1929 Jan.12 -- Horace Marden Albright became Director of the National Park Service. He became a law clerk in 1913 in the Department of Interior. In 1917, '18, and '19 as Assistant and Acting Director, he took part in many of the greatest events in the National Park History. On June 28th, 1919, he became Supt. of Yellowstone National Park; in March, 1920, he was made Assistant Director (Field) and during the winter of 1928-8 acted as Superintendent of Yosemite National Park. On Jan. 12th, 1929, he succeeded Stephen Tyng Mather as Director, having served almost ten years as Yellowstone Superintendent.

Feb. 26 -- The Grand Teton National Park was established by act of Congress signed by President Coolidge, setting aside an area south of the Yellowstone National Park, which embraces the Teton Range, including the Grand Teton, Mount Owen, and Mount Moran.

March 1 -- The boundary of Yellowstone National Park was changed to include two slight areas on the northwest and the northeast containing the Petrified Forests in the Gallatin National Forest and the Hoodoo Region, respectively. The boundary on the east was changed to follow the crest of the Absoroka Mts., thus excluding one area and adding two. The total change increased the area of the Park by 78 square miles.

SOME MEMORABLE DATES IN YELLOWSTONE HISTORY Joyner and Haynes

Feb. 1 -- Roger W. Toll, Supt. of Rocky Mountain National Park was transferred to the superintendency of Yellowstone National Park. Mr. Toll is a man of considerable National Park experience, having been Superintendent of Mt. Ranier National Park in 1919 and 1920. In October, 1921 he was appointed Superintendent of the Rocky Mountain Nat. Park, which place he held until his recent transfer to Yellowstone. Previous to his coming to the N.P.S., he served as Engineer with the Massachusetts State Board of Health, the U.S. Coast and Geodetic Survey in Alaska, and the Denver Tramway Co. (as Chief Engineer). He is the 19th man to act as Superintendent of Yellowstone Park.

Chief Ranger Samuel T. Woodring was appointed first superintendent of the newly created Grand Teton National Park. In 1898 he enlisted in the U.S. Volunteers and served in the Spanish-American War. The following year he joined the Quartermaster Corps, U.S.A. and served as packmaster for many years, ending the service in June, 1920, at which time he became a Park Ranger under the National Park Service in Yellowstone Park. In 1922 he became Chief Ranger, which position he held until his recent appointment in the Grand Teton National Park.

Death of George Trischman, pioneer in this region, ex-soldier government contractor, and ex-concessioner in the Park. He passed away in California. His son, Harry Trischman is an Assistant Chief Ranger in Yellowstone.

An Outline of
THE HISTORY OF EDUCATIONAL ACTIVITIES IN YELLOWSTONE PARK

Prepared by:
Newell F. Joyner, Ranger Naturalist.

Approved by:
Horace M. Albright, Director, National Park Service.

As a background for the summer's work of the temporary ranger and ranger naturalist, and of the year-around work of the permanent ranger and other National Park Service employees in Yellowstone Park, the history of the Service of the park to the hundreds of thousands of people who have visited it seems not only desirable, but necessary. As we answer the same questions hour after hour, or walk the same trails day after day, the seeming monotony of which is varied by a question that is different, a visitor that is interesting or very well known, we sometimes wonder why men return year after year to their work in the park. After the romance and glamour of the season is over, we set to thinking about the "something" that is ever present in the park, and we realize that if we should have the opportunity to return we, too, would be impelled by that "something" that acts as a magnet to draw old men back again and brings new rangers and ranger naturalists to the work.

And it is that "something" that I'm going to tell you about. Men and women, better equipped with words and experience than I have written and lectured about this park, and about the National Park Service. They have inspired many to visit or serve in one or more of our great National Parks. They have defined that "something" as I am going to define it, but as far as I know have never used it as an explanation of the central theme back of the history of our great playground, "The Yellowstone". You may feel that I have over-emphasized one phase of the work -- you may tell me that that "something" does not exist -- that a lot of the men do not come back from year to year. The only answer I can give is to ask you to explain a recent statement from the Director of the National Park Service which will be quoted later; to explain how it has happened that more and more people are becoming interested in the work of the National Park Service; and, I ask you to completely explain the existence of our National Park Service and the regions which it controls.

That "something" is "SERVICE". Imagine that it had been your privilege to have suddenly dropped in on the camp-fire of a little party of men on the evening of September 19, 1870, at the foot of a mountain now called "National Park Mountain", located at the junction of the Gibbon and Firehole Rivers. Suppose that you had heard those men talking of the wonders which they had recently seen in their exploration of the Yellowstone region. Suppose that you, too, could see, as did the members of the Washburn-Langford-Doane Expedition, the financial possibilities which lay before them in the matter of taking claims which embraced the principal wonders of the region, the

charging of admission to see those phenomena -- all of the glory and power that could be theirs by the ownership of something which everyone would want to see, and by the possession of the great wealth which would come to them from such an arrangement. If these men had suddenly turned to you and offered you an opportunity to share in their enterprise, wouldn't you have accepted? And yet, that would not have been all of the little drama being enacted there. These men were all pioneers; they had all been "up against it" at some time or other for food, shelter, companionship, pleasure or money. Would it be possible that they were of the nature that they would share their food, their shelter, their money with some other pioneer who was in the same "tight place" that they had once experienced, and yet that they would wish to gain complete control of some of the wonders of Nature -- to shut off everybody else from enjoying them unless they had paid a certain price? Apparently not, for of a sudden one of the members of the group, Cornelius Hedges, who had been silent for a time, fervently spoke with words to this effect -- "Gentlemen, wouldn't it be a better plan to act as a group in recommending to Congress that this region be set aside for all of the people? Wouldn't it be more of a privilege to watch and think of thousands of people enjoying the sights of these wonders of which they were a part owner?" This complete reversal of motives, and the manner in which the rest of the party agreed to the suggestion -- the manner in which you, too, would have agreed -- can be explained by no other means than by that "something" -- SERVICE.

As the minutes passed, and the enthusiasm relative to the new idea increased, plans were outlined, and the movement was started which brought about the establishment of Yellowstone National Park, a year and a half later. It is no wonder that one of the men, writing of that evening, tells us that he could not get to sleep for a long time that night. There was a pleasure -- yes, even a joy, to be gained from the thoughts of the idea they had conceived. It was the opportunity to be of service to the rest of the world which caused these men to go onto the lecture platform and to write and talk to all who would give attention.

On March 1, 1872, President U. S. Grant signed the Act of Congress which set aside a region in the Rocky Mountains for the benefit and enjoyment of the people. "Benefit" and "enjoyment" of "the people" -- all of the people in the United States, the whole world! Surely that act of dedication was written in a spirit of service to humanity. It was necessary to make someone responsible for the region to Congress and the people. One of the members of that expedition of a year and a half previous, a man who had spent considerable time writing and lecturing and lobbying in Congress, was chosen as Superintendent. Congress, in its haste, forgot to provide a source of revenue to pay that superintendent, but nevertheless, Nathanial P. Langford served without remuneration for five years. Why? Because of the chance to serve his fellows by stepping into the breach left by Congress, and taking a job which offered nothing as a reward except the pleasure of

doing. "What pleasure?" you ask. The pleasure of giving service can be the only answer. Subsequent superintendents, although receiving fair salary, have been men who chose to serve their fellows in that capacity instead of working at some task which offered a bigger money consideration, but did not hold the opportunity for service.

For the time being (pretend it is in the year 1887) join us and become one of a party of gay men and women alighting from the train at Cinnabar, Montana, the terminus of the Yellowstone Park branch of the Northern Pacific Railroad. You are one of a small group of say twenty-five people. You find yourself, along with the other men in the party, arrayed in the conventional clothes of the day -- a short tight coat, a low-crowned flat-topped hat, trousers varying somewhat from the present day's style. You are carrying your umbrella, for the weather, you are told, will be constantly attacking you either by a drenching rain or by severe sunshine. You are met by "Professor" Henderson, manager of the Cottage Hotel at Mammoth Hot Springs. This gentleman, recently of Iowa, came out to the Park in 1882 to serve as one of the ten assistant superintendents of the region. He later became interested in the hotel business, and now is ready to help you get the fullest pleasure from your trip in the Wonderland. Let's look at the guide-book of the region which he has prepared.

> "Cinnabar Station is at the end of the park branch of the Northern Pacific Railroad, from the platform of which you see to the west the Sepulchre range, 9000 feet, and beyond them Electric Peak rising 2000 feet higher, and from which the snow never melts.
>
> "The Cottage Hotel's elegant Quincy carriages are waiting at Cinnabar to transport you to Mammoth Hot Springs in care of experienced guides, who, after seeing that you are all safely seated, sing out "All's right", and away you go over hill and vale in absolute safety toward "Wonderland".
>
> "Gardiner City is drawn up like an army in single file on the National Park frontier. Leaving Gardiner City you are in the park and are on one of the grand highways constructed by Lieutenant Dan C. Kingman, late park engineer, a man who has made his record among the rocks and canyons that will live while geysers gush, terraces build and tourists tour."

An thus the guide-book reads. Descriptions are given, as one continues to read in this interesting pamphlet, of "Canyon Avenue", "Eagle Rock", "Sentinel Rock","Castle Rock", "Boiling River", "Hotel Plateau", "Hymen Terrace", "Liberty Cap","Devils Thumb", etc., etc. Each item to be found of interest on the terraces, along the roads, at the Geyser Basins, etc., is catalogued. This guide-book is the

first one published of this region. Its purpose was -- well, let's read the paragraph which the "Professor" has written and headed "The Hotel Plateau". We may then get an idea of why this guide-book was written, an idea of why the "Professor" turned from the task of assisting in the administration of the park to that of hotel keeping.

> "The Hotel Plateau presents the appearance of a young city. The National Hotel is a fine three-story structure with 414 feet fronting the grand terraces." (This was not Henderson's Hotel, but the older building belonging to the Yellowstone Park Association, which was a powerful company affiliated with the Northern Pacific Railroad and possessed of several hotel buildings throughout the park.) "In front of it is F. Jay Haynes art gallery, where photographic views are made of individuals or groups standing beside cones, terraces, or other marvels of the park. The Cottage Hotel is intended to supply a long felt want by parties who desire quiet, home-like and less expensive quarters. Visitors whose time is limited should secure an intelligent guide to conduct them over the upper terraces, and by ascending the old Terrace Mountain road will see all that is worth seeing with the least fatigue and in the shortest time, as well as in the order of their increasing beauty."

This paragraph, then, shows that the Professor was "bucking" a more powerful company; that he was going to the expense of publishing a guide-book of the region which was supplied to his guests; that he also provided "intelligent" guide service for his guests. His whole proposition was not based on an opportunity to make money, but rather on a wonderful opportunity to be of service to the tourists in the region. At those times his efforts were not sufficiently appreciated to permit him to continue in this work of service, and we find that his buildings and lease were transferred to the Yellowstone Park Association, and that he went to work for them, but along the same lines as he had followed in the conduction of his own business. Appreciative letters by the hundreds have been published to show how much the "Professor's" services were appreciated.

There were others who prepared guide-books previous to that of Mr. Henderson. One of these was the booklet containing a series of letters orginally published in the Virginia City, Montana "Montanian". It was prepared by Harry J. Norton, and published in booklet form in 1873. Another of the guide-books was that prepared by Herman Haupt, evidently at the instigation of the Northern Pacific Railroad in 1883. But neither of these were as complete, or as valuable as the one prepared by Professor W. W. Wylie in the previous year. Professor Wylie's guide was replete with accurate information in a popular form. It was based on considerable experience and was not an advertising medium. However, the Professor in later years conducted camping parties through the park. There were so many of these parties that

he sought permission to erect his camps and leave them standing all of the season. This was the origin of the permanent camps or lodges as we know them today. He fought every possible sort of opposition brought to bear upon him by the hotel and transportation companies. In fact, at one time he was forbidden to use springs on his wagons in which he conveyed tourists around the park. But all of this opposition was finally overcome, his idea took root, and today the lodges in the park serve more people than do the hotels. More than that, some people by the name of Curry came from California to tour the park. They took the trip with the Wylie Camps Company and from that system gained the idea which led to the very popular Curry Camping Company of Yosemite National Park. Wylie persevered in his desire to be of service to the visitors to the Yellowstone.

At a later date the Haynes Guide Book supplanted the older ones and it, with its chapters on history, birds, geology, flowers, animals, and road log has become a very valuable help in offering the greatest service to the visitors to Yellowstone Park.

In 1886, Camp Sheridan was established at the south side of Capitol Hill in Mammoth. The troops were brought into the park because it was felt that they could better protect the region against vandalism, better protect the animals, and better maintain the roads, etc., to be found here, than could an underpaid and underfinanced civilian administration. The ordinary type of army man was used in this work. These men were of the stock of Indian fighters and such that had been kept so busy over a period of years breaking the spirit of the Indian in the West. They were not interested, the majority of them at least, in the wonders of the region. In fact, it is reported that some of them even worked contrary to the ethics and ideals upon which this park was established. But Captain George S. Anderson, who came into the region in 1891 as commanding officer of the troops stationed here, and also as Acting Superintendent, conceived that it was his duty to perform the service of protecting the animals to be found here. Previous to 1894, there was no law protecting the animals or any part of the region. There were park regulations, to be enforced by the troops and the Superintendent, but there were no laws "with teeth in them". There were a number of poachers operating in the park and Captain Anderson decided to stop them. He had no legal procedure or methods which could be used. So he would, upon capture of one of these enemies of the wild life, throw the offender in the guard-house. Then, without any great haste, he would inform the Secretary of the Interior that he was holding a man for the violation of one of the Park Regulations, and that he awaited the Secretary's instructions as to the disposal of the case. The Secretary, after due consideration of the case, would give his usual reply -- "Reprimand the man and turn him loose". This the Captain would do. Possibly some sixty days had elapsed, the loss of which greatly inconvenienced the poacher; in fact, it was a veritable jail sentence by the time word had been returned from Washington to free the man.

EDUCATIONAL ACTIVITIES IN YELLOWSTONE PARK Joyner

In 1894, however, Congress passed a law providing for the protection of the animals within the Park, and also for the establishment of the office of United States Commissioner to administer the various laws and regulations within the park. Judge John W. Meldrum arrived in the park in August, 1894, to serve in that capacity, and has held the office ever since. Why did such men as Emerson Hough, Billy Hofer, F. Jay Haynes, Captain Anderson, and a score of others work against a great many obstacles, bear the most scathing criticism, and spend a deal of time and money in their effort to get Congress to pass a law protecting these wild animals? It was doubtedly through their efforts that we have a herd of buffalo in the park today. It was undoubtedly through their efforts that we have wonderful herds of elk and deer, and small herds of antelope and mountain sheep within the region. These men were not impelled by the same motives that cause game clubs throughout the country to fight to protect the game and birds eleven months during the year, so that they may provide "sport" for them in the remaining one month. These men were not moved by selfish motives. They were moved by the opportunity of giving "Service" -- that something which controls the destiny of the park.

The efforts of Captain Anderson to secure the protection of the animals within the park were not the only efforts made by individuals within the army to provide service for the tourists. In 1907 Superintendent Colonel S. B. M. Young, who had previously served as Acting Superintendent of Yellowstone and Yosemite National Parks, made the recommendation to the Secretary of the Interior that a different type of personnel be provided for the protection of the park. He made the statement that the necessary requisites for such a personnel would be interest in the region, an opportunity to stay in it long enough to become thoroughly familiar with it, and a training that could appreciate and explain the causes of all the natural phenomena to be found in this region.

But still it was felt that all that was needed in the region was mere protection. There had been a number of the army men serving in the park who had taken a special interest in its phenomena, in its animal life, in its opportunity for service to the tourists. Notable among these was Elmer Lindsley, first a Lieutenant and then a Captain in charge of troops here. One cannot read the early reports of Military Superintendents of the park, or read of Mr. Lindsley's various reconnaisances in the park and out without realizing that he was imbued with more than his mere military duty in the matter. It was Lieutenant Lindsley who was called upon to inform the troops of the wild life; it was this same man who interpreted the reports of the civilian scouts in the region as to the game conditions, as to whether the buffalo or elk were increasing or decreasing. His duties and capabilities remind one of a Chief Ranger under the present system of Park Administration. He saw an opportunity to give Service.

EDUCATIONAL ACTIVITIES IN YELLOWSTONE PARK Joyner

About 1915 the War Department changed its policy concerning the garrisoning of Fort Yellowstone. Previous to that time, the troops stationed in the Park comprised one or more units of cavalry. In 1913, there were four troops of cavalry and one machine-gun platoon protecting the park. But in 1915, with the withdrawal of these troops, replacements were made with a group of men picked from various units of the cavalry. These men were chosen because of their qualifications and their ability to serve the tourists, to act as mountaineers and also on account of their interest in the wild life and the phenomena of the region. This was a step on the part of the War Department to make available to the tourists all possible Service. It was a great step, for it meant disrupting various cavalry units, and waiving all opportunity to put into effect the highly organized military discipline which the army has always so jealously guarded. It was based purely on the idea of Service.

Troops were withdrawn from the Park in 1916, following the creation of the National Park Service. With their withdrawal a ranger force was organized, principally from soldiers who had served in the region and who were released at their own request to permit them to serve in the Park. But due to a financial situation, troops were returned in the following year and it was not until 1918 that they were withdrawn for good. From that time on, the National Park Service has been administering the park and under its control a new emphasis has been placed on the position of our National Parks in regard to their relationship to the people of the country. Whether it is a coincidence or not, I do not know, but nevertheless the final word in the name of that branch of the Department of Interior which controls our National Parks is Service, and that final word is the key-note to the reasons for existence of that branch. That branch must surely have adopted that word as its motto.

The man who had served as Assistant and Acting Director of the National Park Service, who had been vitally interested in it from the time of its birth in 1916, was appointed Superintendent of Yellowstone Park in 1919. This man was Horace M. Albright, recently appointed Director of the National Park Service. He shared with Director Mather and others the idea that Yellowstone Park and the other National Parks should be more than a place where the tourist could go to spend his money and to exclaim in wonder at the marvels he had seen. Whether he knew it or not, he was looking into a time when the people who visited the parks would get more than the trip for their money -- to a time when they would gain the satisfaction that comes from knowing all about the strange things that they see. In other words, there was dawning in the minds of those men the idea of our national parks as educational areas -- where education, although differing from the class-room education which so many times is lacking in inspiration, could be obtained at points where inspiration would bring about both a desire to teach and to learn of the wonders of Nature.

EDUCATIONAL ACTIVITIES IN YELLOWSTONE PARK Joyner

When the troops were finally removed for good, and a permanent ranger force was organized, the park was protected by men who had an interest in the region. As before stated, a great many of them were men who had previously served in the park in connection with the army. They were men who were interested in the region, who enjoyed the wild life, who could protect the animals and phenomena from the ravages of the over-anxious hunter and curio-seeker. They certainly were not attracted to the region by fabulous wage-offers, for at that time the permanent park ranger received only $100 per month -- and this was immediately after the war, when wages were so high in other lines of work. The reason that these men came to serve under the National Park Service was that they might be of service to the tourists, the scientists and the animals. Whether they knew it or not, Service was the keynote of their work.

At the time that the troops were withdrawn from the Park, the army engineers relinquished their claims to build the roads within the region. They were then replaced by civilian engineers for the first time in the history of the park. One of the men connected with the Engineer Corps, U. S. A., was Milton P. Skinner. He had been more than a road-overseer, in which capacity he was serving. He had spent nearly twenty summers in the park, had assisted the Biological Survey in its work in the region, and had provided valuable information for eight years in the preparation of the Circular of Information. Most of his services in these connections had been gratuitous. His actions had been modified by his desire to give Service. In March, 1919, he had written to the Acting Superintendent suggesting the establishment of a Museum and Information Office in the Park. He was first employed as a park ranger on October 1st, 1919. His duties were collecting and preparing material for a museum. He assumed some ranger duties in addition.

Superintendent Albright felt that due to the nature of the work which Mr. Skinner was doing, he should not be classed as a park ranger. It was suggested that he be given the name of Park Biologist, or Geologist, or Forester, but the name of Park Naturalist was settled upon, the position created in 1920, and thus we have the origin of the name "Park Naturalist". To Yellowstone Park, to Mr. Albright and to Mr. Skinner go the honors of the innovation of a movement which was intended primarily for the giving of Service, and which today is called the Educational work of the National Park Service. This division, in nine years, has grown to include permanent or temporary summer organizations not only in Yellowstone, but also in a number of other National Parks.

This division was not organized to take the place of the protection work which is so important in a number of our parks -- particularly Yellowstone, which has the large herds of game and the myriads of easily destroyed phenomena -- but it was organized to supplement this protection work. It was organized in order that more Service could be offered to the tourists and the guests of the park.

EDUCATIONAL ACTIVITIES IN YELLOWSTONE PARK Joyner

With the appointment of Mr. Skinner as Park Naturalist of Yellowstone, a similar movement was on foot in Yosemite National Park. It had its origin in the need felt by the resort managers on Lake Tahoe in California. They had heard of the nature guide work of Enos Mills in the Rocky Mountains. They felt that, since it was so successful in the Rockies, it ought to be as successful and as much in demand in the Sierras of California. Therefore, they employed Dr. Harold C. Bryant during the summers of 1918 and 1919 to act as Nature Guide. During a visit to those resorts in 1919, Director Mather of the National Park Service took cognizance of the work done by Dr. Bryant and as a result nature guide service under Dr. Bryant was established in Yosemite Park during the season of 1920. The same year there was a ranger in Yosemite Park, Ansel F. Hall, who took quite an interest in museum work, and who had come from the same college as Dr. Bryant. Through his efforts, a small museum was established in 1920. This was subsequently enlarged upon, and a new building constructed with the aid of the American Association of Museums and the Laura Spelman Rockefeller Memorial Foundation. Mr. Hall was appointed Chief Naturalist of the National Park Service. Dr. Bryant soon afterwards founded the Yosemite School of Field Natural History, which is operated in conjunction with the Ranger Naturalist Guide and Lecture Service in that park. Of course all of these advancements took place over a period of several years, and they are of interest in this article, for they form an interesting parallel to the work in Yellowstone Park. The movement in the two parks has gone forward hand in hand, and it is impossible to say that either is the leader. In fact, the leaders were such men as former Director Mather, Director Albright, Chief Naturalist Hall, Dr. Bryant and a host of related agencies which have cooperated in the presentation of this new service to the guests of our National Parks.

And now back to Yellowstone. In January, 1920, Skinner made preparations for a system of lectures to be established during the tourist season. He also suggested wild flower exhibits, monthly letters concerning the birds, flowers, animals, etc. of the region. These letters were to be posted in hotels, lodges, auto camps, and could be used by the press. When Skinner was appointed Park Naturalist on April 1, 1920, he was charged with the duty of supervision of woodcutting in the park, to prevent indiscriminate destruction of our forests, and with the duty of scientific investigation of diseases and pests of forests and of the elk. In addition to all of this, he was busy lecturing, guiding special parties, collecting and preparing museum exhibits.

The Information Office was opened in the Administration Building on June 20th, 1920. It contained a few exhibits of the wild flowers and of photographs and drawings of the region. Pamphlets were offered for sale and for free distribution. Road information, scientific information and general information could be obtained in this office. The new Museum and Information Office in the old Bachelor Officers' Quarters was not opened until 1922. Room was provided for it by the remodeling of the billiard and parlor rooms, dining room and the pantry in the building. The latter room became the office of the Park Naturalist

and the dining room was set aside as a room for the mounted animals. Recently, however, this room has been made over into a work-room in connection with the preparation of exhibits for the enlarged museum program now under way. The attendance in the Information Office and museum at Mammoth has grown from 9860 in 1920 to 68,487 in 1928; in other words an increase of 700%. In the meantime, the number of tourists entering the park has increased a little less than 300%, or from 79,000 in 1920 to 230,000 in 1928.

Our present museum program, supervised by the American Association of Museums, and financed by the Laura Spelman Rockefeller Memorial Foundation, has already resulted in a Museum of Thermal Activity at Upper Basin. This is quite a step forward from the two dozen sinter specimens to be found in the Mammoth Museum in 1922. This new museum will be opened in June this year, and predictions are that it will be visited by 100,000 tourists during the season of 1929. It is the result of a desire on the part of the National Park Service and the American Association of Museums to be of greater service to the visitors of the park. It is an attempt to go farther than just to say "Here is a geyser, temperature 200 degrees F., depth 40 feet, interval of two hours, plays to a height of 100 feet. And the next geyser, folks, is ------ etc., etc." It is an attempt to tell people the how and the why of geysers and hot springs. It is an attempt to tell them of the formation of sinter, to compare the Yellowstone geysers with those of other regions of the world. It is based on a desire on the part of those connected with it to teach the tourists -- to give him the satisfaction of being able to say more than "I saw the geysers in Yellowstone Park". He can say "I know about the geysers in Yellowstone Park, and while the appearance of the region at times leads one to think that it is a great area of super-natural conditions, I know that there is nothing super-natural about them -- that they are only the result of an unusual set of underground conditions, these conditions being similar to only two other known regions in the world, in New Zealand and Iceland".

What was your first impulse when given a toy or a piece of machinery to play with when you were a child? The odds are that you attempted to find out how it worked. Tourists come to this region with as much knowledge of the geysers as a little child has of a clock. The effects of what goes on inside may be readily noted in both the clock and the geyser, but the cause can only be surmised. Most every family has an old clock or watch lying around, waiting for some boy or girl to tear it to pieces some day. But geysers can not be treated in this manner -- they must be preserved for those who wish to visit Yellowstone Park. Therefore it is left to scientists to determine, by inference in most cases, a theory as to what goes on inside a geyser. Scientists are by necessity so accurate that they have established a nomenclature and a vocabulary which the layman cannot readily understand. It is the duty of the

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Educational Division of the National Park Service to interpret the findings of the scientist in a manner so that the majority of tourists, who are untutored in the sciences, can readily grasp the causes of all of these phenomena to be found here. Such a duty and privilege of interpretation belongs to the rangers and ranger naturalists in Yellowstone Park. Theirs is a real opportunity to give Service -- to put into effect the principal underlying excuse for the existence of our National Parks.

The program outlined at present by the American Association of Museums, in cooperation with the National Park Service, proposes the erection of a number of trailside museums throughout the park and a large, well equipped museum at Mammoth. This wonderful program is made possible by a grant of money from the Laura Spelman Rockefeller Memorial Foundation -- an organization which believes strongly in the idea of Service, and which is backing quite an extensive program in our National Park, which has been proposed by the American Association of Museums, whose field representative is Herbert Maier, the architect who has designed and constructed a number of museum buildings, notable among them being the Yosemite, Bear Mountain and Grand Canyon museums. To Dr. H. C. Bumpus, former Director of the American Museum of Natural History, and head of the committee of Outdoor Education of the American Association of Museums, and to Mr. Maier, goes considerable credit for carrying out the plans which the previously mentioned agencies have furthered in the interest of Service to park visitors.

As before mentioned, Park Naturalist Skinner suggested the idea of lectures under the auspices of the National Park Service. But this does not necessarily mean that he originated the idea of a system of lectures in Yellowstone Park. There had been a number of efforts made, such as the lectures around the camp-fires of the expeditions accompanied by Professor Wylie, the lectures given by Jack Haynes at the Upper Geyser Basin in 1908, and other such instances. The origin of the lectures in Yellowstone Park was in its sister area -- Glacier National Park. The Brooklyn "Eagle" tour included both Yellowstone and Glacier National Parks in the year of 1919. Director Horace M. Albright, then superintendent of Yellowstone, accompanied the party to Glacier Park. There, one evening around the indoor camp-fire in Many Glaciers Hotel, one of the members of that party told the rest of the group of the geological history of the Yellowstone and Glacier National Parks. This talk so impressed Superintendent Albright that he immediately entered into negotiations with the speaker, Isabel D. Bassett, for similar services in Yellowstone Park for the following summer season. And so it came about that Isabel Bassett Wassen was the first lecturer in Yellowstone Park. Her topic was physiography as related to the region around Mammoth Hot Springs.

The next year another lady lectured at Mammoth. She was Mary Rolfe of the University of Illinois. She gave three lectures each evening -- at the auto camp, at the hotel, and at the lodge. Her topic was more general than was that of Mrs. Wassen's. In the following years the lecture program has been enlarged, so that in 1928

there were thirteen lectures every evening throughout the park. These were given at Mammoth Auto Camp, lodge and hotel; at Old Faithful bear feeding ground, Inn and auto camp; at Thumb auto camp; at Lake Hotel and Lodge; at Fishing Bridge; at Canyon Hotel and Lodge; at Tower Falls auto camp or Roosevelt Lodge. There were, in addition, day-time lectures to tourists on top of Mount Washburn. The lecture movement in the park is being influenced by the movement for Visual Education, now in vogue among educators. Illustrated lectures have previously been given from time to time at various points in the park, but future plans are being made to use the illustrated lecture, not for entertainment, as the old idea was, but as an aid to the lecture -- in other words, to talk about the subject, and not about the pictures. Lectures are being drawn up and equipment is being considered to bring it all about. Again the reason for the progress, for it is certainly that, is a desire to make better service available to the tourist. The Service idea is making history in Yellowstone Park.

When George Henderson, W. W. Wylie, and others prepared their guide-books and employed "intelligent guides" for the public's service, little could they have dreamed about the developments that would eventually grow from that idea.

For years it was the custom of the hotel porters to conduct large parties over the various formations and to the various phenomena. As everyone knows, part of the wages which a porter receives are through tips. The practice was to give them tips for their services as guides. This was perfectly proper, but there were objections to this method. Some of those acting as guides would abuse the privilege, and demand tips -- would use mild forms of extortion -- would not give the best sort of "intelligent" service.

There was general feeling by a large portion of people at that time as to the propriety of giving tips. These people certainly did not understand the situation -- but it was decided that such an arrangement could never be of the greatest benefit to the tourists. Therefore, the National Park Service did away with the practice of permitting hotel porters to act as guides, offering in their stead the free guide services of rangers stationed at the various points in the park. In 1921 there were five trips per day conducted at Mammoth and four trips per day conducted at Old Faithful, making a total of 703 trips with 32,069 tourists during the season. We might compare this to the season of 1928, when there were 79,406 tourists served on the various guide trips, which numbered sixteen each day, or a total of 1168 during the season.

There are at present two types of guide parties. One of them is called a "formation party". The subject under observation is that of the Canyon, geyser or hot springs activity. The other type of guide party is the "nature study party", dealing with general nature study,

the branch emphasized being dependent upon the locality. The nature study parties near the lake deal with the plant and animal life along the shores and in the lake. The parties at Mammoth and Old Faithful deal principally with the bird and plant life. The trips at Tower Falls deal with the animal, bird and plant life and with the geological formations found nearby. Self-guiding trails have been established on the formations at Mammoth and Old Faithful and on the nature trails at those places. Self-explanatory signs are placed so that they are a help to those who find it impossible, or who do not care to accompany the ranger naturalist who conducts the guide party. These self-guiding trails are another effort to render all the service possible to the guests of the park.

As to the personnel of the Educational work in Yellowstone Park, a number of names may be mentioned again as they have been elaborated on previously. Mather, Albright, Skinner, Hall -- all are names which have recently been closely connected with the Educational work in Yellowstone Park. The hundred men and some dozen women who have been connected with the work in the capacities of park rangers or ranger naturalists include the names of noted college men, scientists, law students, theological students. Dr. Frank E. Thone, now of Science Service of Washington, D. C.; Dr. H. S. Conard of Grinnell College; Dr. Harry M. Kelly of the biology department of Cornell College in Iowa; Dr. E. N. Jones of Baylor University, Texas; and there are a number of noted scientists to be on the staff this coming summer. All of these names mean little of themselves. The names of the colleges with which they are affiliated may mean but little. But the thing that is impressive is the fact that men of this calibre come to the park and spend the summer, bringing their wealth of scientific knowledge and their teaching experience, giving of that wealth in order that they may help the tourist to more fully appreciate the wonders which he sees; spending their time and the results of their training for a sum of money that does not repay them for their efforts; and returning summer after summer to the same task; all this means that there is a something beyond a doubt which is very much in evidence in the park -- a something that is not based on selfish gain -- a something that is explainable in no other way than that these men desire to be of service to the visitors to the park. And again the history of educational work -- of the Park Service -- the prestige which it has attained and which it maintains is due to all that is embodied in the word "Service".

Upon the resignation of Milton P. Skinner from the position of Park Naturalist in the fall of 1922, Dr. Frank E. Thone was secured to act as Temporary Park Naturalist for the following season. In 1922 he had served as lecturer at Mammoth and as an attendant in the Information Office at that place. He carried on during the one season, and planned to return for the season of 1924, but at the last minute he received an attractive offer which gave an opportunity for educational work in the field of science and which was also a permanent position. This he accepted, with the understanding that he

would come to the park and spend a month there in getting the Educational organization for the season started, an arrangement made at his own request. He had proposed Dr. H. S. Conard of Grinnell College for the nature guide work at Tower Falls. He was the first nature guide in the park, following the movement in Yosemite. Then Dr. Thone found that he could not be in the park in 1924, he suggested that Dr. Conard be appointed to act in his place. In the meantime a Park Naturalist had been selected.

This new Park Naturalist was Edmund J. Sawyer, an artist of considerable renown and an ornithologist of no less merit. Mr. Sawyer's abilities were promptly put to use in the preparation of a series of wild animal, bird and flower paintings, as well as considerable other art work in connection with the Mammoth Museum and the Educational work in the park. The monthly letters on birds, flowers, animals, phenomena, etc., which had been discontinued after the resignation of Mr. Skinner, were again sent out, called at this time "Nature Notes from Yellowstone Park", and most interestingly illustrated by Mr. Sawyer.

As Mr. Sawyer's time was so completely taken up by the type of work which put to advantage his abilities, it was felt that a Head Ranger Naturalist would be advisable in the summer time to supervise the summer activities of the Educational work. This position fell to Dr. Conard, and was most ably filled during the seasons of 1924, 1925 and 1926. During his incumbency the Ranger Naturalists Manual was first issued, made up principally of lectures delivered by the various lecturers in the park. This work was done in conjunction with Acting Director of the Yellowstone Museum Mr. J. E. Haynes. Dr. Conard also suggested and instituted the pre-season tour for Ranger Naturalists, giving them an opportunity to see the park, and to get more first hand knowledge of the region which they were to interpret to the tourists. During the summer of 1924, he collected a considerable number of flowers of the park, and was thereby enabled to establish the flora of Yellowstone Park, comprising 547 species and subspecies. This he later enlarged upon, with the help of various other interested persons, until there have been more than 700 species and subspecies identified in the park.

As before mentioned, Park Naturalist Sawyer's time was taken up entirely with the art work in connection with the museum. He was relieved of the administration of the summer work of the Educational Division, and was also relieved of the extensive work in connection with the administration of the museum when it became apparent that there would be a larger museum program developing within the next few years. Accordingly, Mr. J. E. Haynes, well-known concessioner and official photographer in the park, and a man who has always been vitally interested in the educational features of the park, was appointed as Acting Director of the Yellowstone Museum. Mr. Haynes gave of his time and resources willingly, from time to time placing

his plant at St. Paul at the disposal of the Educational work in the park. His appointment was dated September 27, 1925, and under his direction there were made a number of interesting and valuable historical accessions to the museum. His wide acquaintance and his long residence in the park (he has spent every summer of his life in the region), his great interest in the work, all made his services so valuable and so much appreciated that it was with deep regret that his resignation was received in February, 1929. The increased museum program, a change in the personnel of the Educational Division, greatly increased activities in his own business, caused his resignation to be made at this time.

With the establishment of the guide service in 1921, one of these rangers who served at Mammoth in such a capacity was Marguerite Lindsley, the daughter of the Assistant Superintendent. She was born in the park, knew the region as very few knew it, was possessed of a scientific training, and of a deep interest to forward the idea of Service in the park. She acted as formation guide at Mammoth during the seasons of 1921, 1922 and 1923. Since that time she has acted in various capacities in connection with the Educational Division. She was in St. Paul during the spring of 1926, acting as Assistant to the Acting Director; she served as Assistant to Park Naturalist; and has served as ranger naturalist in charge of the Information Office. Her sketches which have appeared in Nature Notes since the resignation of Park Naturalist Sawyer have gone a great way toward making that pamphlet the very interesting and valuable publication that it now is.

As hinted at in another article in this Manual, "The History of Some Improvements in Yellowstone Park", there are numerous stories to be told concerning park personnel. The one referred to in the above mentioned article is that of the family of George Henderson which originally came to this region in 1882, and in time, by marriage and by acquisition of leases, operated several hotels, general stores and the post office within the park for a score of years. But that is not the only story of that nature that can be told, for "Jack" Haynes and "Peg" Lindsley (now Mrs. Arnold), as they have always been known to those in the park, grew up in this region, probably know more of the park that any other two persons, both trained as scientists, worked together, gave of their time, that the opportunity for Service within the park might be increased -- that the tourists might receive some of the joy and satisfaction that they themselves possess due to a knowledge of the region and its plant and animal life, as well as a knowledge of the phenomena to be seen here. And as an interesting side-light, it might be mentioned that one of "Peg's playmates in the old "haunted house" on Capitol Hill (the old blockhouse), a boy who had been born in that house, is now Superintendent of Zion and Bryce Canyon National Parks. This man is Eivind Scoyen, who had previously served as park ranger and Assistant Chief Ranger in Yellowstone Park. All of these people have engaged in this work because of the opportunity for Service which the parks present, to them, especially.

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And another story can be told of how Dr. Frank E. Thone, a graduate of Grinnell College, acting as temporary Park Naturalist, recommended the appointment of his former professor, Dr. H. S. Conard, to serve as the first nature guide in Yellowstone park, of how, when Dr. Thone found that he could not return, he suggested that Dr. Conard be placed as Head Ranger Naturalist. The story can be continued by telling how Dr. Conard recommended a co-worker, Dr. Harry M. Kelly of Cornell College of Iowa to act as nature guide at Lake, which position hehas most successfully held for four seasons, beginning in 1926. Dr. Kelly's work and personality have been a wonderful example of the opportunity which presents itself to the ranger and ranger naturalist -- the opportunity of giving Service. He has certainly placed the work of the Educational Division before the tourists in such a manner as to bring forth many compliments for the work and for himself. In other words, the Service which he gives is noticed and greatly appreciated.

To continue the story, Dr. Conard brought one of his students out to the park in the capacity of ranger naturalist in the season of 1925. This student was Dorr G. Yeager who had previously been in the park as a "savage" at Canyon in 1921 and 1922. Furthermore, he had spent some time in and near Rocky Mountain National Park, and had seen the opportunity to be of service to the tourists that came to our National Parks. Yeager served as ranger naturalist in 1925 and 1926 in Yellowstone National Park, being the first guide over the Nature Trail at Mammoth. In 1927 he served in Yosemite National Park in the same capacity. In 1928, upon the resignation of E. J. Sawyer, he was appointed as Park Naturalist of Yellowstone Park.

And thus the influence of Dr. Conard was felt again in Yellowstone Park. But this is not all of the story, for he recommended the appointment as ranger naturalist of Dr. E. N. Jones, head of the Botany Department of Baylor University at Waco, Texas. Dr. Jones came to the park as a ranger naturalist in the season of 1928, when he lectured at the Mammoth Hotel and conducted guide parties over the Terrace Trail at that place. Undoubtedly, this man is one of the three most popular lecturers to have ever served in the park, and when a vacancy existed in the position of Head Ranger Naturalist for the season of 1929, he was promptly chosen to act in that capacity. Of course, there were a number of other very efficient ranger naturalists whose coming to the park was due to Dr. Conard's recommendation, and thus is continued the story of the influence of Dr. Conard.

Mention should be made of two other persons connected with the personnel of the Educational Division in Yellowstone Park. These people are Gerald E. Marsh and Phillip Martindale. Mr. Marsh was appointed as Ranger Naturalist to serve during the season of 1927. At the last minute, however, he was chosen to act as Head Ranger Naturalist. Mr. Marsh was connected with the public-speaking department of Carleton College, Minnesota. He had received general training in the sciences and had spent a great deal of time in the

outdoors. He arose to the emergency that existed in Yellowstone, and his services as Head Ranger Naturalist were continued again during the season of 1928. Due to an appointment to teach in the University of California, a permanent position which would not permit his giving his services for all of the season, he found it impossible to return to the park for the 1929 season.

Phillip Martindale, probably the favorite lecturer among the tourists through the park during the last few years, served as a permanent park ranger for two years. The last two winters have been spent by him on the lecture platform; this last winter under the auspices of the Department of the Interior. His talks on Yellowstone Park and its many features have been heralded far and wide and have done a great deal toward the increased knowledge of the park and toward making it possible for the tourists to get the greatest possible enjoyment from their visit here. Letters received from tourists after they have returned to their homes furnish the basis on which to make this statement.

To close this article, I want to emphasize the opportunity that has been presented and taken advantage of, throughout the history of the park. It is the opportunity for Service, which is today being best presented during the tourist season by the work of the Educational Division. This is to be in no way construed to belittle the work of the Protection Department but, as someone said last summer, "There's all the difference in the world between a polite policeman and a teacher. They are both necessary, but isn't it true that if we had more and better teachers throughout our country, that there would be less need for policemen ?" I think that this person was right in the answer which he inferred in the asking of that question. The work of the Protection Department is to protect the park from the thoughtlessness of the visitors, to protect the animals from the ruthless slaughter by hunters. But if more people understood the reasons for the existence of our National Parks, if more people understood the principles underlying the existence of wild life and the phenomena of the park, there would certainly be less vandalism and less danger to the wild life of the region. The attitude of curiosity and of lack of respect would be replaced by an attitude of respect and of knowledge about the various features, and of a desire to get behind the movement to conserve. So many times people have said to me, when it was suggested that they not destroy the flowers or the formations, and the reasons for such conservation given, "Why, you're right -- I didn't think about that". So, it seems to me, from my own experience, that the future of our National Parks lies not in protecting them but in educating the people to the conservation of them. This is not an opinion which is unique with me. The history of the Park Service has borne out this contention. Such men as former Director Mather and Director Albright have been working for fifteen years or more to further educational work in the parks. In fact, in a recent bulletin to the superintendents of the various National Parks, Director Albright outlines the qualifications for the temporary employees.

He mentions that they should not necessarily be of the type that would be good protectors of the park, but that they should be of the type that would make good teachers of the park. He says further "I would be glad to see every temporary ranger appointed to the National Park Service qualified to act as a ranger naturalist, and I believe that ultimately our temporary ranger force will be made up almost wholly of such men".

In the writing of this article it has been impossible, on account of the limited space, to mention every ranger naturalist who has served on the force. But such an omission of names is not to be construed to mean that those men have no place in the History of the Educational Activities in Yellowstone Park. They have been the ones who carried on, unsung; they have been the ones who have made suggestions that were not in their power to put into effect. They have been the ones who have done their work well, but failed to receive special commendation. As our nation sings praises and pays homage to its Unknown Soldier as exemplifying that great mass of unsung and unnamed heroes, we, the Educational Division, should pay homage to the men who have been placed under similar circumstances in our work in the park. You, as a ranger naturalist or a ranger, should never feel that your work is in vain. You will be discouraged by numerous petty things, but route out that discouragement; remember that your job is to give Service. Remember that Service is a thing which is rarely repaid by those who receive it; remember, though, that they appreciate it and that they will remember it. And last of all, remember that the history of Yellowstone Park, of our National Park Service, has been based on the idea of Service, and that when you give Service you are helping to make History.

YELLOWSTONE BOUNDARY REVISION AND NEW GRAND TETON NATIONAL PARK

Prepared by:
Joseph Joffe, Assistant to the Superintendent.

Approved by:
Horace M. Albright, Director, National Park Service.

The seventieth United States Congress has cut a niche for itself in national park history, especially so far as Yellowstone National Park is concerned. Three bills of vital interest to nature lovers, conservationists, mountaineers and those who admire the rugged grandeur of the west were passed upon during the second session of this body and received the signature of President Coolidge prior to his turning over the Ship of State to President Herbert Hoover.

Foremost among these bills is the one creating the new Grand Teton National Park in the State of Wyoming. After thirty one years of effort this beautiful rugged country south of the Yellowstone was given a national park status and is destined to become one of the outstanding of the twenty one national parks. The bill as introduced was Senate 5543, and its history is as follows:

> "S. 5543 - Grand Teton National Park. Reported in Senate January 26, 1929. Public Lands. Report No. 1512. Passed Senate February 7, 1929. Reported February 14, 1929; Report No. 2516. Union Calendar. Passed House, amended, February 18, 1929. Senate agrees to House amendments February 21, 1929. Approved February 26, 1929. Public Law No. 817."

Nature lovers particularly will delight in knowing that this country is to be retained as one of America's last wildernesses. The bill provides that only trails are to be built in the park, that there are to be no hotels or lodges constructed, and that everything is to be left in just as natural a state as possible.

The Grand Teton National Park lies to the west of the Jackson Hole and is bounded partly on the east by Jackson Lake. The other boundaries follow natural lines along the tops of adjacent ranges. It comprises an area of about 150 square miles, is roughly about 27 miles long and from 4 to 5 miles wide and includes the incomparable Teton Mountains and the beautiful Jenny and Leigh Lakes. The principal peaks of the Teton Range are the Grand Teton, 13,747 feet, Mt. Owen, 12,910 feet, the Middle Teton 12,769 feet, the South Teton 12,500 feet, and Mt. Moran, 12,000 feet. The first ascent of the Grand Teton, which is a very difficult peak to climb, was attempted in 1872 by N. P. Langford, Yellowstone's first superintendent, and James Stevenson of the Hayden Survey Party, which at that time was exploring the park. These men claimed they reached the summit of the Grand Teton but they left no record and even until this day there has waged a controversy as to who was the first to ascend this noble peak.

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In 1898 W. O. Owen, Bishop Franklin S. Spaulding, John Shive and Frank Peterson climbed the peak and left a complete account of their ascent. The Wyoming Legislature at its last session recognized the Owen party as the first to reach the summit of the Grand Teton and the second highest of the peaks of the range now bears his name. Of late years there have been quite a few ascents of this peak, which compares favorably to the famous Matterhorn of Switzerland.

Sam T. Woodring, Chief Ranger of Yellowstone National Park from January 16, 1922 was selected as the first superintendent for the newly created park and on May 15, 1929 he took his oath of office as such.

The second bill revised the boundaries so that now they more nearly follow the natural lay of the land than was the case when the park was created. It added an area of 43 square miles in the northwest corner, which includes a fine petrified forest; a small area of 4 square miles at the head of Pebble Creek in the northeast corner, which gives a more natural line for hunters to distinguish; and 110 square miles on the east side of the park at the headwaters of the Lamar River, which is the home of the buffalo and contains the famous Hoodoo region. However, in order to follow the summit of the Absaroka Mountains on the east and give the park a more natural line it was necessary to throw out 78 square miles, which have been turned over to the Forest Service. The areas released contain no particular park values and are very difficult of access. Through this bill a total of 157 square miles have been added to the park and a total of 79 square miles taken out, leaving a net addition of 78 square miles. These boundary changes now give the park an area of 3,426 square miles or 2,192,640 acres, as against the former figures 3,348 square miles and 2,142,720 acres.

The history of this second bill follows:

> "S. 3001 - Yellowstone National Park, boundaries. Reported in Senate January 23, 1929. Public Lands. Report No. 1489. Passed Senate February 7, 1929. Referred to Public Lands February 12, 1929. Reported February 14, 1929; Report No. 2515. Passed House, amended February 25, 1929. Senate agrees to House amendments February 27, 1929. Approved March 1, 1929. Public Law No. 888."

The third measure, Senate Joint Resolution 206, provided for the creation of a commission to make an extensive study of the Thorofare country and the headwaters of the Yellowstone River, southeast of the park, and the much discussed Bechler River section in the southwest corner of the park, which Idaho irrigationists are seeking to obtain for a reservoir site.

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The addition of the land southeast of the park would give a natural boundary to the park in that corner and would include some exceedingly interesting rugged wilderness country which possesses natural park characteristics. This section is also the favorite feeding ground of moose and even though the section had no scenic value whatever its inclusion would be justified as a means of protecting this animal.

The personnel of this commission, appointed by President Hoover, is made up of Dr. E. E. Brownell, of San Francisco, the man who introduced antelopes into the Grand Canyon; Dr. T. Gilbert Pearson, President of the National Association of Audubon Societies; Dr. Arthur Morgan, President of Antioch College; C. H. Ramsdell, of Minneapolis, Minnesota; and Arthur Ringland, Secretary of the President's Coordinating Commission on National Parks and Forests, appointed in 1925. Drs. Brownell and Pearson are both very much interested in all conservation problems and are very familiar with the Western country. President Morgan is an outstanding engineer of the country and his advice will be particularly valuable in connection with the dispute regarding the removal of the Bechler River section for irrigation purposes; Mr. Ramsdell, a landscape architect of note, will contribute invaluable assistance since the Bechler River situation involves the question as to whether or not this area is scenically worthy of retention in the national park system; while Mr. Ringland is an expert on forest matters and knows the forest resources that would be affected by the park boundary adjustment.

Director Horace M. Albright of the National Park Service and Chief Forester R. Y. Stuart of the Forest Service hope to accompany the commission on its inspection of the areas involved.

The commission plan to hold a hearing at Cody, Wyoming on July 20th and will then proceed to the southeast corner and later to the southwest corner for a thorough study of conditions.

The history of Senate Joint Resolution 206 follows:

> "S. J. Res. 206 - Yellowstone National Park, boundary commission. Reported in Senate January 31, 1929. Read twice and placed on calendar. Passed Senate February 9, 1929. Referred to Public Lands February 13, 1929. Reported February 14, 1929; Report No. 2529. Union Calendar. Passed House February 25, 1929. Approved February 28, 1929. Public Resolution No. 94."

HISTORY OF SOME IMPROVEMENTS IN YELLOWSTONE PARK

Prepared by:
Newell F. Joyner, Ranger Naturalist.

Approved by:
Horace M. Albright, Director of National Park Service
J. E. Haynes, former Acting Director of Yellowstone Park Museum

Note: The compilation of the material set forth in this article has necessarily been hurried. It has resulted in the copying of pertinent passages from the reports of the park superintendents, from Congressional documents and from reports of the various branches of the Army represented in the park, all of which may be found in the Yellowstone Library. After the copying of the passages had been completed, a card index bibliography was established. From this bibliography, and also from conversation with early residents of the park, this article was prepared. Peculiarly, hearsay evidence often is in variance with the records, but where several records point to the same conclusion they have over-ruled hearsay evidence.

It is to be remembered that the last word has not been said in regard to the history of improvements. In fact, the field has just been opened, and valuable help may be obtained from tourists, Ranger Naturalists, residents and others. If a question arises as to the origin or history of some building standing at present or in the past within the boundaries of the park, refer that question and any information you m ay have obtained to the office of the Park Naturalist, and an answer will be given, if known. If no information is available, notes will be made and the desired information will be obtained as soon as possible.

Bear in mind, while reading the article, that there are three eras of improvement within the park -- first, prior to the coming of the Army; second, during the Army's stay; and the third era beginning at about the time of motorization of transportation and the creation of the National Park Service.

This article makes no attempt to deal with the history of roads, transportation, and lodges. These will be treated in a subsequent article.

* * * * * * * * * * * * *

As we are all well aware, this region was unvisited by white men until the year 1807. That is, there is no record of any previous visit. After the first visitor, John Colter, there were a number of trappers who came here in the quest of furs -- for furs meant money, provisions, and a general livelihood to them. Just before 1870, it became known to a part of the world that gold and other minerals were to be found in quantities in the Rocky Mountains, and in particular, the mountains surrounding what is now called Yellowstone National Park.

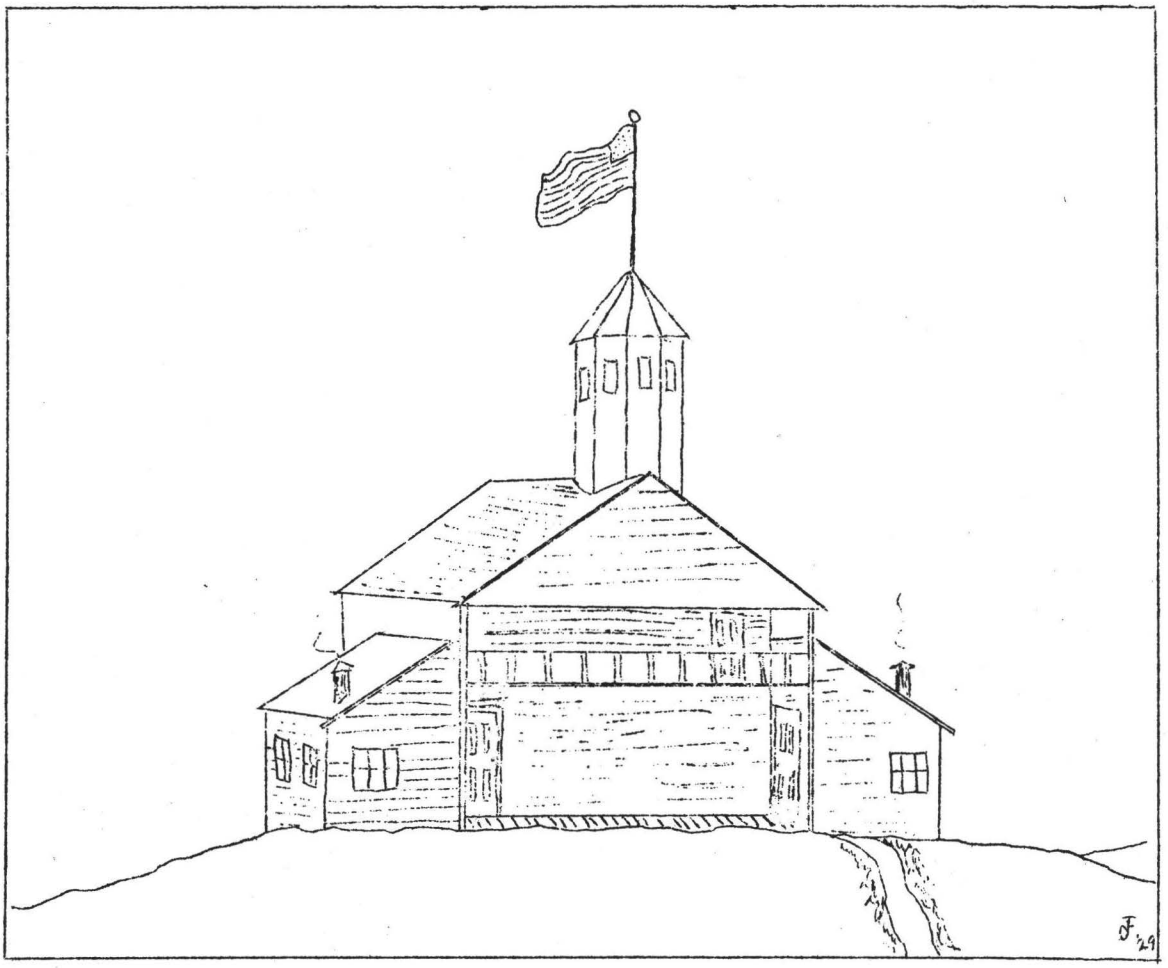
HISTORY OF SOME IMPROVEMENTS IN YELLOWSTONE PARK Joyner

In 1869 the Folsom-Cook expedition set out to see the region which was reputed to contain geysers, petrified forests, a large lake, a great canyon, and a host of other wonders. After a somewhat hurried examination of this region, the members of that party went back to their mining. The great Territory of Montana, strengthened by the finding of minerals, had as some of its leaders a group of men who, in 1870, formed the Washburn-Langford-Doane Expedition which was the first party to really explore this region. It was because of the idea which this party set forth that Yellowstone National Park was created in March, 1872, by an Act of Congress signed by President Grant.

In order to make the creation of this great park a reality, these men, headed by Nathaniel P. Langford, wrote, lectured and talked to all who would listen, setting forth the value of this region as a playground for the people of our country. While yet in the Park, they had considered the taking of claims and erection of buildings and suitable fences, in order that they might realize some money on this great discovery, but the idea of commercialization was overcome by their desire to give this region to the whole people. There were those, however, who, when they heard of the wonders to be found here, felt that there would be no harm in making a settlement within the proposed park, and if the park were not created, they would be on the ground, and a great profit would be theirs. Thus began the first era of improvements.

In the summer of 1871, Mathew McGuirk entered the region from the north, followed up the Gardiner River, and staked a claim near what is now called Boiling River. This stream of water, which bursts from underground, is the run-off from the Mammoth Hot Springs, located a mile and a half above. It is warm, quite hot, in fact, possessing certain properties thought to be of great medicinal value at that time. On account of this, McGuirk established a rude log bathhouse and cottage near Boiling River, and filed his claim under the Homestead Act in August, 1871.

J. C. McCartney and his partner, Henry Horr, came into the region from the north, also, and located their claim at the foot of the Mammoth Hot Springs or, as it was called at that time, White Mountain. These men built several cabins and made other improvements, McCartney subsequently buying out Horr's interests. The cabins were rude, being built without window-glass or floor, having a dirt roof and being made up of rough logs. But at least one of them persisted for forty years, finally burning in 1912. During the last few years of its existence it was known as the "Chinese Laundry" and was operated by Sam Toy, whose hospitality was famous among the soldiers and residents of the park. Another of these buildings contained the first Yellowstone Park Post Office and another was used as the first hotel in the park -- it would be better to say, it offered the first accommodations to be obtained in the Park, for it was in no sense the sort of a structure we think of today when we speak of a hotel. During the Nez Perce troubles



Sketch of restoration of

HEADQUARTERS BUILDING

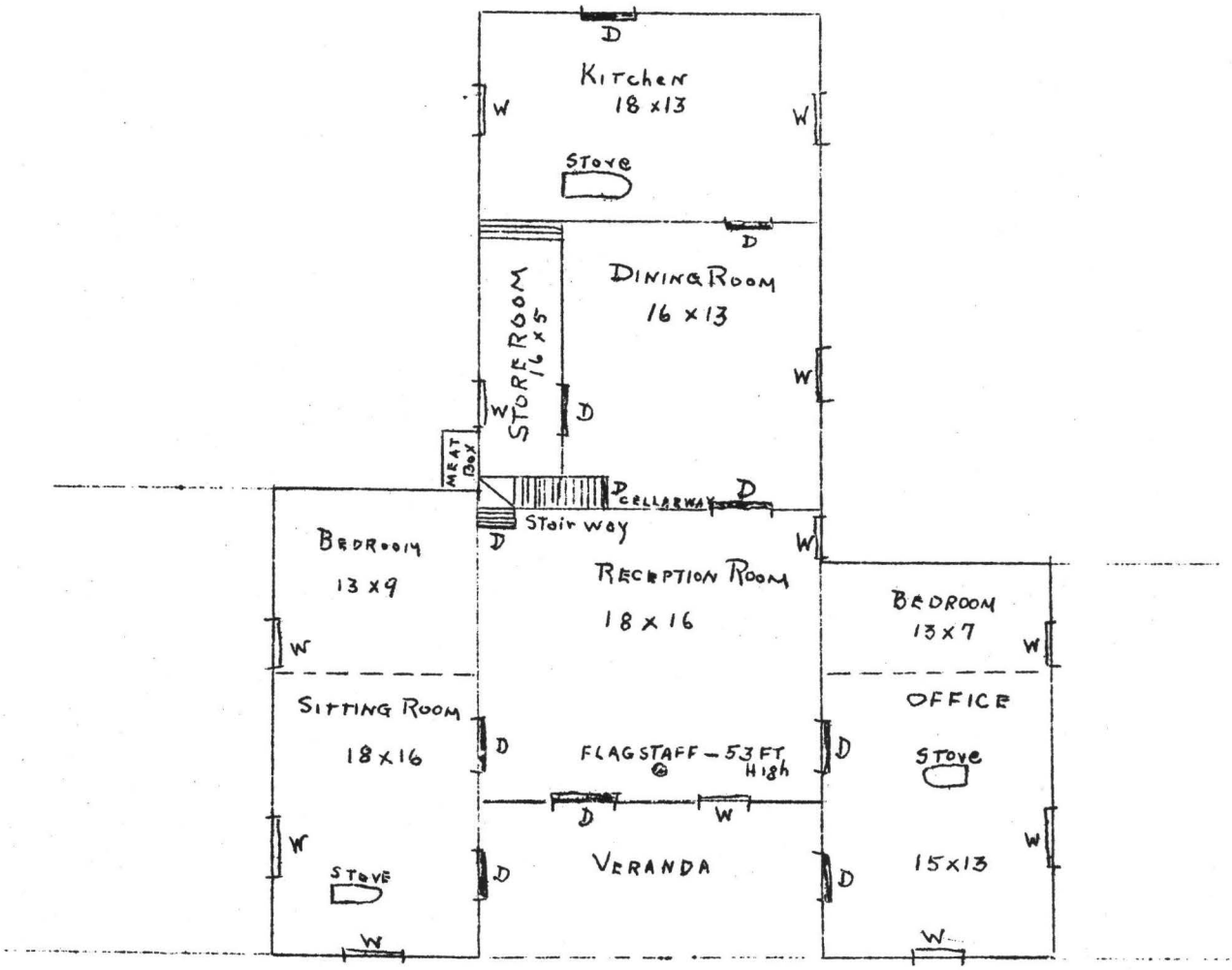
by Sawyer

of 1877, Indians raided the place, killing a tourist who happened to be so unfortunate as to come to the door when he heard a noise, thinking that his comrades had returned. This is an interesting story, the manuscript of which may be found in the Superintendent's office.

Previous to the establishment of the Park, a group of prospectors had settled on the Clark's Fork, to the east of the Park. These men were mining some gold and other minerals, and the ore and supplies necessary for the work were hauled over to Soda Butte Creek, or else the Lamar River, then called the East Fork of the Yellowstone, and down that river and on down the Yellowstone. Most of the rivers were forded, but it became advantageous to build a bridge across the Yellowstone River. C. J. Baronett constructed this bridge, and operated it as a toll bridge from the year 1871 on. The Nez Perce Indians, in their flight across the Park in 1877, while being pursued by General Howard, partially burned the bridge. The owners of the bridge had constructed a few buildings for the bridge-keeper, and when the General and his force came along, they promptly tore down some of those buildings to temporarily reconstruct the bridge, in order that they might continue their pursuit of the Indians. The next year the owner partially reconstructed the bridge, and two years later built a new one. This was in 1880, and with the booms in the mining community of Cooke at the Northeast corner of the Park, the bridge became of great value, not only to the miners, but to the troops which later were stationed in the Park. In 1893, Captain George S. Anderson, in charge of the troops in the Park and Acting Superintendent, made the statement that the bridge could not withstand another spring flood. Previous to its final destruction, a steel bridge bearing the same name was built one-half mile above it.

In 1872, Nathaniel P. Langford, one of the leaders in the movement to make this region into a National Park, was graciously offered the position of Superintendent of the Park at a salary of nothing per annum. There were very little, if any, funds available for the administration of the Park. No improvements were made as a consequence of this economical arrangement on the part of the Government. But in 1877, Philetus W. Norris succeeded Langford as Superintendent, Congress providing him with a small sum to be expended in administration. With this he built several buildings near the Mammoth Hot Springs to be used as headquarters. The chief building of that group was built in the summer of 1879, and was located on Capitol Hill. It was known at that time as "Headquarters Building" and was apparently well constructed, but unfortunately situated with reference to water, accessibility, strong winds, and relation to other buildings.

Supt. Norris described this building as "A fine shingle-roofed block-house of hewn timber, with a balcony and three wings, and surmounted by a gun turret". Sad to relate, Superintendent Conger, when he arrived in the Park in 1882, found the building in a dilapidated condition with "vermin infesting the premises in such vast numbers that no person with a cuticle less sensitive than that of a rhinoceros could live there during the summer". He immediately had the place overhauled

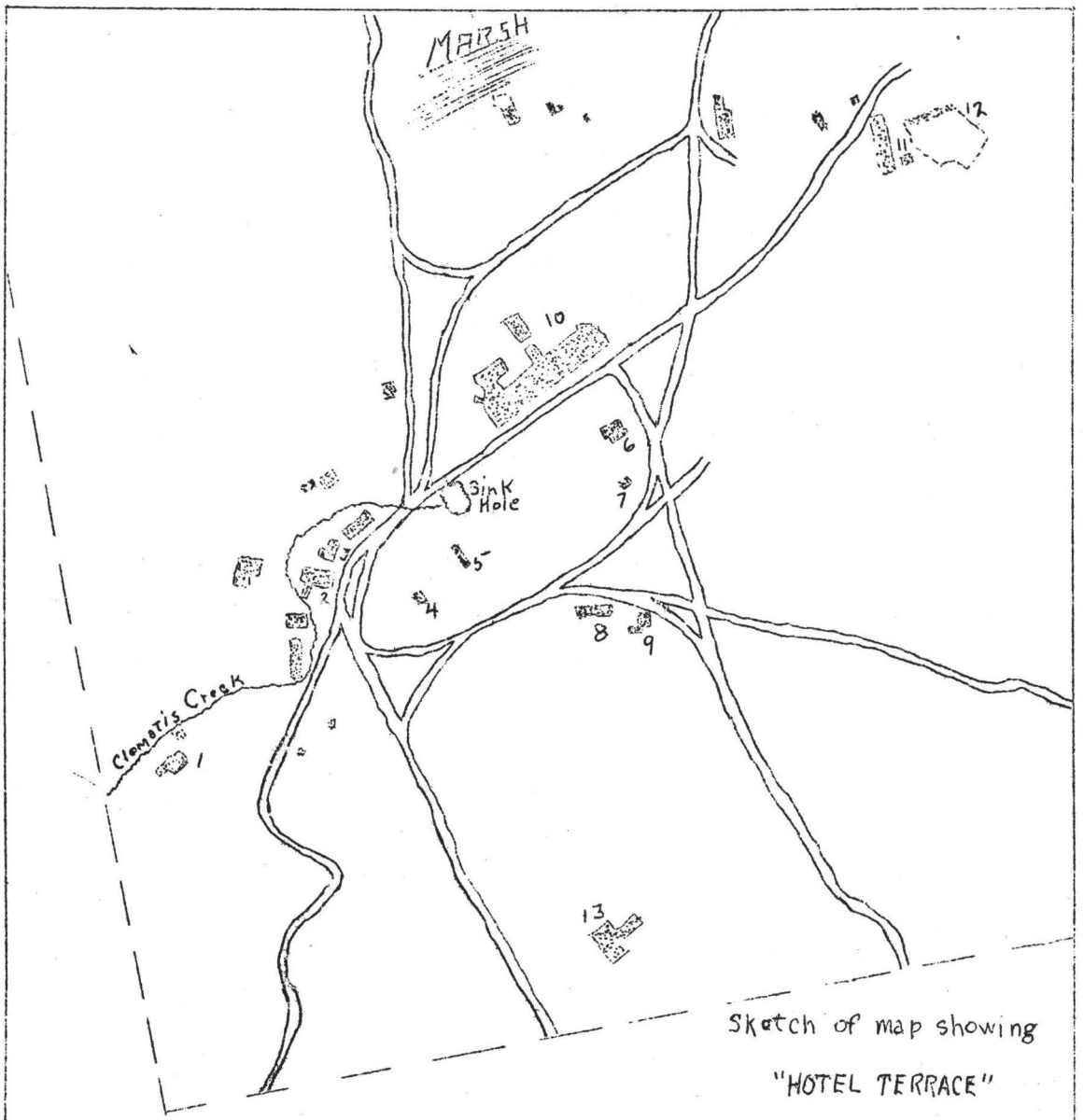


GROUND PLAN
of
HEADQUARTERS BUILDING
1879

and made tenantable for the summer. In 1883 he reports that it is "nothing but a log cabin at the best -- roof leaky, out of repair, and winds shake the plaster out from between the cracks." In the summer of 1885 Superintendent Wear tells us that it was uninhabitable on account of the leaky roof, and that he would build an addition to one of the Assistant Superintendent's houses as a residence during the winter. This criticism I believe to be unjust, judging from reports of those who lived in and were familiar with the building after 1895. When the army came in to protect the Park in the fall of 1886, they established Camp Sheridan at the south side of Capitol Hill, and, as far as we can ascertain, made no use of Headquarters Building. For a long time it was used as a residence, and it is interesting to note that it was the birthplace of the present Superintendent of Zion National Park, E. T. Scoyen. It was vacant, and in a state of ruins for a number of years before it was finally torn down in 1909, but in recent years there have been suggestions made that it be reconstructed as an object of historical interest. In 1891, Camp Sheridan was deserted in favor of Fort Yellowstone, the buildings of which had been constructed on the southeast side of the plateau in front of the hotel.

In 1882, there came to Mammoth George L. Henderson and his son and four daughters. Mr. Henderson was employed as an Assistant Superintendent for a number of years, and as such resided in the McCartney house, which stood near the present site of the Park Curio Shop. In March, 1885, the Secretary of the Interior made out a lease to Walter J. and Helen L. Henderson for a site for the purpose of erecting a hotel. On August 8th Superintendent Wear, in a sworn statement to the Secretary of the Interior, stated that the Cottage Hotel was being erected on that site. In 1887, an addition was built, 86 feet long and 30 feet wide, and was two and a half stories tall. Between the years 1886 and 1891, the Yellowstone Park Association, which controlled a majority of the hotel leases in the Park, bought the structure and it was used as late as 1911 as a hotel for the accommodation of tourists. Later it was used as a dormitory for hotel employees, being remodeled in 1921. In connection with this hotel, an interesting fact was disclosed by a perusal of the records to be found in the office of the Superintendent of the Park. It has been the general opinion in the park that the Cottage Hotel is the oldest existing hotel structure at Mammoth. But every bit of evidence to be found concerning the Cottage and the Mammoth hotels points to the fact that the latter hotel was built and had accommodations for tourists in 1883, two years prior to the report of the Superintendent of the Park that the Cottage Hotel was being constructed. A glance at the accompanying maps of Mammoth for the years 1885 and 1894 also will serve to bear out the idea of the priority of the Mammoth Hotel.

In 1883, according to the report of the Superintendent for that year, as well as the statement of the president of the Yellowstone Park Improvement Company which held the hotel leases in the park at the time, the Mammoth Hotel was erected. It was constructed 414 feet long, 54 feet deep and varied from three to four stories in height. It contained 141 rooms, and it was claimed to have cost $140,000 up to the close of



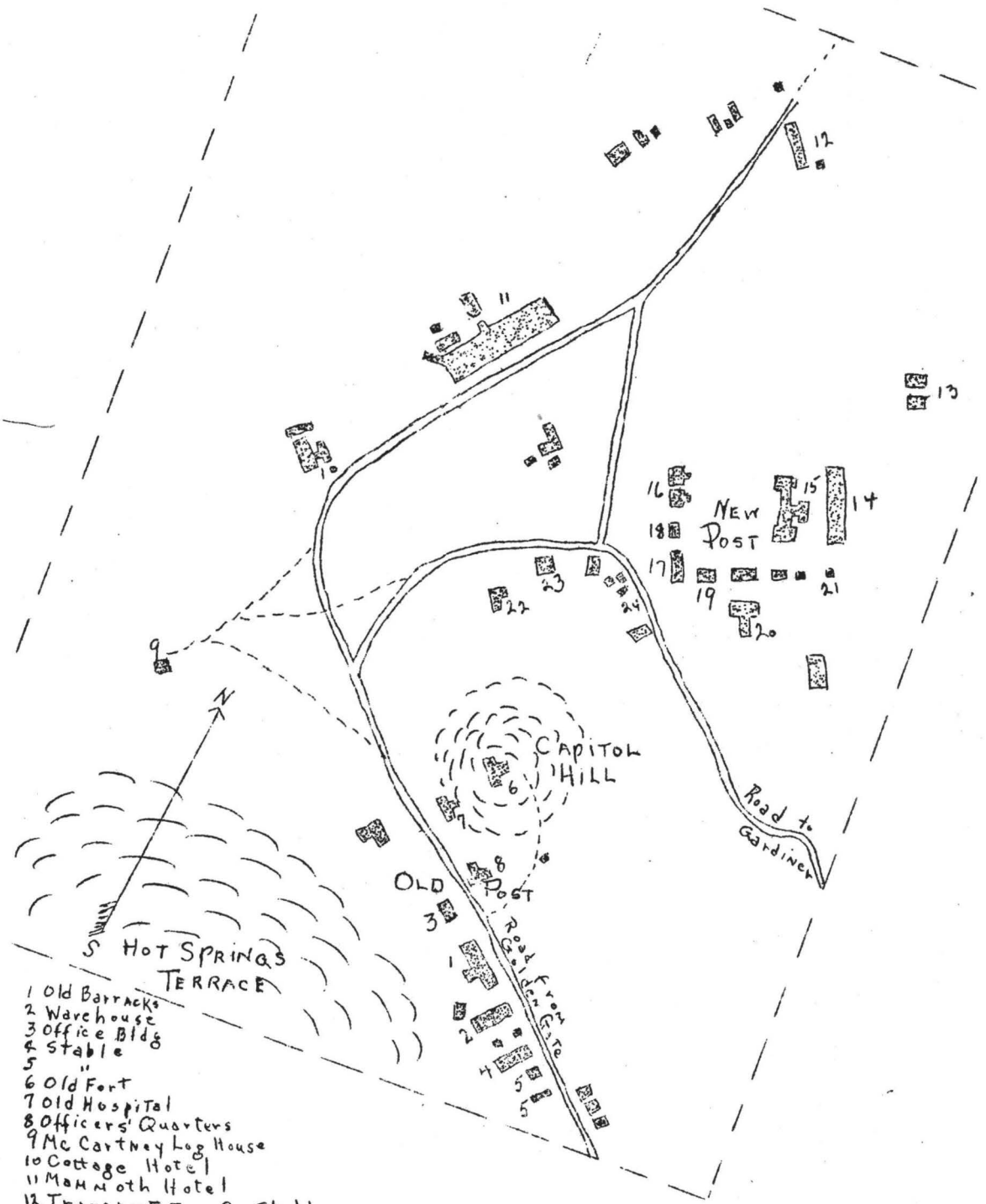
Sketch of map showing

"HOTEL TERRACE"

MAMMOTH HOT SPRING

1885

1 McCartney Bldg.
2 McCartney Store and Old Post Office
3 Post Office
4 Bath House - J. A. Clark
5 Dwelling of J. A. Clark
6 F. J. Haynes - Photographer
7 Barn - Haynes
8 Stable - J. A. Clark
9 Blacksmith Shop - J. A. Clark
10 Hotel - Yellowstone Nat. Park Improvement Co.
11 Stable - Wakefield and Hoffman
12 Shed and Corral
13 Supt. Office

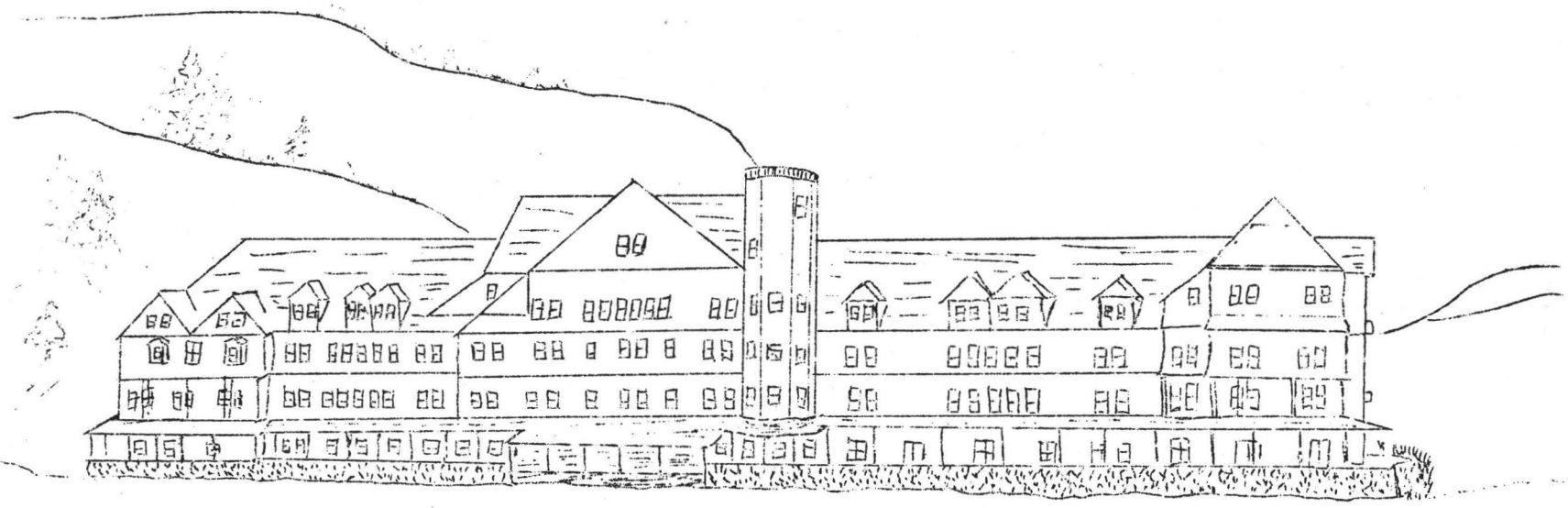


1 Old Barracks
2 Warehouse
3 Office Bldg
4 Stable
5 "
6 Old Fort
7 Old Hospital
8 Officers' Quarters
9 Mc Cartney Log House
10 Cottage Hotel
11 Mammoth Hotel
12 Transportation Co. Stables
13 Non-Com. Officers Quarters
14 Troop Stable
15 Troop Barracks
16 Officers' Quarters
17 Guard House
18 Post Head quarters
19 Commissary Store and Office
20 Hospital
21 Bakery
22 Mr. Huntley's House
23 Syndicate Stable
24. Post Office

Sketch
of
MAP OF FORT YELLOWSTONE
1894

1883. It was as yet unfinished, but accommodations were available on August 1st, when the Northern Pacific Railroad completed its branch line to Cinnabar, seven miles from Mammoth. In 1884, financial embarrassment overtood the Yellowstone Park Improvement Company, and the building was held by unpaid workmen who defied the authorities to remove them until they had been paid. Subsequently a receiver was appointed, and the leases and properties of the Improvement Company passed into the hands of the Yellowstone Park Association, which completed the Mammoth Hotel and erected a hotel at Norris in 1886. They even attempted to illuminate the rooms of this great building by electricity the following year, but soon abandoned the project. In 1901, however, they had equipped the structure with electric lights, built a covered loading platform, heated the building with steam heat, and added 27 new rooms. A lease dated 1905, to the Yellowstone Park Hotel Company, closes the history of the Yellowstone Park Association in regard to the history of administration of the hotel. A new wing was added in 1913, and minor repairs and improvements from time to time have permitted the satisfactory use of the oldest existing hotel building in the Park.

With the coming of the soldiers in 1886, and their protection of the park for a little more than the next 30 years, a new era in park improvements was commenced. Their headquarters camp was Camp Sheridan, situated, as before explained, at the south side of Capitol Hill. The first fall there were erected a number of wooden buildings to serve as office, storehouses, quarters, and stables. This was sufficient to accommodate one troop of cavalry. During the summer season, a great share of the troops were stationed out in the park at the various geyser basins and other objects of interest. During the winter small detachments were stationed at vatage points to protect the game and other animals from poachers. All of the buildings at Camp Sheridan, however, were temporary, and built as such. In 1891, Fort Yellowstone was completed, and occupied about November 1st. It was built to accommodate one troop of cavalry and supplemented Camp Sheridan, which was used only during the winter for quartering troops which had been stationed during the summer at Lower Geyser Basin. A second troop of cavalry was stationed in the park, but not provided with quarters at the Fort proper until 1897. Five years later the lawn on the parade ground was started, and a power plant constructed. In 1909, after improvements had been recommended for several years, making it possible to be used as a four-troop post, to cost $75,000, the necessary buildings were constructed at a still greater expense and in 1911 it was garrisoned with four troops of cavalry and a machine-gun platoon, which were charged with the protection of the park.



MAMMOTH HOTEL
- 1900 -

Sketch of Photograph

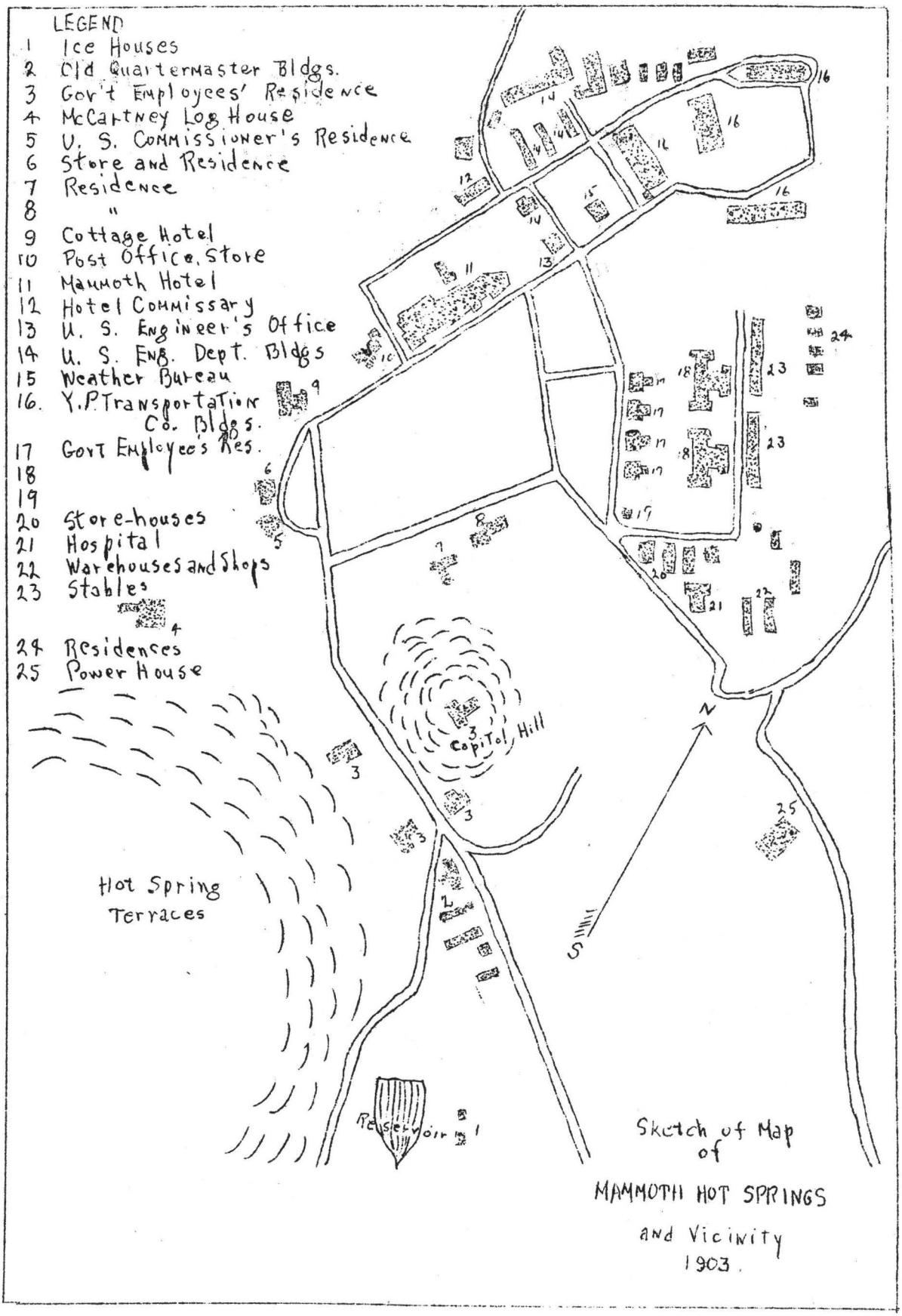
HISTORY OF SOME IMPROVEMENTS IN YELLOWSTONE PARK Joyner

On October 1st, 1916, troops were withdrawn from the Park, to be returned on July 17th of the next summer. A little over a year later, or on October 31, 1918, the troops were withdrawn for good, and the National Park Service, which had been created in 1916, took control, taking over the buildings and remodeling them from time to time. The Bachelor Officers' Quarters became the Museum, the Office of the Engineering Department was converted into the Administrative Offices of the National Park Service in Yellowstone Park, and sundry other changes were effected. In the meantime, a number of buildings had been constructed in Mammoth by the various concessioners. These will be mentioned later.

At Norris, Marshall and Goff erected a mail station in 1880. This was a rude, earth-covered building, and no further history of it is available. In 1885, Superintendent Wear mentions that there existed at Norris a four-room frame house built for the Assistant Superintendents but never used. In 1883, the Yellowstone Park Improvement Company established a tent-hotel. This semi-temporary structure was replaced by a "splendid hotel" built in 1886 by the Yellowstone Park Association. Unfortunately, the structure burned in July of the next season. None of the guests were injured, and all of their luggage was saved. A hotel camp, which accommodated 60 guests, was immediately constructed. This hotel-camp burned in 1892, and a canvas lunch station was put in operation. This in turn was abandoned in 1901 with the erection of the new hotel overlooking the Geyser Basin, which was used chiefly as a lunch station, but had accommodations for 25 guests. With the motorization of transportation in 1917, there was no need for a lunch station, the run from Mammoth to Old Faithful being accomplished in one-half day, and the buildings were abandoned and finally wrecked and burned in 1927. The older structures were located close to the present Norris Ranger Station, while the new hotel was erected on the space where the busses unload at the present time.

During the history of the Park, there were erected near Gibbon Falls, two lunch stations operated by the two permanent camping companies in the Park prior to 1917. These were located at what was called Gibbon Junction. Temporary camps were also erected in Swan Lake Valley, Apollinaris Spring, Beaver Lake, and Beryl Spring.

Most of the early explorers and travelers in the park came in at the north side and followed up the Yellowstone River, or else the Gardiner, and crossed over to the Yellowstone, and more or less followed that river to the Lake, thence across to the Geyser Basins on the Firehole River, and down that river till it was joined by the Gibbon to form the Madison, which they followed to Virginia City, and then out

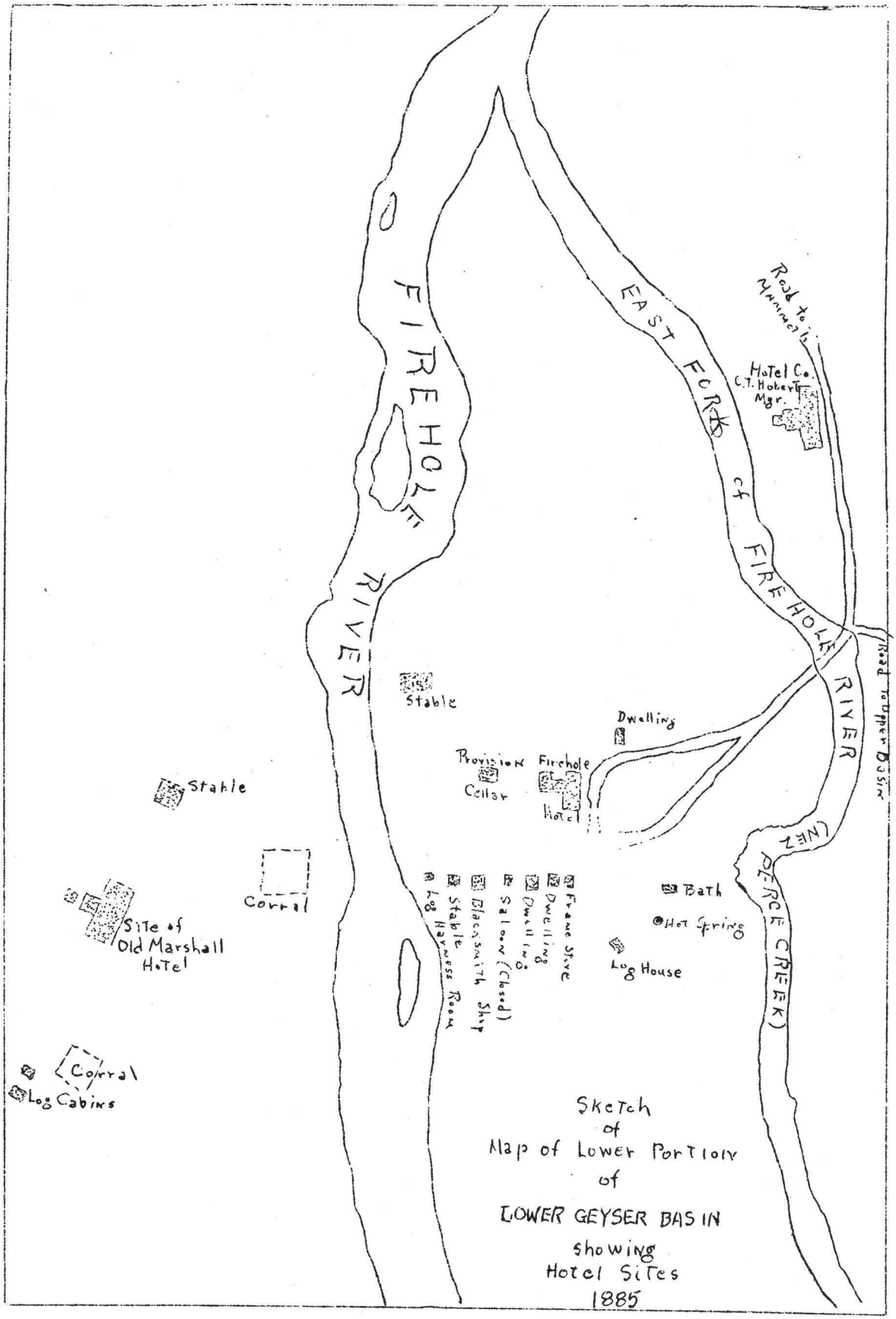


Sketch of Map of MAMMOTH HOT SPRINGS and Vicinity 1903.

into "civilization". With this route, and then the discovery of the Norris Basin and the subsequent road from Mammoth to the geyser basins, the importance of the Lower Geyser Basin, or, as it was called at that time, the Firehole Forks (Firehole River and Nez Perce Creek) was realized by the early park and concession superintendents. Therefore, we are not surprised to find in 1878 that Superintendent Norris urged the erection of a small military camp and pointed out the advisability of the establishment of a hotel at that place. In 1880, Marshall and Goff, mail contractors, built a mail station with a hotel in connection, at the junction of Nez Perce Creek and the Firehole River. Its location was across the river from the present Fountain Ranger Station.

Marshall soon turned his attention to hotel keeping, and until 1883, his was the only hotel in the park with the exception of "Job's Hotel" at Mammoth -- evidently one of the McCartney buildings. The Marshall House was a fine shingle roof structure, with a number of smaller buildings in connection. In 1884 Marshall secured a lease for the site on which the hotel was erected. This was in January and in April he assigned one half of his lease to George L. Henderson, whose son and daughter had at this time just secured a lease for a site on which to erect the Cottage Hotel. In August of the next year the lease was in the name of Henderson and Klamer, Klamer being a son-in-law of the former man and the same person who afterwards built a store at Upper Basin. This hotel has received favorable comment by the patrons of the Yellowstone Park Improvement Company's tent-hotel across the river. Of course, "the pasture on the other side of the fence looks greener to the cow", as the old saying goes, and it may be that it was not so much superior but that the rates were more reasonable. In 1886, the Yellowstone Park Association took over the Old Marshall House.

The Improvement Company's Lower Basin Hotel was a tent-hotel at first, but more improvements were put up, and in 1885, after the Improvement Company had gone into the hands of a receiver, Hobart (one of the members of the defunct Company) and Carpenter (ex-Superintendent of the park) were conducting a hotel-business in a "canvas and slab" layout near the other structures. In 1886, the Yellowstone Park Association bought the three plants (Marshall House, Improvement Company's Hotel, and Hobart and Carpenter Hotel) for $6,000. They also erected a log cabin on each side of the Marshall House in 1887. Each of these cabins "contained 8 rooms, each room being 16 feet square with 10 foot ceilings, and an outside window". In 1891, the Fountain Hotel was completed, the Lower Basin plant abandoned and the hotel business conducted in this fine new building not over two miles away. Before the season was over all of the buildings pertinent to the old Lower Basin Hotel were burned except the two cottages erected in 1887.



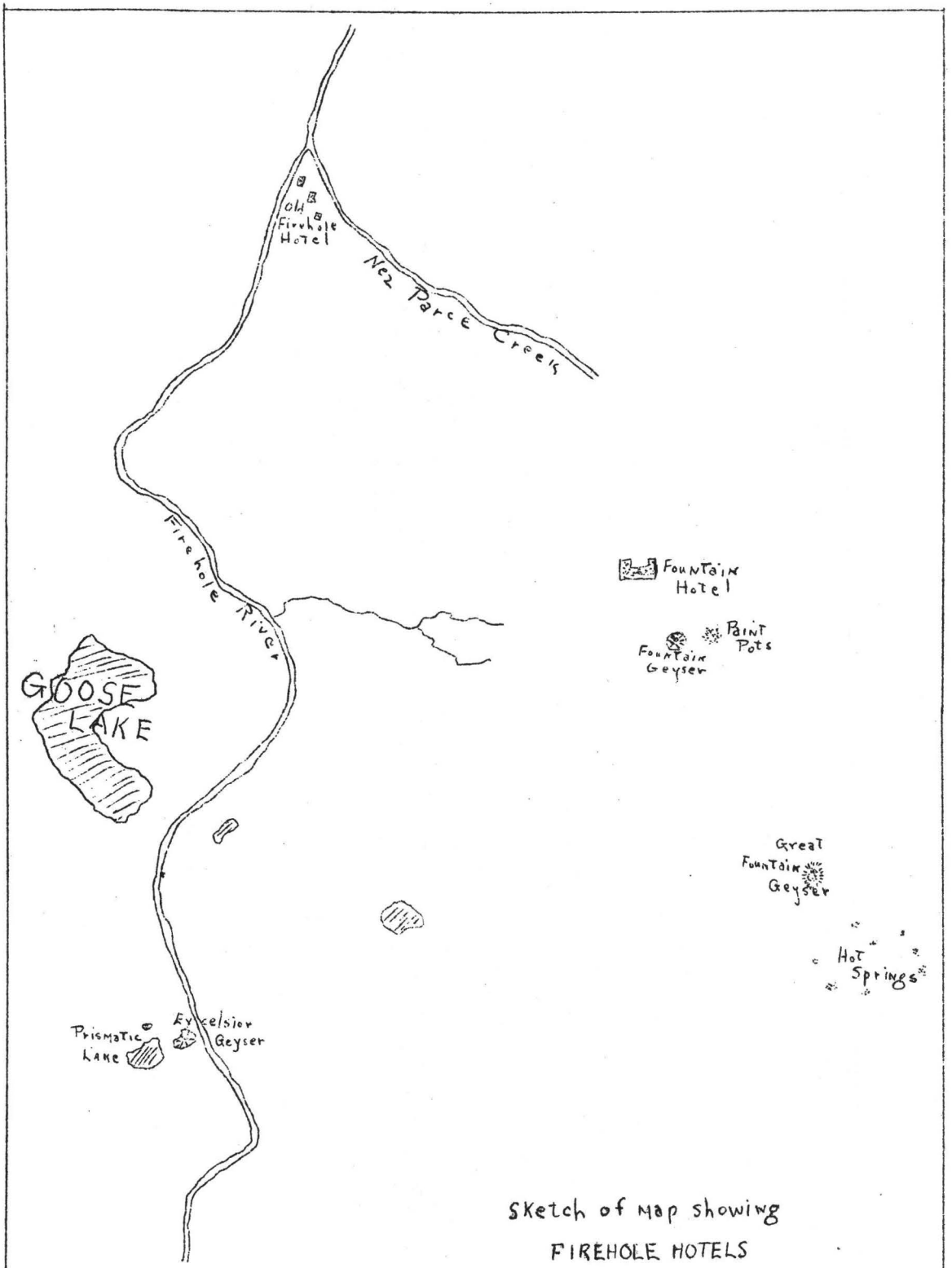
Sketch
of
Map of Lower Portion
of
LOWER GEYSER BASIN
showing
Hotel Sites
1885

HISTORY OF SOME IMPROVEMENTS IN YELLOWSTONE PARK Joyner

The Fountain Hotel, the largest hotel in the park at that time, was erected in 1890 at a cost of $100,000. It was occupied for the first time in 1891, succeeding the old Lower Basin Hotel. This new hotel was located in the woods back of the Fountain Geyser and close to the Mammoth Paint Pots. In 1901 it was described as being "lighted by electricity", having steam heat, and that the waters in the bath-rooms came from a large hot spring. In 1911 it accommodated 350 guests. In 1917 it was abandoned, due in part to motorization of transportation, which made this stop unnecessary and due also to the erection at an earlier date of the fine Old Faithful Inn only seven miles away. In 1927, after the building had been razed, Assistant Chief Ranger Joe Douglas set fire to the debris, and in the following season, the site was cleaned up so efficiently that it is now difficult to find any trace of this once historic structure.

At the time of the razing of the old hotel, a story was given much circulation among the newspapers of the country as to the fact that it had been haunted. The story goes that one fall the winter keeper was aroused on several days at the same time by the ringing of the service bells connected to one of the rooms. On each occasion he immediately went to the room, but was never able to find anyone in it. As you can imagine, such a regularly occurring incident with no apparent cause is inducive of imaginary fears. The story goes that the winter keeper finally fled, vowing never to return to this building which was surely haunted. An investigation undertaken a few months later showed that a mouse had built a nest within the walls of the room, and every evening about a certain time had gone out for a stroll, as it were, and in so doing had stepped on the annunciator wire, closing the circuit and causing the bell to ring.

At Upper Basin, where Old Faithful, Grand, Castle, Grotto, and a number of other famed geysers are located, the first improvement so far as is known was an earth-roofed loop-holed log cabin and associated buildings built by Superintendent Norris in 1879, and later used as a dwelling house for Assistant Superintendents. It was located in a grove of trees on the bank of the Firehole River, between Castle and Beehive geysers. In 1883 a tent-hotel offered accommodations for tourists. This condition existed again during the season of 1884. In the fall of that year, however, the Upper Basin Hotel was erected for the Yellowstone Park Improvement Company on a site less than a quarter-mile from Old Faithful Geyser. This building was a frame structure which was afterwards called a sham and a cheat. It was noted that it kept out the light and did not hold the heat at times when light and heat were most desirable. In addition to this it was erected on a site different from that specified in the lease. In fact, its site was illegal, for Congress had, in order to protect the natural wonders of the park, passed a law prohibiting the construction of any building less than one-fourth mile from an object of natural wonder. This building accommodated about 70 persons in 1887, but soon thereafter it was used only as a lunch station, for the tour of the park provided that the visitors go from the Lower Basin to the Upper Basin and



Sketch of map showing
FIREHOLE HOTELS
1892
(From Major W. A. Jones' Report of 1892)
Sketched by Joyner

return in one day. The next day they were taken over Marys Mountain to Hayden Valley. In 1892 a new road was constructed from the Upper Basin to the Thumb of the Lake. This should have made the Upper Basin of importance as an all-night stop, but since the old hotel was so unsatisfactory, and a suitable site unavailable for the erection of a new hotel, and since the fine Fountain Hotel was only seven miles away, no move was made to erect a new building. In 1895 a law was passed, permitting the erection of buildings at a distance of less than one-fourth mile from a natural wonder. But the plant at Fountain had been too recently erected and there were not enough tourists to justify the operation of two hotels so close together, therefore no move was made to construct a new hotel at the Upper Basin. However, by 1901, these restraints had been somewhat done away with, resulting in the planning of the Old Faithful Inn. It was under construction in 1903 and opened to the public for the first time in 1904. It was described at that time as being rustic in appearance, constructed chiefly of logs and stone, but containing all of the conveniences which a tourist might reasonably expect -- such as electric lights steam heat, baths, etc. In 1911 it was next to the largest hotel in the Park, having a stated capacity of 400 guests but actually not able to accommodate that number. Over 100 rooms were added in 1913. During 1918 it, along with the other hotels of the park, was closed as a measure of War economy. Dormitories have been built for the employees, thereby making more rooms available for the guests. The dining room has been enlarged, more than doubling its capacity. Only last season 150 new rooms were opened for the first time. At the time of its erection it was the largest log structure in existence, but I understand that it does not now hold that distinction. However, it has become far-famed, and with the abandonment of the Fountain Hotel in 1917, it became the center of interest in the park in the way of buildings.

Prior to 1892, guests continuing on their trip around the Park left the Lower Basin and toiled up Marys Mountain and, according to the stories told by a number of visitors, the majority of the men, and some of the women, were forced to walk up the hill. They even out-distanced the stage-coach, which had to stop at frequent intervals to permit the horses to rest. It is interesting to read the account of the Michigan Press Association's "roughing-it" trip through the Park. Members of this group went ahead of the coach and took a plunge in Marys Lake, getting as much pleasure thereby as a group of boys in the old swimming hole -- that is, until the stage-coach approached that spot, when they suddenly realized that they were men and donned their raiment and rushed to the coach. One of the group described such a situation in these flowery phrases: "..... Sylph-like forms of the unconscious editors in all their pristine beauty, like 'daisies dipped in dew'".

HISTORY OF SOME IMPROVEMENTS IN YELLOWSTONE PARK Joyner

The road across Marys Mountain led to Hayden Valley, where the tourists dined at "Larry's". At a later date mention is made of a lunch station at Trout Creek. We are told by the older residents that it was the genial Larry who operated this lunch station. Later he operated the Norris Lunch Station and was the first manager of Old Faithful Inn. When the new road from the Upper Basin to the West Thumb was constructed, the lunch station at Trout Creek went out of existence, and one was established at West Thumb. This differed from the other lunch stations, in that it provided no night accommodations whatsoever for tourists, and it was necessary for them to stay over night near the Lake Outlet.

Before the year 1880 there had been found along the east and south shores of Lake Yellowstone a number of old camp-sites of early trappers and Indians. A raft, a dug-out canoe, and a number of other evidences so situated that their age must have been between 30 and 40 years makes one realize that the Lake was known and treated familiarly by a certain class of people long before the regularity of Old Faithful or the name-giving qualities of Splendid, Beehive, Grand, Giant, Grotto or Castle Geysers had been known. In 1875, there existed at Toppin's or Topping's Point near the outlet of the lake a cabin built by Captain Topping. It was here that a boat called "the Toppin" was built. There seems to have been some confusion as to the spelling of Captain Topping's name. Superintendent Norris and others spelled it "Toppin" but the Captain himself at a later date spelled it with a final "g".

The Yellowstone Improvement Company failed to realize its dreams about establishing a tent-hotel at the Lake, and it was not until 1887 that a wagon-trail was pushed 17 miles beyond any Government roads in order that the Yellowstone Park Association might establish a hotel at the Lake. In 1891, the Lake House stood on its present site -- but there was only one wing completed, containing perhaps 80 rooms. In 1889 the Yellowstone Park Boat Company had come into existence under the leadership of Mr. E. C. Waters, and had erected boat-house, store, dwelling, corrals, and stables. The latter buildings were located too near the new wing of the Lake House, which was built in 1901. In 1903 the building had again been added to in such a way as to double its capacity. It was then the largest hotel in the park, providing 210 rooms, accommodating 466 guests. It was electrically lighted and steam-heated at an earlier date. In 1918 and 1919 this building was closed as an emergency war measure, and the overnight stop which had formerly been scheduled for Lake was made at Canyon. It was reopened in 1920 after having been remodeled somewhat, including the building of a porte-cochere. In 1922 and 1923 an annex and new wing were built. During the season of 1924 the plant was enlarged by the construction of dormitories and improved from an aesthetic standpoint by the removal of the old buildings in front of it.

HISTORY OF SOME IMPROVEMENTS IN YELLOWSTONE PARK Joyner

The Falls of the Yellowstone had always drawn gasps of wonder from the tongue-tied, reams of description from those whose ability included the pen, and oaths or a stronger sense of devotion to the Great Power of Nature from the rougher men who visited it in the earlier days. It was therefore only natural that the Canyon should be the only other object of wonder besides the Geyser Basins at which tent-hotels were established in 1883 by the Improvement Company. In 1886 the Yellowstone Park Association built a temporary hotel structure, one story high, and located near the present ranger station. In a recent conversation with the son of the winter keeper for the years 1887 and 1886 (this man is also a brother of Ole Anderson, whose concession at Mammoth will be discussed later), we learned that the snow was as much as 15 feet deep during those winters and that the top of the building was barely visible for several weeks at a time. He possesses a photograph, evidently taken by F. J. Haynes, who made the first winter photographic expedition into the Park in 1887, which shows the tunnel in the snow leading down to the door of that building. In the summer, with its glorious sunshine and mass of tourists, it is hard to picture that such a rigorous situation ever existed. In 1891, a new hotel was completed, which was reported as being lighted by electricity in the following year. However, the foundations of this building were not solid enough and the settling of the building made it necessary to replaster the hotel in 1896 and to temporarily repair the foundation at the same time. In 1901, the foundation was again repaired and 24 new rooms added. Yet the Superintendent of the Park, in several successive reports between the year 1904 and 1908, recommended that a new hotel be constructed. In 1910 considerable improvement was accomplished, and additions made, using the old building as a nucleus so that to all appearances a new hotel had been constructed. Accommodations were then afforded for 350 guests. There has been but little change in the structure since that time. Of course, it was closed during 1918 as a war-time measure of economy along with the other hotels.

With the building of the Canyon-Tower Falls road via Dunraven Pass and Mt. Washburn, the loop-road of the Park was completed, making it possible to visit all of the major points of interest, covering but little of the roads more than once. The Transportation Company, however, did not take advantage of the new road to Mammoth via Tower Falls, on account of the long climb required, which was considered too hard on the horses. They would take passengers over that route at the expense of another day's stay in the Park, but did not encourage such a trip. In 1906 the Wylie Camps Company established a permanent camp at Tower Falls. This was the outcome of the new road, and an approach to a fulfillment of the predictions that a hotel would be established in time at Tower Falls and Soda Butte. Previously, Yancey's Hotel was in existence at this point.

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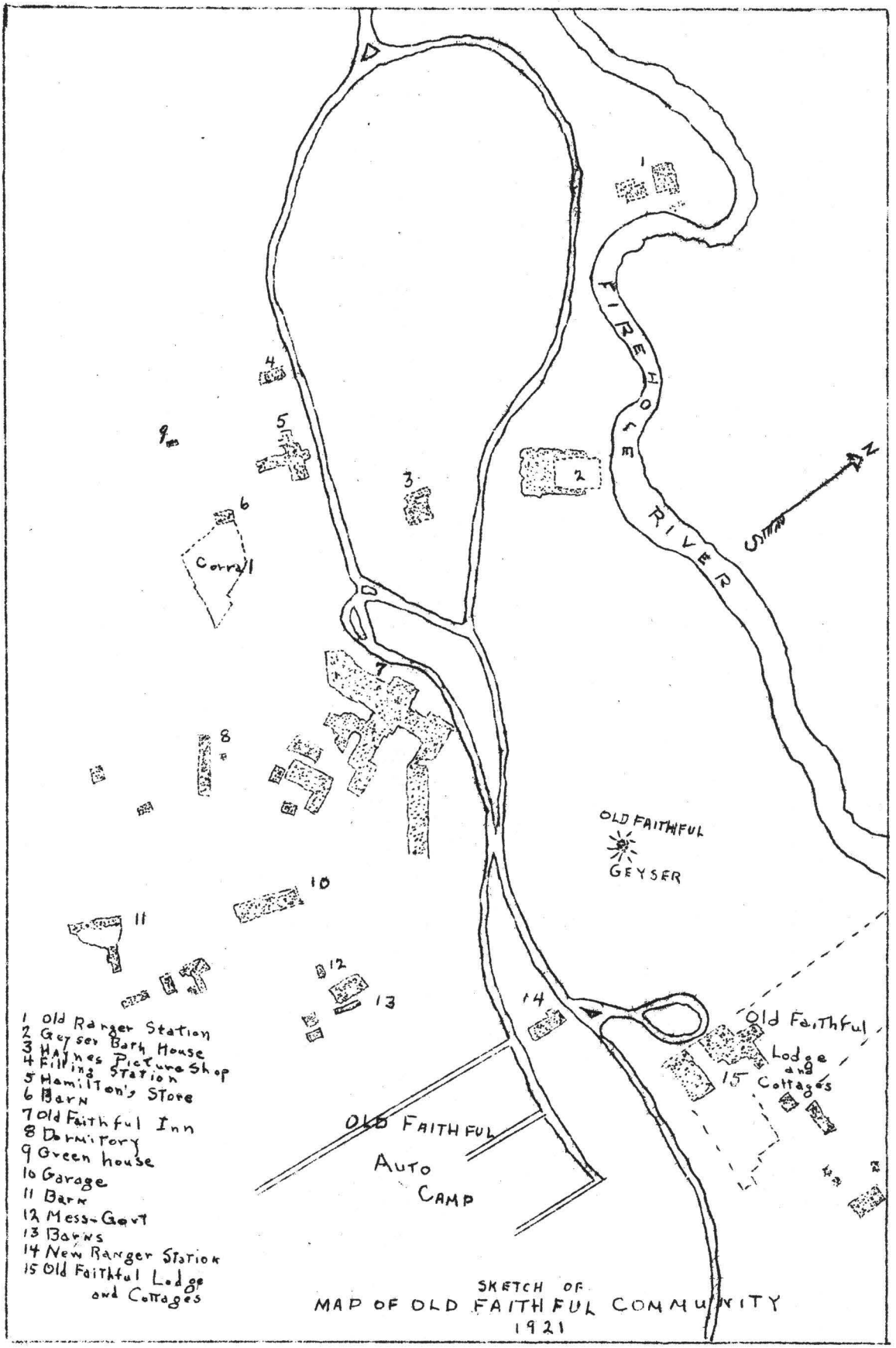
This property was first established in 1882, when John Yancey was permitted to erect a building for the accommodation of teamsters and mail-carriers on the route to and from Cooke. In 1884, a lease was granted for a site on which to conduct a hotel business. "Yancey's" was soon famed far and wide as an out-of-the-way place where followers of Izaak Walton could outfit for their pleasure during the day and where the evenings might be spent in stories, "stag-parties" or peaceful slumber. The locality was called Pleasant Valley, and it is sure that Uncle John Yancey did his best to perpetuate that name, for he provided hospitality, a whiskey glass too much in use to be washed for a dozen years or more, and a care-free life; a combination that was hard to beat. Those of us who have read Ernest Thompson-Seton's works get a strange thrill today as we ride in upon Yancey's Ranch -- a part of which is still standing and is now used as a hay ranch where horses and the wild animals are fed during the winter. President Roosevelt, in 1903, in company with John Burroughs, chose what they called the most beautiful and enjoyable spot in the park as a camp-site. There they spent some time, and in later years, the attractive little Los Creek, with Los Falls in the woods in the rear, has become the site of Roosevelt Lodge, now maintained by the Yellowstone Park Camps and Lodge Company. This camp is close to the Junction of the Cooke City Road and the Grand Loop Road, where the Tower Falls Ranger Station is located. The old Tower Falls soldier station, located at some distance from the junction, became uninhabitable in 1907, and a new building was constructed which was remodeled in 1923 to become the present Tower Falls Ranger Station.

The history of concessions, in the park, exclusive of hotels, rightfully begins with the Haynes Picture Shops, Inc., established in 1884. In 1881, F. Jay Haynes, a photographer of Fargo, Territory of North Dakota, visited Yellowstone Park, taking pictures of the various wonders to be found here. In 1884, he secured a lease for four acres of land at Mammoth Hot Springs, and the same area at the Upper Basin. He constructed a frame studio on the plateau in front of the hotel at Mammoth, and there conducted his business until 1903, when the building was moved to the foot of Capitol Hill. In time the Haynes plant at Mammoth increased, and this old building became merely the office and dormitory. A new picture shop was erected in 1920, which was remodeled into a residence in 1928. In the fall of 1928 the present new Haynes' headquarters building and shop was built and the old Haynes residence built in 1884 was razed. At the Upper Basin, the old hotel occupied the Haynes lease site. In 1897 the "most beautiful and appropriate building in the park" -- a log cabin studio, one story tall, 50 feet long, and 24 feet wide with 10 foot walls was constructed by the Haynes Picture Shops, Inc., at the Upper Basin. A shingled porch ten feet wide was constructed along the entire east front. There has been very little change since that time, with the exception of the recent construction of living quarters. In 1916, Mr. Haynes' ill health forced him to withdraw from active work, and in 1921, after 40 consecutive summers spent in the park, he was

laid away to join the majority of the men who gave of their time to make this region accessible and enjoyable for us. Upon his retirement from business, his son, Jack E. Haynes, took over the photographic concessions in the park. Under his able leadership the Haynes Picture Shops have grown -- a shop at Tower Falls being erected in 1917, another at Canyon in 1923, one in Mammoth and Old Faithful automobile camps in 1927, and at Fishing Bridge in 1928. During the last few years Mr. Haynes has given generously of his time to serve as Acting Director of the Museum at Yellowstone Park, and he, along with the majority of concessioners, has always been ready to back anything that is for the good of the Park.

As before stated, a man by the name of Anderson was employed by the Yellowstone Park Association during the winters of 1887 and 1888 as winter keeper of Canyon Hotel. His son, Ole Anderson, conceived the idea of coating articles in the mineral-laden hot springs waters at Mammoth. The tourists had previously been promiscuously attempting such a practice, with the resultant injury to the hot springs formations. Therefore, the administration of the park permitted Mr. Anderson to coat such articles as pine cones, leaves, etc., and to sell them. At the same time the tourists were prohibited from continuing such a practice. The lease to Mr. Anderson specifically stated that the privilege granted to him was non-transferable. He erected some tents between Liberty Cap and the Cottage Hotel for the purpose of conducting his business. In 1896 he completed a building on the site formerly occupied by his tents, under authority of a lease of the previous year. In 1908, or thereabouts, he sold out his business to the Park Curio Shop, operated by Pryor and Pryor. This firm, known later as Pryor and Trischman, in time built additions to the buildings, and in 1924 established the Devils Kitchenette, a refreshment stand near the opening of the cave known as the Devils Kitchen. In the same year they cooperated with another concessioner at Mammoth, George Whittaker, in establishing delicatessen service at the Mammoth Auto Camp. In 1927 they built a cafeteria in the same camp.

Before the year 1898, the troops which were generally little more than transient -- never staying here more than long enough to get acquainted with the region, were supplemented by a force of several civilian scouts. These latter were permanent employees who guided and aided the soldiers in the protection of the park. Moreover, these men were all skilled woodsmen and capable of undergoing more hardships with less injury than were the soldiers. Among them was one, George Whittaker. If one were to read Scout Whittaker's report for the year 1897 which was incorporated in the Superintendent's report for that year, they would be given an insight into the strenuousness of the duties performed by a civilian scout. After several years' service, Mr. Whittaker resigned, to return to the park at a later date in a different capacity. In 1913 he purchased the interests of the firm Lyall and Henderson, which controlled the post office store at Mammoth. Besides building several additions to that store, he cooperated with the Park Curio Shop in the establishment of delicatessen service in



SKETCH OF
MAP OF OLD FAITHFUL COMMUNITY
1921

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Mammoth Auto Camp in 1924. In 1917 he converted one of the buildings formerly used by the Holm Transportation Company at Canyon into a store by way of experiment. Satisfied with the experiment a fine store-building was erected there two years later.

As before mentioned, the first post-office in the park was operated by Jennie Henderson, daughter of George L. Henderson, who had come to the region as an Assistant Superintendent, and who afterwards was connected with the Old Marshall House, and the Cottage Hotel. This first post-office was located in one of the old McCartney buildings, which stood near the present site of the Park Curio Shop. In 1888, the post-office with a store in conjunction, was located on the north side of the Capitol Hill, near the present site of the new Haynes Picture Shop and was operated by Mrs. M. A. Baronett. The next year the post office store was conducted by Mrs. Jennie Henderson Dewing -- the original postmistress who had now married. Five years later Mrs. George Ash -- the original postmistress with her name again changed -- secured a lease for a site of ground located between the Cottage and the Mammoth Hotels, upon which she intended to erect a new post office store building. This building was erected in 1895 and 1896, and the old buildings at the foot of Capitol Hill torn down. A man by the name of Lyall worked on the construction of the building. This man in due time married a sister of Mrs. Ash, and in 1905 in conjunction with his brother-in-law, Walter Henderson, secured the lease for the post office store. The firm of Lyall and Henderson continued until 1913 when it was bought out by George Whittaker. The year 1922 saw another change in the post office. Mr. Chester Lindsley, who had been in Yellowstone Park for a number of years in various capacities such as Assistant Superintendent and Acting Superintendent, becoming postmaster in that year and the office being removed to the old Bachelor Officers' Quarters, where it is now located during most of the year. In the summer time there are a number of branch post-offices established throughout the park that the tourist may be only one day from the railroad mail service.

As before mentioned, George L. Henderson and his son-in-law, Henry Klamer, in August, 1885, were operating the old Marshall House at the Firehole Forks. In 1897 Klamer erected a two-story frame building at the Upper Basin. This was on a site leased to him for the operation of a store. Mr. Klamer died in 1914, and his wife operated the store till the next season, when it was purchased by Mr. C. A. Hamilton. At the Upper basin in 1923, a wing was added to the existing structure, and a small grocery store constructed in the auto camp. The following year the store was enlarged some more, a filling station was constructed in 1927 and a new store constructed in the auto camp in 1929. In addition to enlarging the Upper Basin plant, this operator increased his holdings, for when the Boat Company at the Lake became nearly inactive in 1917, he sublet their store at Lake outlet. This store was replaced by a new one in 1921. Hamilton enlarged his system again in 1924 by the construction of small stores at West Thumb and at Fishing Bridge, the latter one of which was enlarged in the following year.

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Although this is the end of the story told here -- the word "finis" cannot properly be inserted, for before the publication of this short history has been accomplished it will be out of date. Thousands of dollars are spent yearly by the Government and by the various concessioners in the improvement of their buildings. Old records are constantly coming to light which fill in a gap in our information and cause us to view certain known facts from a new angle. But my hope is that research will be stimulated, and that in time a complete knowledge of the history of Improvements in Yellowstone Park will be ours.

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