YOSEMITE
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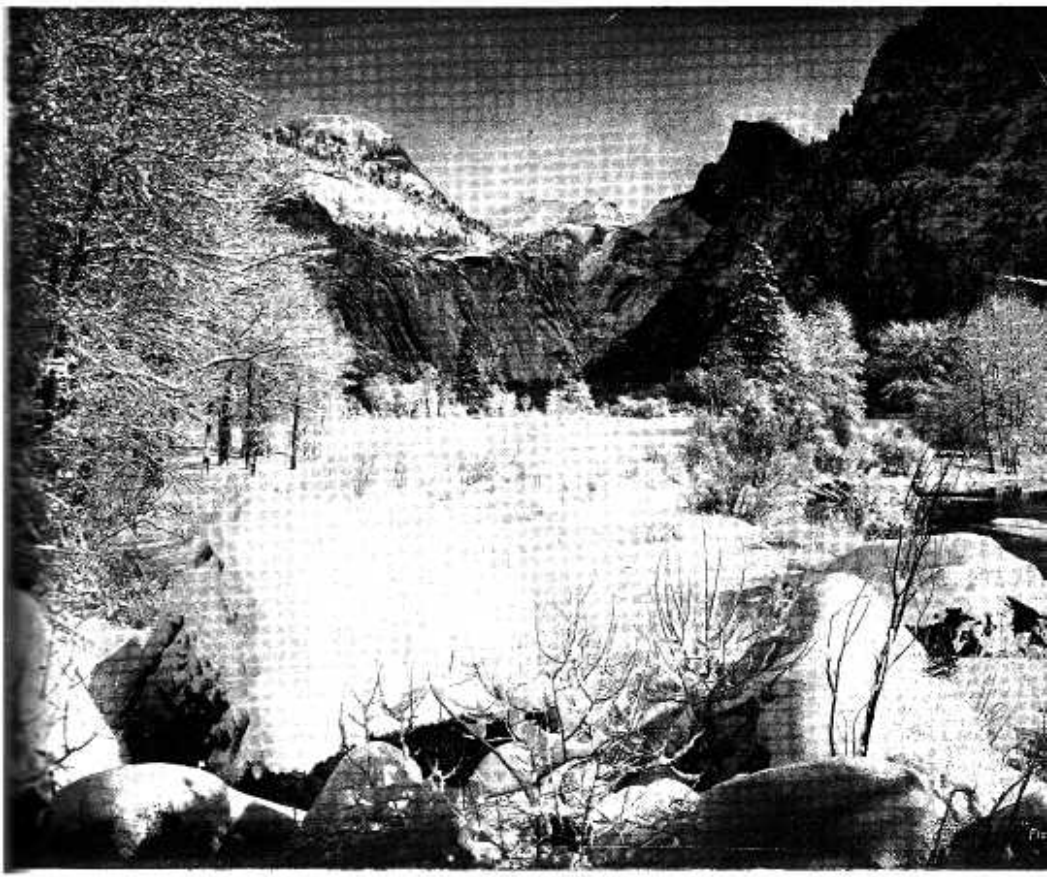

The Domes of Yosemite
—*Fiske c.* 1885

LOVERS OF YOSEMITE will be relieved to know that most of the damage from the flood of December 23-24 was to man-made features, with little impairment to the natural beauty of the park. A full report of the flood as compared to those of the past will be made by Park Forester Emil Ernst in a future issue of *Yosemite Nature Notes.*

LIBRARIANS PLEASE NOTE: We have found a few copies of **A General Index to Yosemite Nature Notes 1922 through 1936.** While they last these may be had without cost except for 25c postage and handling, on a first-come, first-served basis. Address: Yosemite Nature Notes, Box 545, Yosemite National Park.

Yosemite Nature Notes

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THE LATEST EVIDENCE BEARING ON THE CREATION OF YOSEMITE VALLEY

By William E. Colby

"Early Theories of Yosemite's Formation" by Richard J. Hartesveldt, which appeared in *Yosemite Nature Notes* is an excellent general review of the early conflicting theories on this subject. As this article points out the main difference of opinion which now exists is as to the relative amount of erosion which is attributable to the action of water and the amount of material which has been removed by glacial action.

Some geologists are of the opinion that the erosion caused by water flowing in preglacial streams cut the Sierra canyons down nearly to their present beds, creating V-shaped troughs which are characteristic of stream action and that the glaciers which subsequently occupied these troughs merely deepened them slightly and widened them to the characteristic U-shapes of ice-carved troughs.

John Muir, on the other hand, was very definitely of the opinion that glacial ice did most of the work and that water was but a feeble agent by comparison. In his *Studies in the Sierra*,[1] pages 45-46, under the subtitle "Ancient Glaciers," he says: "Every valley in the region gives understandable evidence of having been equally obedient and sensitive to glacial force, and no other. The erosive energy of ice is almost universally underrated . . . Streams of ice explain all the phenomena; streams of water do not explain any . . ."

In other portions of these *Studies* he discusses the comparatively small amount of erosion that can be attributed to stream action.

Francois E. Matthes of the United States Geological Survey prepared the excellent monograph, *Geologic History of Yosemite Valley* (1930, USGS Professional Paper 160).[2] During the early portion of his field investigation he was inclined to the view that pre-glacial water erosion accounted for the largest part of the excavation of Yosemite. But as his examination progressed he became more and more impressed with the pronounced evidences of the power of the glaciers, and toward the end of his investigation he was willing to give John Muir's conclusions much more weight than he had initially. As Secretary of the Sierra Club, which had induced the federal government to undertake this study, I had ample opportunity to talk with Matthes and get his views as the work progressed. Matthes' conclusions as finally expressed in his

monograph occupy a middle ground attributing a considerable portion of the canyon's erosion to preglacial stream action but also giving large credit to the subsequent work of glaciers.

While it seemed that the determination of the relative amount of erosion accomplished by streams and that due to glaciers might forever remain unascertainable, powerful evidence bearing on this moot question has more recently come to light. In October 1941 the late Dr. John P. Buwalda, then head of the Geological Department of the California Institute of Technology, published an article in *Yosemite Nature Notes* (20:89-93) entitled "Form and Depth of the Bedrock Trough of Yosemite Valley."

This article gave the results of a series of 85 seismic reflection tests made at various points on the floor of Yosemite Valley in 1934 and 1935. Holes were drilled to shallow depths and dynamite exploded in them. The reflection returns of the resulting waves were accurately timed on special recording instruments, giving data from which the depth to bedrock could be calculated. This method is now in regular use in determining the depth of oil strata beneath the surface. It has proven so accurate that it is now generally accepted by scientists. Many of the depth measurements obtained by Dr. Buwalda, assisted by Dr. Beno Gutenberg, were subsequently reshot from the same points and depths to bedrock redetermined by a second geographical crew, using entirely different equipment. This group was under the supervision of Dr. Eliot Blackwelder, for many years head of the Geology Department of Stanford University. His results substantiate the earlier Buwalda figures.

Every geologist who has given any thought to the matter has conceded that there was a "Lake Yosemite" at one time occupying the floor of the valley. Even Josiah Dwight Whitney recognized the existence of such a lake. The disparity in opinion was as to the depth of this lake to bedrock.

Yosemite Valley in its early formation.

Matthes, in an article entitled "Little Studies in Yosemite Valley," *Sierra Club Bulletin* (9:15) stated that "the existence of the ["Yosemite Lake"] rock basin is purely inferential . . . until a series of borings along the whole length of the valley shall afford the necessary facts," and added that such borings "would contribute much desired data *regarding the still challenged eroding efficiency of glaciers.*

"As to the extent to which the ancient glaciers have remodelled and excavated the valley, nothing perhaps would go further toward settling this vexed question than a series of direct measurements establishing beyond doubt the depth of the former "Lake Yosemite."

Matthes estimated this depth to range "from 100 feet to not less than

300 feet" with the probability that "the basin was deepest . . . in the upper part of the valley, opposite Yosemite Village."

The results obtained from the Buwalda-Gutenberg tests, later confirmed by Blackwelder, gave a depth to "Lake Yosemite" which far exceeded any prognostication. They disclosed that the solid rock bed of the glacially-scooped lake trough was spoon-shaped. The bottom of this depression is 1800 to 2000 feet below the present valley floor in front of Camp Curry. Three miles downstream, opposite El Capitan, bedrock is around 1000 feet below the present surface while at the westerly end of the valley it is only 200 feet to bedrock. The excavation in the upper end of the valley is, therefore, 5000 feet, or nearly a mile deep to bedrock, measured from the elevation of Glacier Point. This spoon-shaped, with great depth at the upper end and comparatively shallow depth at the lower end, Muir found to be characteristic of the new born yosemites of Alaska which he explored during trips on several successive years, made to confirm his observations on the work of Sierra glaciers.

Maximum glaciation of Yosemite Valley.

When Matthes was advised of these results he realized that if accepted they would necessitate a profound modification of his expressed views on the amount of glacial degradation as opposed to water erosion in the carving out of the valley. Only actual borings to establish the various depths to bedrock would satisfy him, he said.

In view of the careful and scientific manner in which the seismic reflection data were obtained by Buwalda and confirmed by Blackwelder, it would seem that the burden now rests on dissenters to disprove their reliability. Since this method of securing similar data is accepted as accurate in the scientific world the burden of disproof is a heavy one.

These depth-findings are independently corroborated by glacial scoring and striations on the rock walls of the Merced Canyon below Yosemite Valley. The direction of these scorings show that after leaving the Yosemite Valley proper the stream of glacial ice continued flowing out of the spoon-shaped depression trough which formed the rock bed of "Lake Yosemite," in the same general upward sloping direction that the seismic reflection tests prove the bed to occupy in the Valley itself. If the rock bed of "Lake Yosemite" in the valley proper were shallow and consequently almost level, as had been assumed by many observers, it is difficult to conceive of the stream of ice taking such a decided upward course upon leaving the Valley. On the other hand, if we recognize that the glacial ice was flowing on two inclined planes that sloped decidedly upward within the Valley itself, it is

not strange but entirely natural and inevitable that the ice stream should have continued to move in that same upward direction for some distance after leaving the valley. Both Muir and Matthes observed these upward-slanting glacial scorings which are found high up on the walls of Merced Canyon beyond the westerly end of the Valley proper.

Corroborative proof was also found by Muir in the fiords of Alaska, Norway, and in Switzerland where yosemitic valleys are in the process of formation. The upper ends of these glacial lakes and lake-like fiords are hundreds of feet in depth, whereas their outer or lower ends are comparatively shallow. Muir observed one case in Alaska where, at low tide, bedrock would be exposed at the outer or lip end of the glacially-excavated depression trough which the fiord occupied. Tarr and Martin, in "Alaskan Glacier Studies" (1914), confirm Muir's observations on these points and agree with him as to the tremendous erosive powers of glaciers.

What do the seismic reflection findings really indicate? Matthes gave the answer when he stated that proof of the existence of a rock basin in Yosemite would contribute data on the eroding efficiency of glaciers and that *nothing would go further* toward settling the vexed question as to the extent to which ancient glaciers have remodeled and excavated the valley than a series of measurements establishing the depth of "Lake Yosemite." Few if any of the geologists who have given thought to this questions ever dreamed that a depth as great as 1800 or 2000 feet below the present surface would be the fact. I have estimated roughly what this means. If we take the depth-to-bedrock seismic measurements as a basis for calculation, we will find that upwards of half a cubic mile of granite rock has been gouged out of the Yosemite Lake trough by glacial action alone and pushed on up out of the valley against gravity and deposited far to the west. Not one pound of this immense block could possibly have been eroded and conveyed out of the spoon-shaped depression by the action of flowing water because the elevation of the rock lip of the depression trough, found to be only 200 feet below the present surface at the lower or westerly end of the valley, would prevent any water erosion. No wonder that Matthes realized that the depth of "Lake Yosemite" would throw important and determinative light on the excavating power of glaciers as opposed to stream action.

The last and smallest of Yosemite Valley glaciers.

Hartesveldt suggests in his article that, "it is possible that Whitney resented" and may have been "irked into stubborness against embracing [Muir's] glacial interpretation." This is not only a possibility but was a fact. Whitney, with his extensive training in American and European universities, and by tem-

perament, was somewhat of an egotist. He was intensely galled by Muir's pointed criticisms of his "bottom-dropping-out" theory of Yosemite's origin (See Chapter II of Muir's *Studies in the Sierra*). So much so in fact that, while in his very commendable State publication, *Geology* (1865), he credits King and Gardiner with obtaining *"ample evidence of the former existence of a glacier in the Yosemite—at least a thousand feet thick"* and goes on to recognize the "large terminal moraine—below El Capitan," he repudiated his earlier published statements by saying, in the various editions of his *Yosemite Guide-Book*:

"There is no reason to suppose, or at least no proof, that glaciers have ever occupied the valley or any portion of it . . . so that this (glacial) theory, *based on entire ignorance of the whole subject*, may be dropped without wasting any more time upon it . . . *A more absurb theory was never advanced* . . ." He referred belittlingly to Muir, without naming him, as a "sheepherder" and a "guide."

Muir, in the winter of 1868 and the summer of 1869, assisted in herding sheep to get money that he might live in Yosemite and carry on his Sierra studies. Occasionally while living in Yosemite he acted as a guide. He had studied geology at the University of Wisconsin and had read Tyndall, Agassiz, and other scientists who had written about the glaciers of the Alps. It was no wonder that with his keen analytical mind and remarkable powers of observation he should have recognized that "glaciers were the principal eroding agents" in carving out the "greatest of mountain temples" Yosemite Valley. (See his glacial observations made in the spring and summer of 1869 in *My First Summer in the Sierra.*)

Yosemite Valley and its ancient lake as it may have appeared some 10,000 years ago.

The Buwalda and Blackwelder findings as to the depth of "Lake Yosemite" have added the most powerful and convincing evidence to support Muir's assertions that glaciers were the major eroding agents in the formation of Yosemite and other great Sierra canyons. If glacial action could dig out and extrude against the force of gravity upwards of half a cubic mile of bedrock from the "Lake Yosemite" trough depression, what tremendous sculptural power must glaciers, with gravity in their favor, have exerted in the fomation of all the yosemitic valleys of the Sierra?

Muir best expressed this situation when he said:

"When we walk the pathways of Yosemite glaciers and contemplate their separate works—the mountains they have shaped, the canyons they have furrowed, the rocks they have worn, and broken, and scattered in moraines--on reaching Yosemite, instead of being overwhelmed as at first with its incomparable magnitude, we ask, *Is this all?* wondering that so mighty a concentration of energy did not find yet grander expression."

[1]Available from the Yosemite Natural History Association, $2.65.

[2]Available from the Yosemite Natural History Association, $5.50.

EDITOR'S NOTE: The writer of the foregoing has been privileged to read a copy of a detailed report entitled "Seismic Explorations on the Floor of Yosemite Valley, California" " by Beno Gutenberg, John P. Buwalda, and Robert P. Sharp, which will appear in the Bulletin of The Geological Society of America in the near future. This excellent and comprehensive article gives detailed results of the seismic tests which are most illuminating and show that not one glaciated basin but two such basins exist beneath the present floor of Yosemite Valley, with a third toward Cascades. These data do not alter but rather serve to confirm the conclusions set forth in the preceeding article.

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ANIMAL ANTICS AT ARCH ROCK

By Robert W. Carpenter, Park Ranger

Roger Tory Peterson describes the Dipper, or Water Ouzel (oo-zel), as a slate colored bird, shaped like a large chunky wren, the size of a large thrush, with a short tail. One or two of these interesting and unusual birds can be seen near the river in the vicinity of Arch Rock at almost any time of day. Occasionally one will be found perched on a dry sunny rock singing its mocking-bird-like song. More often, however, it will be seen going through its incredible search for food.,

Not content wth catching insects in the air or on dry land, or even in still water, the dipper prefers to duck into the rushing water of the rapids. Perched precariously near the edge of the water the dipper will bob its whole body up and down several times. Then the bird will either plunge its head into the water for food or deliberately walk into the water so that at times the whole body is submerged. The swift current sometimes carries the bird several yards before it nonchalantly walks out onto another rock.

A casual observer might be led to believe that the ouzel is a poor flyer. Once in a while the bird will jump from a rock to catch an insect in the air and, seemingly, rather than fly to another rock, the dipper will simply drop into the water and be carried or walk to safety. However, on flights from one feeding area to another the dipper exhibits a strong, rapid wingbeat at times, barely skimming the surface of the water.

This interesting bird also builds an unusual nest, composed mainly of closely-woven mosses completely roofed over with a dipper-sized entrance on the side. The nest is often located near water on a ledge, or a rock in midstream, or even behind a waterfall. But there are exceptions—just a short distance from the Arch Ranger Station the dippers have built their nest about head-height in the crotch of a tree.

THE ORIGIN OF THE NATIONAL PARK IDEA IN AMERICA

A Condensation by Douglass H. Hubbard

Associate Park Naturalist

Part 4

(conclusion)

[At this point let us leave Dr. Huth briefly to mention that this missing report was found in 1952 after a diligent and lengthy search on the part of Miss Stella Obst, secretary to the present Mr. Frederick Law Olmsted. It was published in its entirety in *Landscape Architecture* for October 1952 in an article by Laura Wood Roper. The following excerpts from it show the great foresight of "The Father of American Landscape Architecture"]:

"It is a scientific fact that the occasional contemplation of natural scenes of an impressive character, particularly if this contemplation occurs in connection with relief from ordinary cares, change of air and change of habits, is favorable to the health and vigor of men and especially to the health and vigor of their intellect beyond any other conditions which can be offered them, that it not only gives pleasure for the time being but increases the subsequent capacity for happiness and the means of securing happiness. The want of such occasional recreation where men and women are habitually pressed by their business or household cares often results in a class of disorders . . .

"If we analyze the operation of scenes of beauty upon the mind, and consider the intimate relation of the mind upon the nervous system and the whole physical economy, the action and reaction which constantly occur between bodily and mental conditions, the reinvigoration which results from such scenes is readily comprehended. Few persons can see such scenery as that of the Yosemite and not be impressed by it in some slight degree . . .

"The first point to be kept in mind . . . is the preservation and maintenance as exactly as is possible of the natural scenery; the restriction, that is to say, within the narrowest limits consistent with the necessary accommodation of visitor of all artificial constructions and the prevention of all constructions markedly inharmonious with the scenery or which would unnecessarily obscure, distort or detract from the dignity of the scenery.

"Second: it is important that it should be remembered that in permitting the sacrifice of anything that would be the slightest value to future visitors to the convenience, bad taste, playfulness, carelessness, or wanton destructiveness of present visitors, we probably yield in each case the interest of uncounted millions to the selfishness of a few individuals.

"It is an important fact that as civilization advances the interest of men in natural scenes of sublimity and beauty increases . . ."

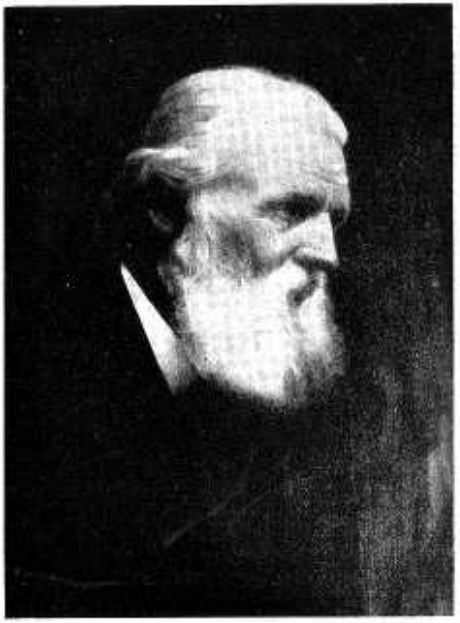
[Now we see Olmsted as a prophet—remember, this was 1865]:

"It is but sixteen years since the

Yosemite was first seen by a white man, several visitors have since made a journey of several thousand miles at large cost to see it, and notwithstanding the difficulties which now interpose, hundreds resort to it annually. Before many years if proper facilities are offered, these hundreds will become thousands and in a century the whole number of visitors will be counted by the millions. [Visitors in 1954: 1,008,031]. An injury to the scenery so slight that it may be unheeded by any visitor now, will be one of deplorable magnitude when its effect upon each visitor's enjoyment is multiplied by these millions. But again, the slight harm which the few hundred visitors of this year might do, if no care were taken to prevent it, would not be slight if it should be repeated by millions . . ."

[We return again to Dr. Huth:]

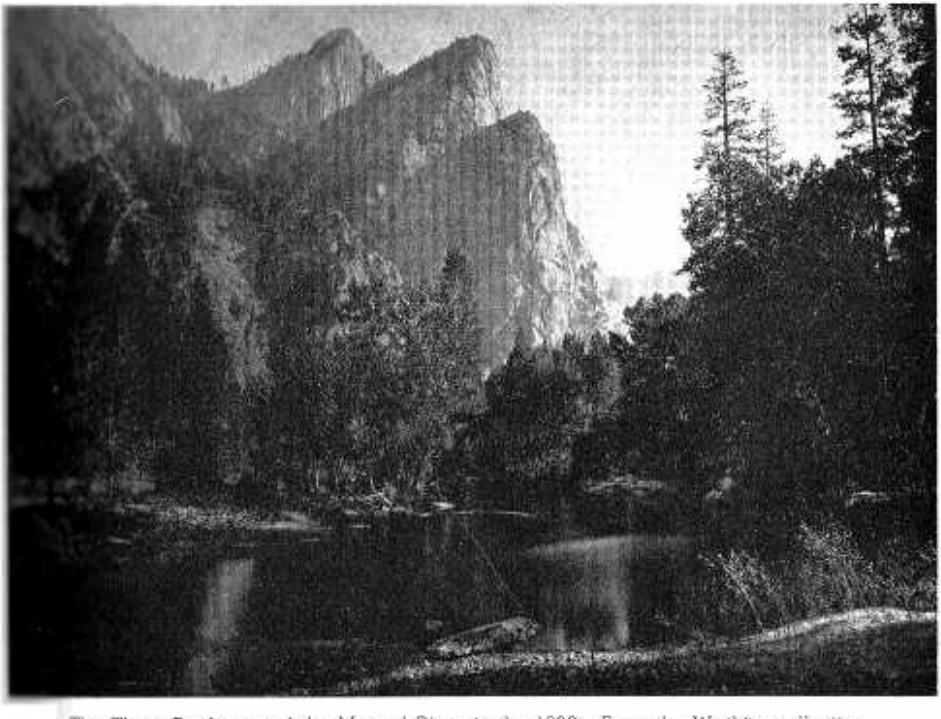
"After 1865 the Yosemite grant was developed normally; . . . The fame of Yosemite grew . . .



JOHN MUIR

"The year 1868 brought John Muir to California. His profound devotion to the Sierra initiated a new era in spreading the glory of Yosemite. [Muir wrote: "Thousand of nerve-shaken, overcivilized people are beginning to find out that going to the mountains is going home; that wilderness is a necessity; and that mountain parks and reservations are useful not only as fountains of timber and irrigating rivers, but as fountains of life."]

"Yosemite, once it was set aside, progressed smoothly, contributing far more than Yellowstone, it would seem, toward advancing the idea of conservation. It makes little difference that one area was under custody of a state and the other of the federal government. Certainly the purpose to which Yellowstone was 'dedicated and set apart as a public park or pleasuring ground for the benefit and enjoyment of the people' in 1872 did not differ from the purpose for which the Yosemite grant had eight years earlier been given in trust to the State of California, upon the express condition that the premises shall be held for public use, resort and recreation . . . inalienable for all time . . . From the time on when the Central Pacific touched Stockton (1869), national tourist travel began to invade the valley. Yosemite was soon in a niche in the minds of the American people, who admired their country and took pride in it. Most people could not go out to California, but a chromo by Prang was within the reach of almost every lover of nature; the enormous editions of these lithographs, showing Yosemite, proved how eager people all over the nation were to satisfy their desire to become familiar with the wonderland of California . . .



The Three Brothers and the Merced River in the 1860s. From the Watkins collection in the Yosemite Museum.

"In the year of the Yosemite grant another milestone was passed in the publication of George P. Marsh's *Man and Nature*. This book was the first to approach the theme of conservation in scholarly fashion. It was widely read and most influential: . . . [From it we take these words:]

'It is desirable that some large and easily accessible region of American soil should remain as far as possible in its primitive condition, at once a museum for the instruction of the students, a garden for the recreation of the lovers of nature, and an asylum where indigenous trees . . . plants . . . beasts may dwell and perpetuate their kind . . .'

"As a logical consequence of these ideas, Theodore Roosevelt [who camped with John Muir in Yosemite in 1903] inaugurated the conservation program out of which the National Park Service [authorized in 1916 and now embracing some 180 acres, of which 28 are national parks] grew. The idea the program represents is based on a series of trends—deeply rooted in the American pattern of life, developing in various strata, ranging over a long period of time—that were finally embodied in park, state, and federal initiative. The idea of keeping intact some of the grand scenery of the New World such as Chateaubriand had celebrated—'there is nothing of age in America but the woods . . . that is well worth monuments and ancestors'—was never quite lost sight of, from the day George Catlin conceived it until it matured in the protection of the jewel of all . . . Yosemite. With this achieved, other successes were no longer difficult. One pearl after another was collected and strung with the others to form a national park system which is the unrivaled adornment of this hemisphere."