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Lectures on Water Conservation

William C. Kennard, ed.

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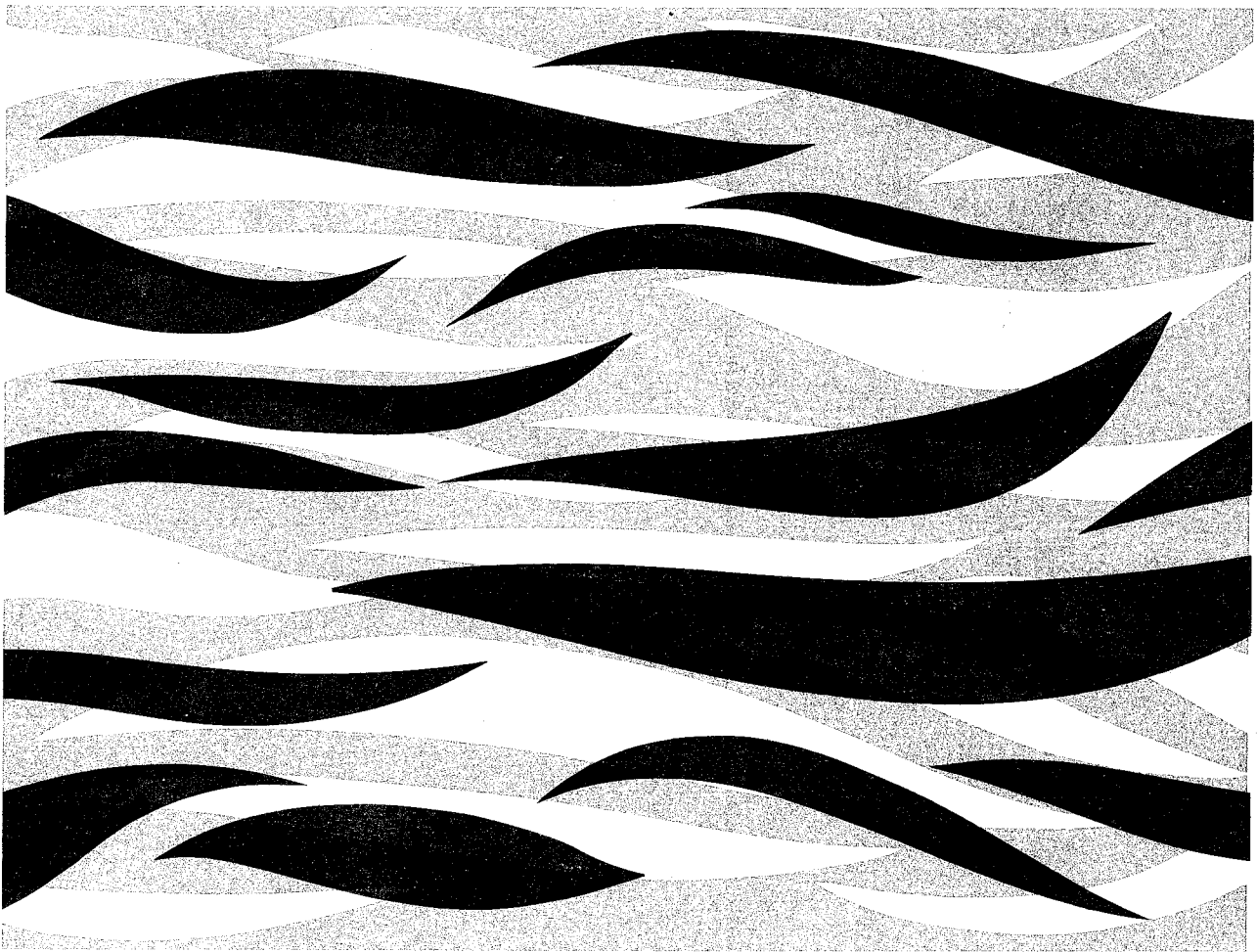
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Lectures on Water Conservation

Report No.7

October 1968



INSTITUTE OF WATER RESOURCES
The University of Connecticut

Lectures on Water Conservation

RECLAMATION OR WRECKLAMATION?

Gary A. Soucie

Assistant to the Executive Director of the Sierra Club

WATER RESOURCES, PRESERVATION AND USE

Walter U. Garstka

Professor of Civil Engineering, Colorado State University

WATER – ITS PRESERVATION AND USE

Roderick M. Vandivert

Executive Director

Scenic Hudson Preservation Committee

HYDRO POWER FOR NINE MILLION PEOPLE

George J. Delaney

Assistant Director, Community Relations

Consolidated Edison Company of New York, Inc.

Edited by

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Institute of Water Resources

The University of Connecticut

Storrs, Connecticut 06268

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FOREWORD

The Institute of Water Resources has as one of its purposes, the development of a greater understanding of and knowledge about the use and development of water resources. As one step in accomplishing this goal, we have sponsored public lectures on a broad range of topics relating to water.

In view of the great interest today in water conservation, preservation and use, it was decided to devote the spring semester lectures to this general topic. Furthermore, we tried to obtain speakers who would present both sides of some of the controversial issues in the field of water conservation.

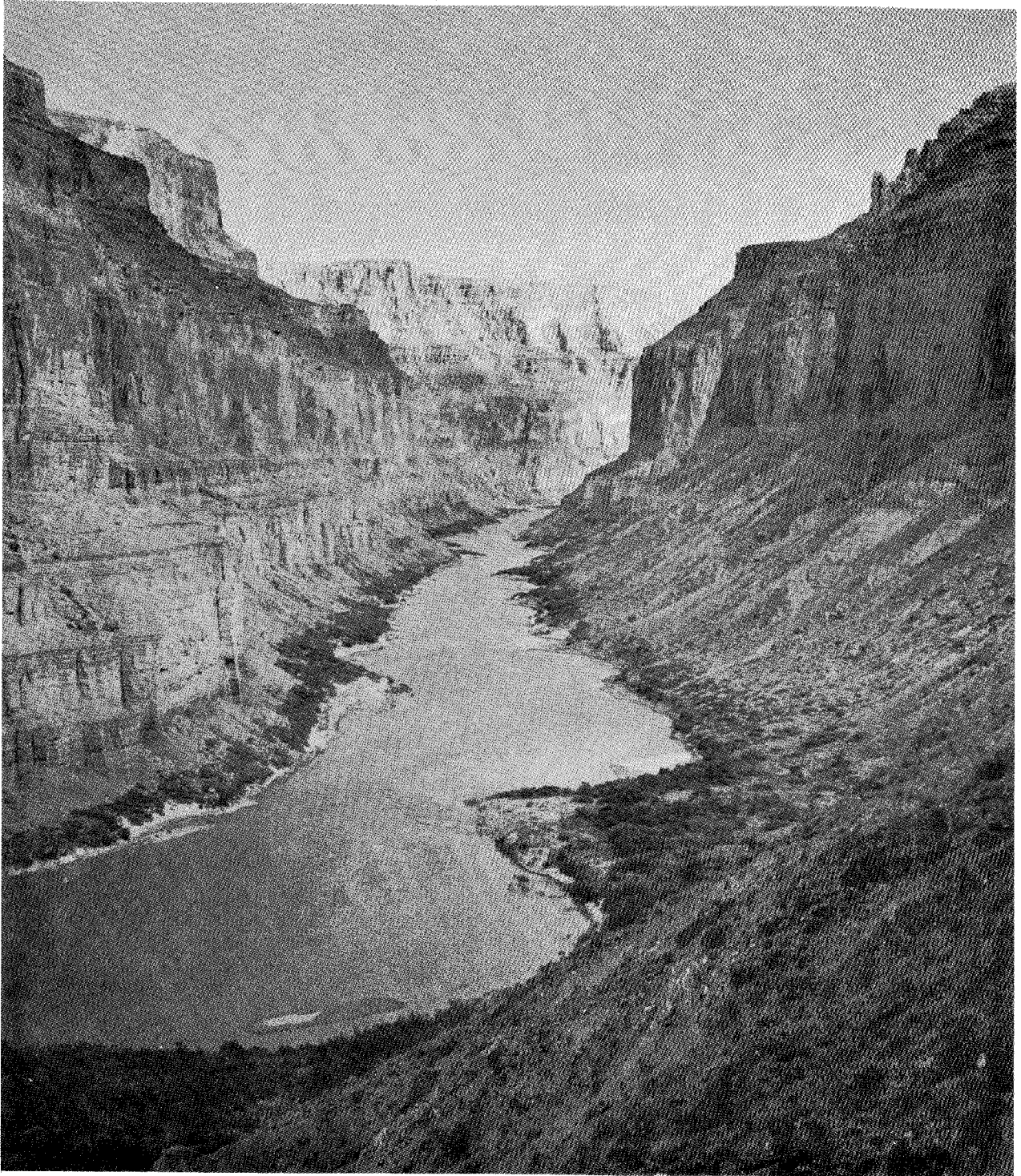
The first two lectures concerned reclamation, especially as it relates to dam construction. On February 28, 1968, Mr. Gary A. Soucie, Assistant to the Executive Director of the Sierra Club, New York City, spoke on the topic, "Reclamation of Wrecklamation?" On March 27, 1968, Mr. Walter U. Garstka, Professor of Civil Engineering at Colorado State University, Ft. Collins, Colorado, gave a lecture entitled "Water Resources, Preservation and Use."

The final two lectures primarily concerned the plans to construct a pumped-storage hydroelectric plant along the Hudson River on Storm King Mountain near the village of Cornwall, N.Y. Mr. Roderick Vandivert, Executive Director of the Scenic Hudson Preservation Conference, New York City, discussed the topic, "Water: Its Use and Preservation" on April 17, 1968. On May 15, 1968, Mr. George J. Delaney, Assistant Director, Community Relations, Consolidated Edison Company, New York City, spoke on the topic, "Hydro Power for Nine Million People."

In every case the speakers gave talks which were stimulating and thought-provoking. This report contains those lectures; however, it was not possible to include the spirited and extended discussions which took place following the formal presentations.

Sincere appreciation is extended to the guest speakers. As might be expected when both sides of controversial issues are discussed, major points of difference appear in the papers. It should be recognized that these opinions and statements are those of the authors and do not necessarily reflect the opinions of the Institute or of The University of Connecticut.

William C. Kennard
Director
Institute of Water Resources



Looking down the Colorado River into Grand Canyon National Park near Nankoweap Creek. This section of the Grand Canyon, sometimes called the "Desert Facade," would be rendered virtually inaccessible if the proposed Marble Canyon Dam were constructed upstream. In addition, the daily surges of water from the power releases would make visitation extremely hazardous, even if access were gained. By "taming" the river's flow the dam also would allow the accumulation of impassable and unsightly debris piles. Not all the destruction caused by hydroelectric dams is from inundation in the reservoir impoundment area.

Photo Courtesy of The Sierra Club.

RECLAMATION OR WRECKLAMATION?

Gary A. Soucie

Assistant to the Executive Director of the Sierra Club

Over a quarter of a century ago, a Bulgarian writer named Svetoslav Minkov wrote a short story entitled, "The Man Who Came from America." The "man" of the title was a robot-butler sent to the hero of the story by a long-forgotten aunt who, while studying pharmacy in Zagreb, had met a millionaire from New Jersey, married him, and emigrated to New York City. A chance encounter on the street with a small boy crying over a broken toy soldier had reminded the aunt of a similar situation involving her nephew back in the homeland, so she decided to send him a new "toy soldier."

From the first encounter between master and "man" at the customs house, things went rather badly. The automated manservant, Faithful John, No. 384,991, turned out to be far more domineering than subservient. At one point, our hero ruefully noted:

God created man. The Devil in reply created the homunculus. Sometimes the homunculi were born in the sorcerers' kitchens, called into life out of a nightmare fancy and by the long vigilance of the servants of black magic.

Today they are manufactured in factories according to tables of strictly scientific estimations and their evil creators are called engineers.

The story ends in tragedy, with the errant automaton committing electronic "suicide," and our hero going mad and thinking that he has become a robot.

While things aren't yet quite that bad, we do live in an age, and in a nation, threatened in many ways by the dominance of a technology that has become as much an end as a means. We have reached a point where man faces the crucial choice of whether he will serve, or be served by, his tools and technology.

Two years ago, in a address before the Royal National Academy in Athens, Vice Admiral Hyman Rickover said:

Much more thought should be given to technological interference with the balance of nature and its consequences for man, present and future. There is need of wider recognition that government has as much a duty to protect the land, the air, the water, the natural environment against technological damage, as it has to protect the country against

foreign enemies and the individual against criminals.

And, to bring us around nearer to the subject at hand, in that same year a special committee of the National Science Foundation, reporting on the future of weather modification in water planning, warned that "scientific and technological progress is running ahead of man's legal, social, and political arrangements to deal with the consequences."

I would like now to look at some of the legal, social, and political arrangements of water-development technology in the arid Colorado River Basin.

But, before we look at the details of the water-resource situation in the area, let us put the Colorado Basin into perspective.

Alarums and editorials to the contrary, there is at present no gross water shortage in this country. The United States is a water-rich nation with a bad habit of abusing its water, and other natural resources. Our water problems are mainly those concerned with quality rather than quantity. Used properly, water is, after all, a renewable resource. But we are so lavish and careless in our use of water that there are local water shortages in many places around the nation. Chemist Donald E. Carr has described the U.S. as "the biggest water hog in the world." Compare the 50-gallon daily per capita water use in large commercial towns and cities in England with the 150- to 200-gallon daily use in our cities. Outside our cities we are so much more lavish with water that our national average jumps to about 1,500 gallons per day per person. That's over 300 billion gallons per day. However, our annual mean rainfall of 29 inches produces 4.4 trillion gallons of water per day and even if a whopping three-fourths is lost to evapotranspiration, that leaves us with over a trillion gallons.

Of course, the Colorado Basin doesn't get anywhere near an annual mean rainfall of 29 inches. Throughout the Basin rainfall is more like seven to fifteen inches per year. Luckily, population density in the Basin is considerably below the national average. But the Lower Basin is one of the fastest growing areas in the country and its per-capita daily water use is over three times as great as the national average, mainly because of cropland

irrigation.

Average annual runoff in the streams of the Colorado Basin comes to about the same on a daily per-capita basis as the runoff in what the U.S. Geological Survey identifies as the New England Water Supply Region—about 6,500 gallons per person per day. But the Colorado Basin *uses* over ten times as much water per capita, and *consumes* more than 100 times as much. The major consumptive use is, of course, agricultural irrigation.

Consider the water-use picture in the State of Arizona, where 4,700 gallons of water per person are used each day. (Four other Basin states—Wyoming, Nevada, Colorado, and Utah—all have higher water-use indexes.) By any reckoning, Arizona has water problems. The state's population is exploding (it increased by nearly 75 per cent in the decade between the last censuses), it has been plagued by legal and political problems in its attempts to use its "fair share" of the Colorado River, and it has been mining its underground water to the tune of a 3.5 million-acre-foot annual overdraft.

Arizona is using about 6.5 million acre-feet of water per year, of which about 5 million acre-feet are consumed. Where did the water go?—mainly to irrigation. According to two agricultural economists at the University of Arizona (Dr. William E. Martin and Leonard G. Bower),

Agricultural industries of Arizona . . . used over 90 per cent of the water supplied for economic production. More than 75 per cent of all water intake . . . went to just three crop-growing sectors: cotton, food and feed grains, and forage crops.

Another Arizona agricultural economist, Dr. Robert A. Young, breaks it down this way:

(1) All uses of water for purposes other than cropland irrigation—all manufacturing, thermal generation of electricity, mining and smelting, livestock watering, timber products, recreation, municipal and household uses—all these uses together take only one-half million acre-feet of the 6.5 million used; (2) of the water used on cropland irrigation, 2.5 million acre-feet are used on high value intensive crops (cotton, vegetables, field fruits, citrus) which produce almost 80 per cent of all income from crop sales in Arizona; and (3) the remaining water used—3.5 million acre-feet—is used to irrigate low-value extensive crops, feed grains and forages, that produce only 20 per cent of all crop income.

Note that the amount of water used to irrigate the low-value extensive crops—3.5 million acre-feet—equals the overdraft of groundwater supplies.

As Martin and Bower have pointed out, "the majority

of solutions to the Arizona water shortage are based on the simple directive, 'get more from somewhere' rather than on the more realistic idea of reallocating the water rights to "economically better uses and where water can be saved to reduce the overdraft." As an example of such a water-saving and economically better use, Dr. Young compares the use of 2.25 million gallons of water per day to irrigate 500 acres of sorghum to the use of the same amount of water at the new Swift & Co. slaughterhouse at Tolleson. The slaughterhouse employs about 225 persons, compared to the 7,500 man-hours (or the equivalent of three year-round workers) of employment offered annually by the irrigation of 500 acres of sorghum. "Furthermore," as Dr. Young observes, "much of the water used in this plant would not be lost in the process, as it would be in agriculture, but would be available for use again in crop irrigation after being suitably processed."

But the old ways, the tried-and-true ways, are as deeply ingrained in Arizona as elsewhere, and in Arizona (as well as the other Western states) the standard answer to all water problems is a Bureau of Reclamation project, even if it means the construction of dams in the State's greatest scenic and scientific asset, the Grand Canyon of the Colorado River.

Twenty-one years ago Senator Carl Hayden of Arizona introduced a bill to authorize the construction of a Central Arizona water project that has yet to be authorized by Congress. For twenty of those 21 years the Central Arizona Project called for the construction of at least one dam in Grand Canyon. But it wasn't until the mid-1960's that the "Grand Canyon Controversy" really flared up. Before then, the objections of conservationists to the damming of the Grand Canyon had taken a back seat to the "holy war" over water between the seven Basin states. In 1963 the U.S. Supreme Court handed down a decision in the case of *Arizona et al. v. California* that paved the way for a grand compromise among the Basin states and turned the political, water-rights controversy into a showdown between reclamationists who would dam the Grand Canyon and the conservationists who would preserve it.

THE GRAND CANYON DAMS

On January 22, 1964 Secretary of the Interior Stewart L. Udall approved the Pacific Southwest Water Plan devised by the Bureau of Reclamation. The plan, incorporating the Central Arizona Project, called for two mainstream dams on the Colorado River, both within the Grand Canyon.

Marble Canyon Dam, in Marble Gorge upstream of Grand Canyon National Park, was to be a 310-foot-high concrete arch dam with a 363,000-acre-foot reservoir extending 40 miles upstream to Lee's Ferry.

Bridge Canyon Dam, downstream of Grand Canyon National Monument, was to be a 673-foot-high concrete arch dam with a reservoir of 3,710,000 acre-feet that would extend all the way through Grand Canyon National Monument and thirteen miles into the National Park.

Both dams were to be used to supply pumping power for the Central Arizona Project and to generate revenue for the Colorado Basin Development Fund.

For the first time in anyone's memory the seven Colorado Basin states were in total agreement on a plan for the river. H.R. 4671, the Central Arizona Project bill introduced by Representative Morris K. Udall, had, for good measure, a little something for everyone tacked onto it.

With the seven states — and the bargaining power of their 51 votes — all going for the same “ball of wax,” with their heavy representation on the Interior committees of both houses (fully half the membership of the Senate committee and the chairmanship of the House committee), and with the Administration backing the plan, things looked rather bleak for the Grand Canyon.

However, conservationists were determined to save Grand Canyon, and we had a rallying cry: “Remember Glen Canyon.”

Back in 1950 the Bureau of Reclamation had devised an omnibus Colorado Basin Storage Project that contained, among other things, plans for locating two dams—Echo Park on the Yampa River and Split Mountain on the Green—within Dinosaur National Monument. Battle was joined and raged on for several years; the project was at a standstill and almost certain of defeat, because conservationists had so well documented the case against dams within the National Park System. So, in 1956, the reclamationists offered a compromise: they would drop Echo Park and Split Mountain dams and would see that Rainbow Bridge National Monument was protected against the waters of the reservoir behind Glen Canyon Dam if the conservationists would drop all other objections to the project. The deal was struck.

Too late did we discover the extraordinary beauty and significance of little-known Glen Canyon, for the death warrant had been signed. In 1963, the same year the gates of Glen Canyon Dam were closed, the Sierra Club published a photographic record and requiem for *The Place No One Knew: Glen Canyon on the Colorado*:

Remember these things lost. The native wildlife; the chance to float quietly down a calm river, to let the current carry you past a thousand years of history, through a living canyon of incredible, haunting beauty. Here the Colorado had created a display that rivaled any in the world. The side canyons simply had no rivals. We lost wholeness, integrity in a place, one that might always have let

man experience a magnificent gesture of the natural world. No man, in all the generations to be born of man, will ever be free to discover for himself one of the greatest places of all. This we inherited, and have denied it to all others — the place no one knew well enough.

There was more than nostalgia in this remorse; there was also bitterness, for the agreement on Rainbow Bridge had been betrayed. Despite the language written into the act authorizing the storage project—

It is the intention of Congress that no dam or reservoir constructed under this Act shall be within any national park or monument.

and

—the Secretary of the Interior shall take adequate protective measures to preclude impairment of Rainbow Bridge National Monument . . .

—the money was never appropriated for the protective measures and the waters of Lake Powell behind Glen Canyon Dam have encroached upon the monument and may someday topple Rainbow Bridge itself.

So, conservationists armed for what promised to be a long and bitter battle over the Grand Canyon dams. And this time we came loaded for bear.

There are many arguments against the dams, but they can be grouped under four main objections:

First, the dams are not necessary—not to the Central Arizona Project, not to the Lower Colorado Basin Project, and not to the power needs of the Pacific Southwest.

Second, the dams are not economically justified.

Third, the dams would be wasteful of resources in a country that can ill afford waste.

Fourth, and most important, the dams would do serious, and irreparable, damage to the Grand Canyon and would encroach upon both Grand Canyon National Monument and Grand Canyon National Park, in violation of the act authorizing the national park and of the National Park Act of 1916.

Let us now consider these objections in order.

THE DAMS ARE NOT NECESSARY

Thanks to large doses of misinformation fed them through virtually every newspaper in the state, the people of Arizona were misled into thinking that the Grand Canyon dams were necessary to the Central Arizona Project. Every time someone said something nasty about the dams, they would have nightmare visions of their wells running dry. But an objective, dispassionate look at the dams proves otherwise.

They aren't necessary in the primary sense of providing water for the project, since that would be

diverted from an existing reservoir, Lake Havasu, behind Parker Dam. In fact, they would waste water through bank and reservoir storage and through evaporation.

It was said the dams were necessary to provide the pumping power for the Central Arizona Project. But this pumping power is available from the other hydropower dams in Arizona: Hoover, Parker, Davis, and eventually Glen Canyon.

Surely, then, the dams are necessary to pay for the construction of the Central Arizona Project, according to the time-honored reclamation financing methods? The answer again is No, and on two counts.

First, there are other methods of producing power for revenue: thermal plants fueled by fossil fuels or uranium, for example.

Second, it was demonstrated by Jeffrey Ingram, the Sierra Club's Southwest Representative and a mathematician, that the Central Arizona Project could be financed from the surplus revenues from Hoover, Parker, and Davis dams. When asked in a congressional hearing if this were possible, Reclamation Commissioner Floyd Dominy said:

This would be contrary to longstanding reclamation policy, but if it were done, you could theoretically do it and actually have a small remaining surplus of about \$100 million.

We come, then, to the alleged necessity of the Grand Canyon dams to build up the so-called Basin Development Fund. First, the same objections apply here as applied to the "necessity" of the dams to pay for the Central Arizona Project: there are other sources, and less destructive ones, for revenue production, and there is always that "small remaining surplus of about \$100 million" available from Hoover, Parker, and Davis. What is the necessity for a development fund ranging up into the billions of dollars?

Under direct questioning by Representative John P. Saylor of Pennsylvania, the ranking minority member of the House Interior Committee and a dedicated conservationist, Commissioner Dominy admitted that the fund would be used as a down payment on a multi-billion-dollar project to import water into the Colorado Basin from some water-surplus area, perhaps Northern California, or, more likely, the Columbia Basin. Alarmed by the possible pirating of waters from their Columbia and Snake Rivers, the congressmen from the Pacific Northwest aligned themselves against the construction of these two dams. This, then, pretty well deadlocked the issue politically, for the chairman of the Senate Interior Committee is Senator Henry M. Jackson from Washington.

Certainly the dams are not necessary to meet the rising power demands of the growing Southwest. Even Kenneth Holum, Assistant Secretary of the Interior for

Water and Power Development, admitted this in his letter transmitting the Pacific Southwest Water Plan to Secretary Udall: "The power needs of the Pacific Southwest region could be met by other means."

The arguments of conservationists that the dams are unnecessary have been borne out by a number of events:

First, the Bureau of the Budget's recommendation, in May 1965, that Bridge Canyon Dam be deferred.

Second, the Bureau of Reclamation's admission that Marble Gorge is a "second-class damsite."

Third, the announcement in February 1967 by Secretary Udall of an alternative Central Arizona Project containing no dams on the mainstream Colorado and substituting a coal-fired powerplant scheme to provide pumping power and other revenues.

Fourth, the passage last summer by the Senate of legislation similar to the Administration's new proposal introduced by Arizona Senator Carl Hayden. An amendment on the floor to put Bridge Canyon Dam back into the bill was defeated by a margin of 6 to 1.

Fifth, the recent introduction by the California delegation of a substitute bill eliminating the Grand Canyon dams.

THE DAMS ARE NOT ECONOMICALLY JUSTIFIED

In the fight against the Grand Canyon dams, conservationists found themselves with three powerful allies: two economists from the RAND Corporation and a nuclear physicist from Atomics International who demonstrated forcefully and often that the proposed dams were economically unsound projects. They attacked the Bureau of Reclamation figures, cost-benefit analysis, and even their very methods. In a RAND Paper, Dr. Alan Carlin wrote:

...the underlying problem in all this is the fusion of interests between Federal water agencies looking for business and Congressmen anxious to obtain projects for their districts. Grossly generous guidelines for evaluating water projects serve the interests of both, as does the practice of having the individual agencies concerned carry out the evaluations of particular projects. Since Congress itself is really the principal body charged with reviewing these evaluations, and the individual taxpayer is rarely effectively represented even at the public hearings held by Congress, the outcome is inevitably large public works expenditures. Until such time as the Executive Branch takes available steps to curb its water agencies and taxpayers organize an effective lobby to protect their interests on public works appropriations, there can be little hope of altering the present state of affairs. At present it is only when other interests, such as conservation, are affected, that effective opposition is organized.

The Bureau of Reclamation had called the dams "cash registers." In a statement before the Senate Subcommittee on Water and Power Resources, nuclear engineer Laurence I. Moss called them "subsidy machines." He defined a subsidy machine as:

...a physical object that, to the casual observer, is capable of making money. Its actual role is to divert money from the U.S. Treasury to another bank account while giving the appearance that the money is being earned.

Naturally, Mr. Moss's testimony caused quite a furor in the subcommittee, eight of whose members, including the chairman, are from Colorado Basin states.

THE DAMS ARE WASTEFUL OF RESOURCES

In an area that has precious little water to waste, the Bridge Canyon and Marble Canyon reservoirs would waste, through evaporation, 32.6 billion gallons of water per year — enough to supply a city larger than any in Arizona. This evaporation problem besets all reservoirs, and the Bureau of Reclamation has experimented with the spraying of "anti-evaporants"—monomolecular films of fatty acids. Winds blow the film away, and the Grand Canyon is a very windy place. The Bureau likes to tout the recreational opportunities of its reservoirs, but boating and water-skiing are rough indeed on monomolecular films. The more successful tack, at least politically, is to minimize the importance of evaporation.

Besides evaporation, the Grand Canyon reservoirs would waste water in other ways. Being hydropower dams, their purpose could not be served without a "hydraulic head," that is, until the reservoir level were up to the generator intakes. All the water below the intakes would be unavailable to produce power or to divert for water supply.

Bank storage is a factor for every reservoir, but particularly so in Marble Gorge, which is laced with chutes, holes, and anastomotic tubes. Secretary Udall himself admitted that "preliminary estimates indicate that this bank storage could amount to between 300,000 and 400,000 acre-feet." It is worth repeating that the capacity of Marble Canyon Reservoir would be 363,000 acre-feet.

Once committed to hydropower production, a gorge is lost forever to other purposes other than the few that are compatible (reservoir recreation, for example). And on the Colorado, with its heavy load of silt—annually as much as the entire excavation of the Panama Canal—reservoirs don't last long. Sedimentation figures are extremely unreliable, so accurate estimates are impossible, but Secretary Udall has given the range of 160 to 250 years for Bridge Canyon Reservoir. Once silted in, the reservoir becomes practically useless, except to

support stands of cottonwood and tamarisk. To build a dam that is absolutely unnecessary in such a gorge is wasteful of the future options. And when that gorge is in the Grand Canyon, it is wasteful of some of the world's most impressive scenery and most scientifically valuable areas.

THE DAMS WOULD HARM GRAND CANYON

The real crux of the conservation argument against dams in the Grand Canyon involves the unnecessary damage they would do to a region that has other, higher, uses and the adverse affect they would have on Grand Canyon National Park and Grand Canyon National Monument.

The Grand Canyon of the Colorado River extends some 280 miles, from Lee's Ferry just below Glen Canyon Dam to the Grand Wash Cliffs, some 40 miles beyond the headwaters of Lake Mead. Only the Upper and Middle Granite Gorges are preserved in the national park and monument.

Quite apart from the relation of the dams to the already otherwise dedicated areas of the canyon, the dams would commit, irrevocably and forever, one of the world's greatest natural areas to short-lived single-purpose use. After the reservoirs would have silted up, they would be absolutely useless for power generation, water supply, or recreation, and what had once been an area of scenic, scientific and recreational value would be severely damaged and impaired for further use.

Let us single out a few of the scientific values of the Grand Canyon. First, the Vishnu schist is one of the oldest rock formations exposed anywhere on the face of the earth. Here we have a natural laboratory for geologic and paleontological studies of a continuous spectrum of the earth's history for two billion years. Yet, as a special study committee of the Arizona Academy of Sciences observed, "There is no adequate, up-to-date biological or geological survey of this region." For this reason, the Academy dispatched Dr. Paul S. Martin, a geochronologist, to Washington last year to recommend a moratorium on dam-building in the area. The Academy reported:

Proposed construction of two dams in the Grand Canyon would (1) obliterate a few small prehistoric archeological sites; (2) seriously disrupt and perhaps extinguish a small, poorly known, presumably highly endemic fast water aquatic fauna; (3) drown extensive parts of the natural river terrace and riparian vegetation, the smallest and most vulnerable of the canyon vegetation zones; (4) inundate significant Precambrian outcrops, lava dam remnants, travertine springs, dry caves, and rock shelters likely to contain mummified plant and animal remains of interest to the Pleistocene

studies of both the river and the present vegetation zones.

The range of climatic and vegetation zones in Grand Canyon complex is truly fantastic. As Francois Leydet observed:

Stupendous as the Grand Canyon is in its physical dimensions, climatically it assumes the proportions of a continent. For at the canyon or within a short distance of it, are represented all the climates and associated life zones of the North American continent with the sole exception of the tropics . . . It is perfectly possible in the summer to start the day high up on Humphreys Peak and end it at Phantom Ranch. The distance traveled will have been fifty-odd miles in a straight line. But the journey is equivalent in climatic and vegetational changes to a four thousand mile trip from Point Barrow, Alaska, to Guayamas, Mexico.

BRIDGE CANYON DAM

Bridge Canyon Dam would utterly destroy the Lower Granite Gorge of the Grand Canyon by flooding the inner gorge for some 93 miles. This flooding would extend throughout the 40 miles of Grand Canyon National Monument, thirteen miles along where the river forms the western boundary of Grand Canyon National Park, and a mile or so into the park at Havasu Creek. This part of the canyon is a magnificent display of vulcanism and erosion. John Wesley Powell, who explored the Colorado River just after the Civil War, was not given to poetic flight, but here is an excerpt from his journal:

We have no difficulty as we float along, and I am able to observe the wonderful phenomena connected with this flood of lava . . . What a conflict of water and fire there must have been here! Just imagine a river of molten rock, running down into a river of melted snow. What a seething and boiling of the waters; what clouds of steam rolled into the heavens!

But what about the encroachment upon the national park and monument? Representative Wayne Aspinall of Colorado, Chairman of the House Interior Committee, tried to solve that little detail by abolishing the national monument and changing the boundaries of the national park. This encroachment was minimized even by Interior Secretary Udall, usually noted for his conservationist philosophies, who called it "a peripheral (invasion) which would occur in the most remote and inaccessible area of the park." Since making that unfortunate statement for the record, Mr. Udall has been through the Grand Canyon by raft and has changed his mind. In a recent issue of *Venture* magazine, he wrote:

Havasu Creek, with its cascades and deep side

canyons, is a sensational sideshow, the closest thing to Shangri-La in the canyon. I realized then that the park experts who drew the boundaries for the National Monument were trying to preserve exceptional features of the Grand Canyon.

(Remember that Havasu Creek is where the reservoir would actually back *into* the park, the waters about 90 feet deep at its mouth.)

But, "peripheral" or not, aren't these invasions patently illegal? Yes, even though the dam builders tried hard to build a case on the following language in the act that established Grand Canyon National Park:

Whenever consistent with the primary purposes of said park, the Secretary of the Interior is authorized to permit the utilization of areas therein which may be necessary for the development and maintenance of a Government reclamation project. (emphasis added)

The case for the defense, drawn by Robert W. Jaspersen, Executive Secretary and General Counsel of the Conservation Law Society of America, poked rather large holes in the dam builders' argument.

First, note the phrase, "whenever consistent with the primary purposes of said park."

Section 2 of the Grand Canyon National Park Act clearly indicates that the park is to be administered, protected, and promoted subject to the provisions of the National Park Act of 1916. Section 1 of that act reads:

The service thus established shall promote and regulate the use of the Federal areas known as national parks, monuments, and reservations, hereinafter specified by such means and measures as conform to the fundamental purposes of the said parks, monuments, and reservations, which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations.

Looking into the legislative history of the Grand Canyon National Park Act, one discovers that the original language introduced by Senator Ashurst of Arizona said:

That the United States Reclamation Service may enter upon and utilize for flowage or other purposes any area within said park which may be necessary for the development and maintenance of a government reclamation project.

This language was considered unsatisfactory and the already-cited language substituted, thus clearly intending to put the park under the overall protection of the National Park Act of 1916.

Considering that the dam would certainly damage the "natural and historic objects and the wild life" in the park and monument, that it would impair the enjoyment of future generations, that it is not for reclamation purposes but for power production, and that it is not necessary for the construction or maintenance of the Central Arizona Project, the dam's illegality seems obvious.

MARBLE CANYON DAM

Marble Canyon Dam would flood 40 miles of the Grand Canyon's Marble Gorge, drowning such unique features as Vasey's Paradise and Redwall Cavern. Downstream from Lee's Ferry the canyon walls are sheer cliffs, thus access for boating would become so difficult as to render impossible the boat and raft travel that has become increasingly popular. From Powell's first voyage in 1869 until 1964, fewer than a thousand persons had made the trip. Since the spring of 1965, over 3,500 persons have made the trip, and the National Park Service is expecting over 3,000 more this year. Even assuming that the access problem could be solved, it is doubtful that the 104 miles of river between Marble Canyon Dam and Bridge Canyon Reservoir, including all of the national park, could be used for boating, camping, or any scientific or recreational purpose dependent on rather extended stays. Marble Canyon Dam, if built, would be operated for peaking power. This would cause fifteen-foot surges of water downstream of the dam every day. As Representative Edward Reinecke of southern California—the only engineer on the House Interior Committee—has observed:

Having been at the bottom of the canyon I know of places where you can't get more than two or three feet above the river. This would be an embarrassing situation.

This same peaking power fluctuation would severely damage the canyon's ecology. Dr. Alfred Etter has observed that natural cycles of fertility and feeding would be changed and that "unique natural communities and rare species, millions of years in the making, will be destroyed *both within and without the park*." (emphasis supplied) He ruefully observed that a listing could not be made because very little is known about these communities and species. "They were to be the challenge of a future naturalist."

Nor would the Marble Canyon Dam's effects on the park be limited to ecological disruption. J.W. Stanley of the Bureau of Reclamation, in another context, described the downstream scouring effect of dams on silt-heavy streams. He traced changes below some dams for more than 40 miles; Marble Canyon Dam would be thirteen miles above the park.

And—the final conundrum—if the Bureau of Reclama-

tion operated the dam to permit extensive downstream river travel and camping (thus further diminishing the power values of a "second-class damsite"), the diminished and regulated river flow would be unable to free the debris that piles up at the mouth of the side canyons. These would become natural dams, and river travel would be ended forever, anyway.

Clearly, Marble Canyon Dam would be as much a violator of the national park as the larger downstream Bridge Canyon Dam, and would be a blight on what is today one of the wildest, most spectacular rivers anywhere in the world.

HOOKEER DAM

But, it now appears likely that the Congress will shortly authorize a Central Arizona Project without any dams in the Grand Canyon. Some have, somewhat prematurely, hailed it as a great victory for conservation. Secretary Udall has more soberly described it as "a victory for common sense." But it is only a partial victory at best.

The Central Arizona Project bill that passed the Senate last summer contained a number of dubious features, including one highly objectionable to conservationists: Hooker Dam on the Gila River in New Mexico. It is a shame that the case of Hooker got buried in the furor over the Grand Canyon, for if authorized, Hooker Dam will set a dangerous precedent in its own field. It will back water up into the Gila Wilderness, the first wilderness area established in this country, and it would be the first invasion of a wilderness area since the passage of the Wilderness Act of 1964, establishing a National Wilderness Preservation System. Great efforts have been made to get Hooker Dam taken out of the bill, but with little measurable success. Even now the fate of the Gila Wilderness is being decided, for this week the House Committee on Interior and Insular Affairs began its markup session on the Central Arizona Project legislation.

The case of Hooker is a strange one, indeed. If it weren't so tragic, it would be funny. We don't know exactly what we're fighting and the other side doesn't know exactly what they are defending. For Hooker Dam is to be authorized now and planned later. Its size, design, purposes, even its precise location, are somewhat uncertain.

Hooker Dam is politically inseparable from the Central Arizona Project. It is a project to let New Mexico have a little part of Arizona's allotment of the Colorado River, the price Arizona was willing to pay for New Mexico's support of the Central Arizona Project. Senator Clinton P. Anderson of New Mexico is chairman of the Senate Subcommittee on Water and Power Resources.

Asked what this additional water is for, the State Engineer of New Mexico has answered, "I believe it is axiomatic that if additional uses in New Mexico from the Gila River system are authorized there is no doubt that the water will be used." Parkinson's Law.

That the Hooker project is a great unknown was made abundantly clear last fall. Congressman Saylor submitted to the Bureau of Reclamation a number of detailed questions about the project. The Bureau's answers were mostly based on studies 20 years old, and were otherwise indicative that they, too, were in the dark. Here are two of the answers:

Hooker Dam would not be a viable development, insofar as its contemplated accomplishments are concerned, without the Central Arizona Project. Hooker Dam, on the contrary, is not necessary to the engineering and operating viability of the other portions of the Central Arizona Project.

It is a feature of the Central Arizona Project dependent upon that project; hence, no determination of a separate benefit-cost ratio for Hooker Dam and Reservoir has been made.

Sierra Club members in New Mexico have made a determination of the benefit-cost ratio, and it comes out 0.5 to 1.0.

But no matter, the Bureau of Reclamation is willing to build a dam anytime, anywhere, regardless of purpose, need, or effect on the environment.

Other issues wrapped up in the Central Arizona Project bill, are: five pork-barrel dams on the west slope of the Rockies in Colorado; continued consumptive use of water in Arizona to irrigate low-value feed grains and forage and higher value—but surplus—price-supported cotton; added aggravation of the water-quality problem downstream on the Colorado because of the concentrated salts from further irrigation; the continuing drive of the Arizona Chamber of Commerce to encourage more and more people to move to this land of little water; and the larger question of priorities and values in the development, use, and consumption of our natural resources. And, so far as the Grand Canyon is concerned, it's only safe for now. The damsites remain, the plans are there in the Bureau's files, and the Southwest water "shortage" is sure to continue.

We must begin to get a grip on our ditch-and-dam builders. In 1959, before the construction of Glen Canyon Dam and before the proposal of the Pacific Southwest Water Plan, the U.S. Geological Survey published a circular by Walter B. Langbein on "Water Yield and Reservoir Storage in the United States" that reads, in part, "Although in the East a considerable increase in usable water supply can be obtained by additional reservoir storage, some drainage basins in the

West may already be approaching the limit. . . The Colorado River Basin is an example of a river basin where storage development may be approaching, if not exceeding, the useful limit."

We must begin to recognize the wisdom in these words by Supreme Court Justice William O. Douglas:

When it comes to building dams we should remember that from now on almost every structure will sacrifice scenically important and spiritually important streams and valleys. If we decide to preserve those beauties rather than bury them forever under muddy waters, our decision is at best a temporary one which the next generation can undo. But if we destroy that stream or valley and wipe out that spot of beauty, we must sacrifice it forever. Then men for all future time must live by the choice we have made.

We tend to follow habits in dam building even when hydroelectric dams are becoming obsolete.

We cannot go on with our uncritical acceptance of the projected "needs" for water, or other resources, without weighing the necessary sacrifices, and without looking carefully at those "needs." Are they really needs? Or are they merely "druthers"? As Peter Isaac has so wisely observed, "An analysis of the daily water demand will show that the majority of the uses are 'desirable' rather than 'essential'."

Yet men like Senator Frank Moss and others who should know better are looking to such brinksmanship water schemes as the North American Water and Power Alliance, a grandiose engineering project that would take 30 years and a \$100 billion to build. It is an engineer's Nirvana: the movement of vast quantities of water from one part of the continent to another, from the Yukon to the Great Lakes to the Rocky Mountain Trench to the Southwest to Mexico. It would "amount to remaking the face of North America" (Laas and Beicos). And what would it accomplish? According to its originator, the Ralph M. Parsons Company, it would supply the United States with water for about 100 years. And beyond that? No answer.

We cannot continue this kind of unplanning. Our projections, for population and for resource demands, go to the year 2000 and then, no more is said. Into the twenty-first century the picture becomes so grim that even the engineer fears to tread. We cannot go on doubling our population and tripling our resource demands every ten or twenty years. It all must end sometime, for we live on a planet of fixed size and with a fixed resource base. So let us begin to face the future with reason and hope. Let us exercise our unique ability to make decisions, to control our appetites, to examine our directions.

Joseph Wood Krutch has written:

We do not tear down a high school because the building industry can prove that it could profitably erect an apartment house on the site and that tenants would be glad to occupy it. We say, instead, that education pays off in a different way and that the space occupied by schools is not wasted. Much the same thing we say also of the space taken up by the green of a city square. But if parks and other public lands are to be held only until someone can show that a "use" has been found for them, they will not last very much longer. If we recognize that there is more than one kind of utility and that the parks are, at the present moment, being put to the best use to be found for them, then they may last a long time—until, perhaps, overpopulation has reached the point where the struggle for mere animal survival is so brutal that no school or theater, no concert hall or church, can be permitted to "waste" the land on which it stands.

There is still time left for us to choose the kind of future we want, for ourselves, for our children, and for

all the generations yet to come. If we wait too long, all the important choices will have been made for us, and we shall have to make do with what's left. These are the real questions that concern conservationists.

I would like to close with these words, written by the late Howard Zahniser, who was, for many years before his death in 1964, executive secretary of The Wilderness Society:

Out of the wilderness has come the substance of our culture, and with a living wilderness—it is our faith—we shall have also a vibrant, vital culture, and enduring civilization of healthful happy people who like Antaeus perpetually renew themselves in contact with the earth. . . We are not fighting a rear-guard action, we are facing a frontier. We are not slowing down a force that inevitably will destroy all the wilderness there is. We are generating another force, never to be wholly spent, that, renewed generation after generation, will always be effective in preserving wilderness. We are not fighting progress. We are making it.

REFERENCES

- ¹Ball, Richard H. *The Grand Canyon Dams: A Brief Analysis*. Los Angeles: Sierra Club, Angeles Chapter, December, 1966.
- ²Carlin, Alan. "The Grand Canyon Controversy, or, How Reclamation Justifies the Unjustifiable," No. P-3541. Santa Monica: The RAND Corporation, April, 1967.
- ³Dominy, Floyd. Letter to Honorable John P. Saylor. October 24, 1967.
- ⁴Frauenglass, Harvey. "The Gila Wilderness and the Hooker Dam Proposal," *The Rio Grande Sierran*, (VI:1) January, 1968.
- ⁵Gregg, John. "The North American Water and Power Alliance," *Sierra Club Study Paper*, March 31, 1967.
- ⁶House of Representatives, Committee on Interior and Insular Affairs. *Colorado River Basin Project: Hearings before the Subcommittee on Irrigation and Reclamation*, 90th Congress, 1st session. March 13, 14, 16 & 17, 1967.
- ⁷Isaac, Peter C. G. "The Development of Water Resources," in Arthur Garratt, ed., *Penguin Technology Survey 1967*. Baltimore: Penguin Books, 1967.
- ⁸Laas, William and Beicos, Dr. S. S. *The Water in Your Life*. New York: Popular Library, 1967.

- ⁹Leydet, Francois. *Time and the River Flowing: Grand Canyon*. San Francisco: Sierra Club, 1964.
- ¹⁰Martin, William E. and Bower, Leonard G. "Patterns of Water Use in the Arizona Economy," *Arizona Review* (XV:12) December, 1966.
- ¹¹Moss, Senator Frank E. *The Water Crisis*. New York: Praeger, 1967.
- ¹²Porter, Eliot. *The Place No One Knew: Glen Canyon on the Colorado*. San Francisco: Sierra Club, 1963.
- ¹³Powell, John Wesley. *The Exploration of the Colorado River*. The Natural History Library. Garden City: Doubleday (Anchor) 1961.
- ¹⁴Udall, Stewart L. "Shooting the Wild Colorado," *Venture* (V:1) February, 1968.
- ¹⁵U.S. Department of the Interior. *Pacific Southwest Water Plan*. January, 1964.
- ¹⁶U.S. Senate, Committee on Interior and Insular Affairs. *Central Arizona Project: Hearings before the Subcommittee on Water and Power Resources*, 90th Cong., 1st session. May 2-5, 1967.
- ¹⁷Young, Robert A. "The Central Arizona Project: Which Way Success?" Remarks prepared for presentation to the Tucson Chamber of Commerce, Breakfast Forum, December 15, 1966.
- ¹⁸Zeller, Henry M. *Report on Hooker Dam*. Albuquerque: Sierra Club, Rio Grande Chapter, January, 1968.

WATER RESOURCES, PRESERVATION AND USE

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The invitation extended me to attend this seminar suggested that I discuss some of the philosophy underlying the place of large dams in water resources development, especially as they pertain to the Colorado River Basin. I shall be very happy to do so as I have been interested in the Colorado River since 1933.

A review of water rights concepts is needed to place the Colorado River in perspective. A concise review of water law is given by Trelease (Ref.1). We inherited from England the doctrine of Riparian Rights as part of the Common Law system of government. The owner of the land contiguous to a stream controls the stream and under the Riparian Doctrine equal rights to the use of water were possessed by the owners of the land which bordered or touched upon a stream or water course. Owners of land not touching a water course had no right to the water. According to the natural flow theory the fundamental right of a riparian owner is to have the stream flow as it was accustomed to flow in nature, unimpaired in quality and undiminished in quantity. The Riparian Doctrine still prevails in the Eastern and Midwestern United States and to some extent in Texas and California.

The doctrine of Prior Appropriation which originated with the gold miners in California in 1849 and which was first set forth with greater clarity with reference to the use of water for irrigation in Colorado, has two principles: one, that the beneficial use of water, and not ownership of the land, is the basis of the right to use water; and, second, that priority in time of initiation of beneficial use is the basis of priority of right to water between appropriators in times of shortage.

Saunders (Ref. 2) quoted an 1882 Colorado adjudication on water rights:

We conclude, then, that the Common Law doctrine giving the riparian owner a right to the flow of water in its natural channel upon and over his lands, even though he makes no beneficial use thereof, is inapplicable to Colorado. Imperative necessity, unknown to the countries which gave it birth, compels the recognition of another doctrine in conflict therewith. And we hold that, in the absence of express statutes to the contrary, the first appropriator of water from a natural stream for a beneficial purpose has, with the qualifica-

tions contained in the Constitution, a prior right thereto, to the extent of such appropriation.

The doctrine of Prior Appropriation is also known as the Colorado Doctrine.

The flow of rivers in arid and semi-arid regions, especially in the mountainous West, is seasonal. Most of the streamflow is from snowmelt which produces runoff during the period from April (usually) through mid-July, with the peak of the flows often occurring in May or June. Water for irrigation is usually needed through September in the colder regions, but in Southern California it is possible to grow crops all year. Cities and industries also require water throughout the year. However, the natural flow of mountain streams in arid and semi-arid regions in the fall and winter is a very small percentage of their peak flow. Thus the availability of natural streamflow in arid regions is inadequate for our established way of life. The population of the West would be small indeed if it were dependent on natural flow in the rivers. The construction of dams which impound and store the flood flows, whether they be from rain or from the melting of snow, has made possible the development of the West.

John Wesley Powell was not only a pioneer explorer of the Colorado River Basin but a visionary political philosopher far ahead of his time. Powell proposed what was then a revolutionary concept, that the system of government and the development of natural resources for the arid regions be based upon scientific knowledge of the needs, rather than upon experience in humid lands. Many of his concepts continue to this day, such as river basin planning, water districts as units of self-government, investment of millions of dollars in large dams to control major streams, land classification, and the anti-monopoly provision of the assignment of water rights to the individual owners of the land which still prevails in the 160-acre limitation at Reclamation projects. It was feared that if no limitation were placed on the area to be provided with water from a federally-financed irrigation project, aggressive individuals or corporations might so control the distribution of water as to reduce the actual tillers of the soil to a condition of peonage. Therefore, the original Reclamation project legislation placed a limitation of 160 acres on which water from the federally-financed project could be

**The opinions and interpretations presented in this paper are those of the author and do not necessarily reflect the thinking of Colorado State University.*

applied. In subsequent years the 160-acre limitation was interpreted as applying separately to husband and wife but not to their offspring.

In October 1893, Powell told those in attendance at the International Irrigation Congress in Los Angeles that their optimistic plans of changing the whole West into a Garden of Eden were unworkable. Stegner, in his biography of Powell, quotes him as saying, "I tell you gentlemen, you are piling up a heritage of conflict and litigation over water rights, for there is not sufficient water to supply the land." (Ref. 3, p. 343)

The Colorado River is an international stream. Before entering the Gulf of California the river flows near the Imperial Valley, first reported by the Spanish navigator, Francisco de Ulloa in 1539. Interest was expressed in 1853 in the possibility of irrigating the valley with waters from the Colorado River (Ref. 4). The California Legislature in 1859 asked the United States Congress to cede three million acres of public land to the State of California for reclamation by irrigation, but in 1862 the bill failed to pass. After various attempts the California Development Company, formed in 1896, succeeded in securing sound financing, and construction of the irrigation project began in 1900. By September 1904, 8,000 valley settlers were cultivating 75,000 acres. In 1905 the Colorado River, while carrying a major flood from the Gila River Basin, washed out the heading to the Alamo Canal. The Colorado changed its course and followed the canal to the Salton Sea. For two years the Colorado River flowed into the Salton Sea raising the level about 72 feet and inundating about 330,000 acres. The Southern Pacific Railroad returned the Colorado River into its natural channel.

Thus, under the Colorado Doctrine, California secured a water right to the Colorado years before the Bureau of Reclamation was founded. The Californians have done everything within their power not only to retain, but to increase, at every opportunity, the amount of water available to the state from the Colorado River.

The Colorado River Compact, signed in 1922, divided the flow, assumed to average 15,000,000 acre-feet per year, between the Upper and Lower Basins. The negotiators of the Compact had no way of knowing at that time that the Colorado was in a wet cycle. Therefore, the Compact did not say that there would be a division of the average flows but that there would be an apportionment of 7,500,000 acre-feet per year on the average to each of the Basins. It was assumed that the Upper Basin would deliver to the Lower Basin a total of 75,000,000 acre-feet during any ten-year period. Mathematically this would require a delivery of 7,500,000 acre-feet each year.

The Compact negotiators were so sure in 1922 of a surplus that they assumed there would be a division

roughly on this order: the first 7,500,000 acre-feet among the states of the Lower Basin as follows: California, 4,400,000 acre-feet; Arizona, 2,800,000 acre-feet; Nevada, 300,000 acre-feet, with (according to one interpretation) an additional 1,000,000 acre-feet per year of the assumed surplus. The Mexican Water Treaty of 1944 apportioned 1,500,000 acre-feet per year of the Colorado River flow to Mexico. This commitment was made a part of the Colorado River Compact under the impression that the quantity would be met out of surplus. If the surplus was insufficient then the Upper Basin would meet half of the need.

The apportionment within the Upper Basin was agreed upon in the Upper Colorado River Basin Compact signed in 1948. Arizona, part of which is in the Upper Basin, was allotted a fixed 50,000 acre-feet per year, with the remainder prorated as follows: Colorado, 51.75 per cent; New Mexico, 11.25 per cent; Utah, 23.00 per cent; and Wyoming, 14.00 per cent. The State of Colorado yields over 70 per cent of the contribution of the Upper Basin and about 60 per cent of the total flow of the Colorado River, whereas California produces less than 0.10 per cent of the total flow. The existence of the Colorado Doctrine led to the compromise.

Instead of the assumed 7,500,000 acre-feet per year, the actual volumes available to the Upper Basin during the first few years have been about 6,200,000 acre-feet. According to one estimate, instead of 75,000,000 acre-feet during any ten-year period, the requirements of delivery to the Lower Basin for the various commitments could call for as much as 83,000,000 acre-feet. There has been no critical shortage in the Lower Basin and Mexico as yet, since about 2,000,000 acre-feet per year have been available due to delays in the utilization of waters within the Upper Basin.

California interests were the first to proceed with construction of projects to use California's share. The Boulder Canyon Project Act under which Hoover Dam was built, was declared effective January 25, 1929, construction began in 1931, and the dam was dedicated in 1935. The Upper Basin did not move as rapidly. It was not until 1950 that a detailed plan for the development of the Colorado River Storage Project was prepared. The report dated December 15, 1950 with reviews and comments, was published as House Document 364 (Ref. 5).

The land resources and growth potential of Southern California were recognized as being sufficiently great to consume not only California's portion of the Lower Basin allocation but even the total flow of the Colorado River. Under our form of government, administrations change with elections and therefore the states insisted that the citizens of California, as a whole, go on record as accepting the apportionment. This led to the passage

by the California Legislature of the Self-Limitation Act.

As the development of the Upper Basin was slow, for a number of years waters allocated to the Upper Basin were physically present in the Lower Basin and the Secretary of the Interior, on a temporary basis, permitted California to divert considerably more than 4,400,000 acre-feet a year. With this additional water, Southern California expanded to a point where it claimed that it could not survive with the amount agreed upon in the Self-Limitation Act.

Arizona also was much slower than California in using its Lower Basin apportionment. Construction began in 1934 on Parker Dam, from which the Metropolitan Water District pumps water into its Colorado River Aqueduct to Los Angeles. While construction was under way, dissatisfaction with the progress of negotiations with California led the Sovereign State of Arizona to occupy its side of the construction site with the military forces at its command, the Arizona National Guard. Construction was delayed for about one year, and Parker Dam was completed in 1938. Apprehension that Arizona might lose its share in view of increasing use of the water by California led ultimately to the Arizona-California U.S. Supreme Court litigation of 1963. This resulted in re-affirmation of the apportionment of waters and in another recognition of the solemnity of California's Self-Limitation Act to 4,400,000 acre-feet.

The States of Colorado and Utah thoroughly recognized the importance of protecting allocations of water long before there were compacts. For example, a part of the area which later was included in the Dinosaur National Monument, had a reclamation withdrawal dated August 17, 1904 for the Brown's Park Reservoir site in connection with the Green River Project.

Let us look into the history of the national monuments. They are created under the authority of "An Act For the Preservation of American Antiquities," (34 Stat. 225) of June 8, 1906. Section 2 of this Act is quoted in part with the italics which I have added:

SEC. 2. That the President of the United States is hereby authorized, in his discretion, to declare by public proclamation historic landmarks, historic and prehistoric structures, and other objects of historic or scientific interest that are situated upon the lands owned or controlled by the Government of the United States to be national monuments, and may reserve as a part thereof parcels of land, *the limits of which in all cases shall be confined to the smallest area compatible with the proper care and management of the objects to be protected.*

Upon establishment of the National Park Service by the Act of August 25, 1916, the national monuments were

placed under the administrative structure of the National Park Service, but, in my opinion, the Act of 1916 did not set aside the precise objectives pertaining to national monuments of the Act of June 8, 1906. It is true that many national monuments, in addition to meeting the requirements for historical and scientific interest, are endowed with scenic features and have recreational potentialities.

The Dinosaur National Monument was created by a proclamation signed by President Woodrow Wilson on October 4, 1915. The Colorado River Storage Project (Ref. 5) included among others the Echo Park Reservoir located in Colorado just below the confluence of the Green and the Yampa Rivers. In planning the dam and reservoir the engineers, in possession of the reclamation withdrawal of October 17, 1904, and in deference to the proclamation of President Woodrow Wilson of October 4, 1915, so designed the Echo Park Dam and Reservoir that none of the structures or features of the project would intrude upon the original area of the monument which includes fossil deposits and monument headquarters.

The engineers felt secure in planning Echo Park Dam and Reservoir this way, in view of the Proclamation of July 14, 1938 enlarging the monument, which stated that:

The Director of the National Park Service, under the direction of the Secretary of the Interior, shall have the supervision, management, and control of this monument as provided in the act of Congress entitled "An Act to Establish a National Park Service, and for Other Purposes," approved August 25, 1916, Thirty-ninth United States Statutes at Large, page 535 (U.S.C., title 16, secs. 1 and 2) and acts supplementary thereto or amendatory thereof, except that this reservation shall not affect the operation of the Federal Water Power Act of June 10, 1920 (41 Stat. 1063), as amended, and the administration of the monument shall be subject to the reclamation withdrawal of October 17, 1904, for the Brown's Park Reservoir site in connection with the Green River Project (Ref. 5, p. 216).

Announcement of the Echo Park Unit precipitated an immediate assault by the Sierra Club. After extensive review, Oscar L. Chapman, Secretary of the Interior, in his memorandum to the Commissioner of Reclamation dated June 27, 1950, (p. 218, Ref. 5) expressed his conviction that the plan for the construction of Echo Park Dam was in the highest public interest and ordered the National Park Service and the Bureau of Reclamation to cooperate in making plans that would assure the most appropriate recreational use of the Dinosaur National Monument under the circumstances.

The Sierra Club is proud of the fact that they defeated the water resources engineers on the Echo Park Dam. To what extent was the Sierra Club actually interested in preserving the modified boundaries of a cemetery of fossilized dinosaur bones? Was the Sierra Club's objection to Echo Park Dam the result of infiltration by those seeking to interpose a delaying tactic to stall water use in the Upper Basin in the hope that the water would become available at some future date for reapportionment? Was the carefully organized assault a deliberate attempt by some to use the preservationists to undermine the validity of all withdrawals for multiple-purpose water resources projects? I cannot answer these questions but the answers may not be long in coming.

Recently the United States Government has asked the Sierra Club to show cause why it should continue to retain its tax-exempt status as a presumably non-profit, charitable, philanthropic organization engaged only in promoting the public good. The Sierra Club engaged in certain lobbying activities which precipitated this action. Undoubtedly the Sierra Club will challenge the loss of tax-exempt status and perhaps in an ensuing Congressional investigation of the activities and financing of the Sierra Club, this and many other questions will be answered.

Let us see exactly what the Sierra Club accomplished with the attainment of which it is so proud, the stalling of Echo Park Dam. No information has reached me concerning the research conducted in the area to be occupied by Echo Park Reservoir since the time of the postponement of that project. It would appear desirable in view of the importance of Echo Park Dam to the Colorado River System that scientists and preservationists exert all their energy in performing their studies at the reservoir site. Of course, under the Antiquities Act, when a project is authorized and when there is Congressional approval for such use of funds and when appropriations have been made, archaeological and other studies can be performed.

Archaeological studies are referred to in the Antiquities Act (34 Stat. 225) of June 8, 1906, the same act which authorized national monuments. Section 3 of this act is quoted in full:

SEC. 3. That permits for the examination of ruins, the excavation of archaeological sites, and the gathering of objects of antiquity upon the lands under their respective jurisdictions may be granted by the Secretaries of the Interior, Agriculture, and War to institutions which they may deem properly qualified to conduct such examination, excavation, or gathering, subject to such rules and regulations as they may prescribe: provided, that the examinations, excavations, and gatherings are

undertaken for the benefit of reputable museums, universities, colleges, or other recognized scientific or educational institutions, with a view to increasing the knowledge of such objects, and that the gatherings shall be made for permanent preservation in public museums.

Sooner or later consideration will be given to the elevation of the Dinosaur National Monument to National Park status. It would seem logical that this step be taken together with authorization of appropriations for Echo Park Dam so that the best possible integration of effort between the National Park Service and the Bureau of Reclamation could be carried out.

The Echo Park Dam site, so far as evaporation loss is concerned, is one of the best in the West. Not only is it a relatively high altitude reservoir, but the depth of the waters and the narrowness of the canyon, coupled with the shadows cast on the exposed water surface by the towering canyon walls, would reduce very greatly the evaporation loss. A decrease in the average annual water yield of the Colorado River, according to hydrologic computations, will require longer periods of carry-over storage, if the commitments to the Upper and Lower Basins and Mexico are to be even partly satisfied. I sincerely believe that Echo Park and Cross Mountain Dams should be built as soon as possible.

The Sierra Club has bemoaned what they call the "loss" of Rainbow Bridge. Prior to the partial filling of Lake Powell, the recorded number of visitors who made the physically arduous, expensive, and time-consuming trip to the Bridge added up to 14,343. During the period 1958-62, 23,890 people visited Rainbow Bridge, and from 1962 through mid-March of 1968 there were 63,342 visitors. The trip is now made chiefly by boat, subsequent to the closure of Glen Canyon Dam on March 13, 1963, through the inspiring reaches of the Canyon, followed by a short walk to the Rainbow Bridge. Elderly people and small children are able to enjoy the trip, while before only those able to hire a pack train or capable of carrying water and food for survival in their back packs, could reach it. The Sierra Club never stated just exactly who "lost" the Rainbow Bridge. Certainly not the thousands of people who enjoy seeing it now.

From the date of its founding in California by John Muir in 1892, the Sierra Club has in most instances taken an uncompromising position in its endeavors to preserve scenic values against any encroachments whatever except its own. For example, when Stephen T. Mather, who was the first Director of the Park Service, began in 1923 a campaign for road-building appropriations to provide access to the national parks, the preservationists of the Sierra Club opposed him.

The attitude of the Club in its campaign to

sequester the Rainbow Bridge from the public is not new. The following quotation from page 298 of Frank E. Smith's book, *The Politics of Conservation* (Ref. 6) expresses precisely the current attitude of the Sierra Club concerning the development of the water resources of the Colorado River:

Too much of the preservationist-conservationist doctrine has implied a "special elite" concept which suggests that the wilderness values are to be preserved for only that small fragment of the population considered capable of proper appreciation. Too many preservationists have made this clear in their abhorrence of the great masses of people drawn to some of our national and state parks. They would like to restrict use of a major part of the public domain to only those people with the proper cultural depth or the physical hardihood to appreciate it as they do, and they have an unfortunate tendency to brush aside all arguments for popular use as "desecration."

Let us now go down river below Grand Canyon to the two dams which formed a part of an earlier Central Arizona Project concept. They are the Marble Canyon Dam upstream from the Grand Canyon National Park, and the Hualapai Dam (formerly called Bridge Canyon) downstream. A new approach to the Central Arizona Project currently under consideration by the Congress does not include either Marble or Hualapai Dams.

Few of us take the time to realize how important electric energy is in our daily lives. Whenever we throw a switch and direct a stream of electrons to whatever use is required, such as lights, pumps, TV, or refrigerators, somewhere in the system connected to our switch there must be a generator capable of accepting the load without faltering or losing its synchronous speed in the interconnected alternating current system. In other words, there must be a spinning reserve ready to deliver power. The thermal power installations are excellent for the steady delivery of the so-called "firm power" but they are at a great disadvantage when a sudden increase in load is required. Generators tend to slow down when overloaded and thereby get out of synchronization. If they deviate too far from the required frequency, protective devices disconnect the generators from the lines. In a steam plant this must be followed immediately by blowing off the boiler pressure and extinguishing the furnace. Every electrical energy generating system requires some so-called "peaking" capacity to take care of changes in power demands.

The massive blackout in the Eastern United States a few years ago was a result of a failure to supply peaking power which progressively cascaded like a row of falling dominoes, and knocked out the generating facilities supplying power to about 30 million people.

Eight hours or more may elapse before a steam turbine-driven generator can be connected to a distribution system; the ideal peaking power is hydroelectric. For example, the Public Service Company of Colorado, a privately-owned utility, has just placed in operation in the mountains west of Denver their Cabin Creek Project. This facility cost about \$39 million and provides 324,000 kilowatts of almost instantly available electric energy. The hydropower generators can be on the line from a standing start in less than five minutes and, if idling at synchronous speed, they can go from no load to practically full load in less than a minute. The Public Service Company found it worthwhile to invest \$39 million in this project because its presence made it possible for the company to run its thermal plants in Denver at practically full output even during off-peak times of the day, the energy in excess of demands being used at Cabin Creek to pump water to the upper reservoir. Specially designed power plant machinery performs either as a turbine-generator or motor-pump. At times of peak demand the Cabin Creek station uses the water to generate power, providing the Public Service Company and interconnected systems with very wide flexibility.

Floyd L. Goss, Chief Electrical Engineer and Assistant Manager of the Los Angeles Department of Water and Power, presented at a recent Congressional hearing, a plan to build a dam and power plant, upstream from Lake Mead, at relatively little expense to the federal government, if the project were to be a partnership. Goss's plan is completely separate from the Central Arizona Project currently under consideration. Goss proposes a pumped-storage power plant. The dam would be built near the old Bridge Canyon Dam site. (The exact site of a major dam is chosen, usually, after it is certain that construction will proceed. For example, Hoover Dam—originally named Boulder Dam—was built in Black Canyon, not in Boulder Canyon). This pumped-storage project would have a capacity of 5,000,000 kilowatts, which is about four times as great as that of the Hoover Dam power plant.

As the population concentrations and industrial demands of Southern California and the Southwest increase, so does the necessity of providing peaking power. An alternative to Goss's pumped-storage dam is the installation of combustion turbine-driven generators. These are coming into use in areas deficient in hydropower. To provide the equivalent peaking power for the Los Angeles Department of Water and Power there would have to be 40 units, each having the capacity of 125,000 kilowatts. The units would be fired with either gas or oil. The combustion products of natural gas do not have a significant air pollution effect other than to increase carbon dioxide content of the atmosphere. Most

furnaces at steam electric generating plants have been designed in recent years to operate on either coal, gas, or oil. When on oil, the 40 units would burn 11,000,000 gallons of oil per year. The burning of oil contributes to the air a variety of nitrogen and sulphur compounds and of various organic substances. In the presence of sunlight and water vapor, extremely complex transformations occur resulting in the creation in the atmosphere of the whole spectrum of nitrogen and sulphur families of acids and of the synthesis of ozone and of several hundred highly complex and, in many cases, irritating and toxic organic substances. A detailed discussion of air pollution and the complex photosynthetic chemistry of smog is beyond the scope of this paper. However, it is obvious that the burning of possibly eleven million gallons of oil a year in the Los Angeles Metropolitan area could hardly be considered a forward step for air pollution abatement.

People are more important than rocks and construction of the pumped-storage project is of tremendous importance not only to the people living in the Southwest but also to the nation as a whole, in view of the concentration of educational, research, and industrial facilities in that area and its importance to national defense.

The frantic efforts of the "special-elite" preservationists to ascribe to those portions of the Colorado River Canyon upstream of Lake Mead unique and elsewhere non-existent scenic, ecological, archaeological, geological and biological attributes have failed. After all, about one hundred miles of the Grand Canyon would remain after the pumped-storage dam is built.

The quintessence of perhaps a thousand pages of testimony is quoted from the remarks of Morris K. Udall, Representative in Congress from the Second Congressional District of the State of Arizona, as they appear on Page 983 of Reference (8):

Professor Dobyns has also made the following observations concerning the construction of Bridge Canyon Dam which, I believe, are food for thought in our deliberations here:

- (1) If a dam kills a river, then the several dams already on the Colorado have left it already quite dead.
- (2) Saving the geological and archaeological features is much better done with a systematic search of the kind made when Glen Canyon was closed against boaters picking up unrelated pieces for souvenirs.
- (3) Those who are concerned over archaeological remains of Indians ought to be equally concerned about living Indians whose future is tied to the construction of the dam.

Parenthetically, Professor Dobyns questions aloud the advisability of preserving these archaeological sites as "... a wilderness playground in which the Hualapais and the Havasupai Tribes would be living museum exhibits."

The Goss plan for a pumped-storage reservoir and power plant on the Colorado River above Lake Mead should be authorized for immediate construction, in my opinion.

The Denver Post for Monday, March 4, 1968, reported a controversy in New Mexico over the Hooker Dam and Reservoir. This is included in the Central Arizona Project Bill now under consideration by the Congress. It would provide a facility through which the State of New Mexico would be able to use some of the water apportioned to it under various compacts. Once again the preservationists are raising the cry "dangerous precedent" as they have done before. The Gila Primitive Area was so designated informally by the Regional Forester of the U.S. Forest Service in 1924. The Forest Service on June 8, 1933 established both the Gila and Black Range Primitive Areas.

When Acting Chief of the Forest Service Earl W. Loveridge classified the Gila as a Wilderness Area on April 3, 1938, his designation acknowledged the then remote possibility of a demand for a license from the Federal Power Commission for a water power development on the Gila River.

An amendment to the 1938 classification was made in 1953 by Charles Brannan, Secretary of Agriculture, establishing the Gila as a Wilderness Area. The Gila Wilderness Area was set aside, again, under the Wilderness Act of September 3, 1964 (78 Stat. 890). Section 4 (4) of this act is quoted:

(4) Within wilderness areas in the national forests designated by this Act, (1) the President may, within a specific area and in accordance with such regulations as he may deem desirable, authorize prospecting for water resources, the establishment and maintenance of reservoirs, water-conservation works, power projects, transmission lines, and other facilities needed in the public interest, including the road construction and maintenance essential to development and use thereof, upon his determination that such use or uses in the specific area will better serve the interests of the United States and the people thereof than will its denial; . . .

Once again the preservationists are taking steps to block the progress in New Mexico of a water resources project in a state where water resources are extremely limited.

There is another instance of the obstructionist tactics

of the preservationists; I refer to the participating projects in Colorado of the Colorado River Storage Project. The five projects included as part of the Central Arizona Project, Bill HR 3300 currently under consideration by the Congress, are: Animas La Plata, Colorado - New Mexico, and four others completely in Colorado: Dallas Creek, Dolores, San Miguel, and West Divide. A Colorado outpost of the Sierra Club, operating with others under the title, "Colorado Open Space Coordinating Council, Inc.," with headquarters in Denver, has issued a statement prepared by the Grand Canyon Workshop of the Colorado Open Space Council, dated February, 1968 (Ref. 9). The report points out that the cost-benefit ratios of the five participating projects are not as favorable as those of other projects. They recommend that the five projects, with an estimated aggregate total cost of \$360 million, would be an unnecessary waste of money and should not be authorized because the portions of Colorado in which they are located contain scenic and recreational resources.

The five participating projects together would provide irrigation water for about 218,910 acres in western Colorado, of which 121,690 acres would receive full supply and 97,220 acres would receive supplemental water. The five projects would also provide 205,000 acre-feet of water annually for the municipal and industrial needs of a rapidly increasing population and for the increasing development of mineral and other natural resources of the region.

Remember that the State of Colorado produces 72 per cent of the flow of the Colorado River for the Upper Basin and almost 60 per cent of the total flow of the Colorado River at the International Boundary. The inclusion of the five participating projects in HR 3300 is in effect an acknowledgment of the State of Colorado's importance to the Colorado River Basin. While objecting to the five projects, the Denver-based preservationists offer no alternative plan through which the State of Colorado could make use of the Upper Basin water apportioned to it under the Compacts.

In a basin-wide development not every activity is expected to support itself completely. Power revenue makes possible irrigation development. That is why we have Basin accounts. For example, in the St. Lawrence Seaway the power income is paying for the dams, spillways, and certain river improvements, while navigation tolls pay for certain channel improvements and maintenance.

Water resources development engineers have contributed tremendously to public recreational facilities. A list of facilities provided by the U.S. Army Corps of Engineers, the Tennessee Valley Authority, and by numerous state, municipal, and industrial organizations would be a very long one. Since this paper has dealt

primarily with western reclamation activities, I quote Michael J. Kirwan from Reference (10):

Thus, to recapitulate, I find that Reclamation is a gilt-edged investment in our future because: . . . It has provided 219 public recreation areas with 1.6 million acres of water surface and 10,955 miles of shoreline available for recreational purposes. The Bureau of Reclamation has cooperated with appropriate federal, state and local agencies in stocking the lakes with fish and managing them for maximum public benefit. Under these circumstances, I do not see how anyone can fairly challenge the value and critical importance of reclamation in our national life. (Paragraph no. 6)

The complex maneuverings of "special-elite" preservationists in interfering with planned water resources development of the West could, if permitted to continue, have a devastating effect on the future of the nation as a whole. There is no doubt that the demands placed upon the water supply of the Colorado River exceed the natural water yield of the drainage basin. It is just a matter of decades before the same can be said of all the river basins including those in Pennsylvania and the Northeast.

For example, the importation by the Colorado River Basin of a volume of water equivalent to only two to three weeks' flow of the Columbia River would be enough to permit full development under the Colorado River Compacts and also provide water which the United States of America promised Mexico in the Water Treaty of 1944. When one considers the history of utilization of the water resources of the Colorado River Basin, the reluctance of the Northwestern States to even talk about export of their waters becomes understandable.

The recent presumptions by the Sierra Club that any water resources development in an area of potential value to a state is to be blocked because it is an encroachment on the national park and national monument system and an interference with the wild lands which must be reserved for the "special-elite," has reached a degree of degeneration which makes it logical to require complete reappraisal of the whole concept of unequivocal reservation of land for recreational purposes.

The North American Water and Power Alliance (NAWAPA) concept, discussed by Kelly (Ref. 11) and Senator Moss (Ref. 12) would tie together the water resources of most of the Continent, from Alaska south to Mexico and Texas, and east through New York and New England. As the population of the Continent doubles or triples the Alliance in some form or other becomes inevitable. For the United States this may never be unless we demonstrate to the Canadians that we are capable of managing intelligently the water resources

within our boundaries. What we accomplish with the Colorado River Basin and how we proceed to do so is of

overwhelming importance to the orderly development for the public good of the water resources of North America.

REFERENCES

¹Trelease, Frank J., "Legal Contributions to Water Resources Development," pages 5 to 11 in Report No. 2, "Lectures on Law in Relation to Water Resources Use and Development," published by the Institute of Water Resources, The University of Connecticut, March 29, 1967.

²Saunders, Glenn G., "Colorado Water Law," a lecture given at Colorado State University Feb. 29, 1968 and sponsored by the Dept. of Civil Engineering, Fort Collins, Colo.

³Stegner, Wallace, *Beyond the Hundredth Meridian - John Wesley Powell and the Second Opening of the West*, 1954 Sentry Edition, Houghton Mifflin Company, Boston, 1962.

⁴Anonymous, "Reclamation Project Data," U.S. Dept. of the Interior - Bureau of Reclamation, U.S. Government Printing Office, 1961.

⁵HD 364, Colorado River Storage Project, Letter from Assistant Secretary of the Interior, transmitting, A Report on the Colorado River Storage Project and Participating Projects, etc., ordered to be printed Apr. 6, 1954, 83rd Congress, 2nd Session, House Document No. 364.

⁶Smith, Frank E., *The Politics of Conservation*, Pantheon Books, Random House, New York, 1966.

⁷Robertson, L. M., F. W. Eastom, Bernard Eyden, Ray Dunaiski, L. S. Burt, C. W. Hubbard, Jack Howe, Paul Johrde, "The Cabin Creek Pumped-Storage Hydroelectric Project - Performance and Field Testing," a paper presented at a joint meeting of IEEE and ASME, Denver, Colo., Jan. 12, 1968.

⁸Lower Colorado River Basin Project, Hearings before the Subcommittee on Irrigation and Reclamation of the Committee on Interior and Insular Affairs, House of Representatives, 89th Cong., 2nd Session on HR 4671 & similar bills, May 9-13 and 18, 1966, Serial No. 89-17 Part II.

⁹Weiner, Eugene R., "The Five Colorado Projects, A Statement prepared by Grand Canyon Workshop of the Colorado Open Space Council, Inc., Eugene R. Weiner, Chairman," published by the Colorado Open Space Coordinating Council, Inc., Denver, Colo., Feb. 1968.

¹⁰*Congressional Record* - Proceedings and Debates of the 90th Congress, 1st session Vol. 113, No. III, Wed., July 19, 1967. Extension of remarks by Mr. Edmonson which include a report by the Hon. Michael J. Kirwan of Ohio, entitled, "Reclamation - A Gilt-Edged National Investment."

¹¹Kelley, Roland P., "North American Water and Power Alliance, Part 1: The Concept," *GeoScience News*, Vol. 1, No. 2, Nov.-Dec. 1967, pp. 8-11, and 27-28.

¹²Moss, Frank E., "North American Water and Power Alliance, Part 2: The Political Problem," *GeoScience News*, Vol. 1, No. 2, Nov.-Dec. 1967, pp. 12, 30-32.

WATER — ITS PRESERVATION AND USE

By Roderick M. Vandivert

Executive Director

Scenic Hudson Preservation Committee

Any examination of this kind needs a series of definitions. So first I will define conservation as we see it.

There are really three kinds of conservationists: First, the "ultra," who are preservationists whose philosophy is a bit unreal. It's a sort of "stop the world, I want to look at it" approach to resource use. In view of a growing America, this is simply not a possible or practical viewpoint.

Next, there is the present national philosophy which is really one of beautification: "paint it green and all will be well, particularly if you plant a tree beside it." Again, not a terribly practical way to fight water pollution, air pollution or any of the resource shortages that we seem to be creating for ourselves.

The approach which we at *Scenic Hudson Preservation Conference* like to assume as the logical position is one of using and yet respecting our resources — not destroying unnecessarily. Yet we do not espouse preservation simply for the sake of preservation, nor preservation at the cost of needed works.

One other point which I should like to make completely clear is that conservation battles, whether they be at Storm King on the Hudson, or somewhere else in the country; or whether they be over basic resources, are not matters of the good fighting the bad, but rather a clash in ideologies.

Those who are thoroughly engineering-oriented always look at the works of nature with an eye to using them; an eye to "improving them for man's use." Any engineer worth his salt would look at Storm King Mountain and wonder what power potential there was in that great drop from the 1,200 foot level to the river. Or, he might be able to estimate just how much could be taken from this natural rockpile and how many million truckloads could be used to build roads or fill swamps and river beds for the good of man, or to build monuments for man to gaze upon. The loss of tremendously scenic areas would probably not even be thought of, for the discipline within which he works would not allow that consideration.

I am sure that a truly sophisticated builder would look at the same mountain and simply wonder how you could get roads to all the houses that could be put on the mountainside and how best they could be served with the various works and alterations necessary, while improving the area, of course!

By the same token, a biologist looking at the river and the mountain would realize that here is something

already serving man— not only as a recreation area but an area in which natural resources abound. A source of fresh water, a river full of fish, an important, multipurpose reservoir of natural resources — all there for the good of present and future generations and for use by present and future generations.

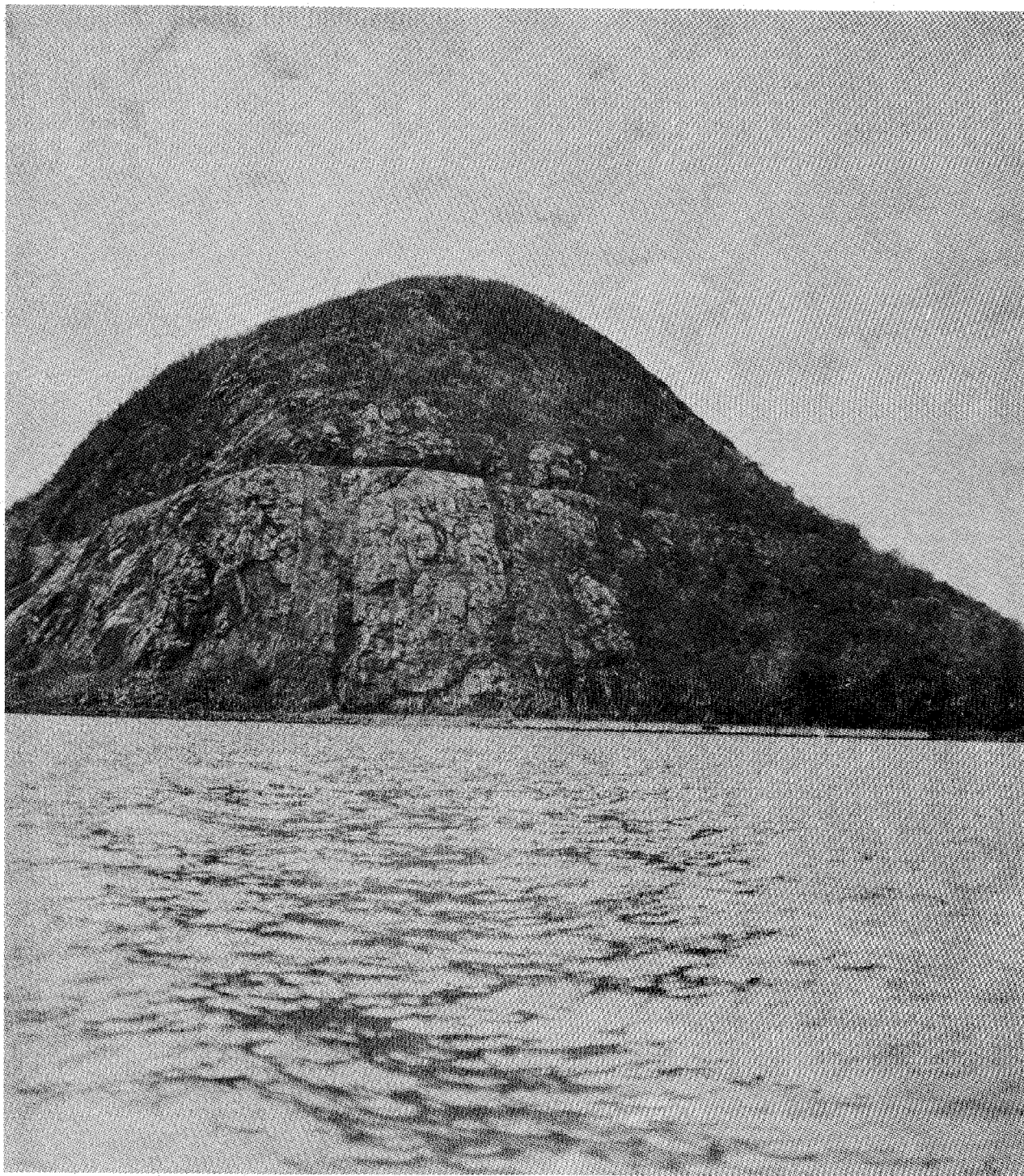
Not one of these people is completely wrong within his own frame of reference. The real problem is we have had virtually no communication between broadly diverse disciplines. Our environment now shows the result of an over-emphasis on engineering potentials and engineering activities.

Economy of production has, in many instances, been the guideline by which waters of our rivers and lakes have been brought to their present quality. The air which lies over our cities in a blanket of soot and smog is again the result of narrow considerations and a lack of foresight on the part of developers and planners. These people were not entirely wrong within the frame of reference they operated: they simply did not understand the need for another discipline, for another viewpoint; for a longer and broader plan based on a balanced growth. In their philosophy, resources are simply things which can be assessed at some later date and, if necessary, replaced, rebuilt or synthesized.

It is now time for our resources to be regarded with a much more realistic view than that of our forefathers or even that of engineers and economists. It is this view which the conservationist who considers resource use is now trying to bring into our society. It is this view that I will try to approach in my discussion today. Most natural scientists warn of dwindling resources being used rather recklessly by industry and the public. Obviously, we cannot preserve *all* natural resources; we must, however, view each as an irreplaceable and enormously valuable contribution to present and future growth and development.

We are now at the point where the conservation, preservation and use of our resources is the business of both industry and citizen. Government has proven that it is unable to cope with various pressures competing with the preservation, wise use or even controlled use of natural resources.

I believe the two areas which I would like to discuss will clearly indicate this. Both of them involve water resources. One is a mountain 50 miles north of New York City on the Hudson River and the other is a wetland area 30 miles east of New York City on Long



A view of Storm King Mountain showing the present rugged quality. The plant site is at the far right of the picture. The blight which Con Ed mentions can be removed without the major and irreparable alteration required for their project.

Photo Courtesy of Scenic Hudson Preservation Committee.

Island. Both are spectacular in their own way; both productive as they stand; both of great value to present and future generations — without alteration. Both are extremely vulnerable to alteration because of their proximity to New York's expanding environs. Both have a delicate balance of nature. Since the early 1600's both have been known to be highly valuable, highly attractive and highly desirable.

On the east side of New York City is the salt marsh, or wetland, just beyond the Queens line — the Hempstead wetlands. Diaries as early as 1650 tell of great use of its highly productive waters, hundreds of varieties of birds, many of them harvestable, of fish abounding in variety and size, of shellfish available for anyone, of marshes from which salt hay and other products were taken. Many of these islands are named after the early families who had been granted the right to farm them: Smithmeadow, Pettit Marsh, Parsonage Island. Others were named for resources. Sea Dog Island, just behind the Barrier Beach, was the island from which seals were taken (seal oil lamps were the source of lighting in that area in the early 1600's). The wetland area remained tremendously productive despite all that man did.

From the early 1600's to 1950, oysters were produced in this area and were used and eaten locally and shipped to other markets. Despite all the use that man made of this resource both for recreation and for economic gain, nature had provided a multi-purpose, highly productive area which did not succumb to the works of man, until finally the changes in waterways, the lack of knowledge, the encroachments and irrevocable alteration of a modern and sophisticated engineering society overdid it.

Much of this, of course, was due to the lack of general knowledge of estuarine values; much more of it was due very simply to the lack of planning on the part of those who did know. Nassau County, in which this wetland span exists, is one of the fastest growing, most badly planned segments of our present megalopolis. For in the urgency of development and the lack of planning that went with it, there was no regard for the resource planning of the wetlands and adjacent waterways. Even fresh water supplies were considered limitless.

There was no understanding that this wetland was a delicately balanced natural water resource. The shallow bays were regarded as a sand mine bordered by an ugly marsh to be filled with sand. And areas immediately adjacent to New York — areas vital for recreation for a teeming mass of people yet to come — were simply filled and became an urban sprawl — a sprawl of people demanding more of the recreation which they and their builders were destroying — demanding the marine products which they were crowding out of existence.

By the mid-1950's, the oyster production had gone

from the area. By the mid-1960's, clam production was off so badly that all of the commercial interests and most of the private interests were going elsewhere. As of now the area has been protected. Much of the protection is too late to maintain the quality and the productivity of the water.

Here is an example of a classic abuse of a water resource — use but not enough preservation. Research, understanding and proper use policies could have precluded much of the loss. Unfortunately, these did not exist. Prior to 1960, weak government agency protests accompanied all of the destruction. They were unable to check it, however, until in the very early 1960's when a strong citizens' reaction began. With the help of informed citizens, government agencies were able to establish sound use and principles and now a 16,000-acre parcel has been set aside in perpetuity for conservation and recreation purposes.

This was the result of seven years work on the part of a strong citizens' organization, bringing to it thousands of supporting members and federal and state agencies finally supported by local people as they became aware of the problems created by development. Policies have been changed and there is still a highly productive recreation area. It has been greatly diminished, unfortunately, through the non-planning of many years, but it still is of great value and it will become more and more valuable for its use as a water resource in a growing society which demands more and more recreation area, which will do more fishing, more waterfowling, and in due time, with proper management, will go back to clamming in these waters and getting a good harvest.

As New York grows and surrounds this area, wise use and care will maintain the value and will insure the proper use and preservation of this water resource. Good planning and the introduction of conservation principles along with use principles can insure perhaps another 300 years of value coming from this area.

Already, however, encroachments, roadways, other pressures are threatening to further diminish the quality of this important, useable water resource. Unfortunately, growth and civilization are still equated rather closely with the amount of concrete that can be poured over any given area, whether it be compatible to a resource or not; whether it diminish ultimate use of the resource or not; and whether there are alternatives or not.

Again, one of the most important criteria is whether a project, development, or an alteration of nature is absolutely necessary. If it is necessary, certainly we must at least be completely aware of the long-term loss in terms of the short or long-term gain through the alteration. Instead, unfortunately, we seem to think in terms of taming and modifying and changing nature in a manner we feel God might have done had He had the

time and the budget. As yet, though, we have not really proven our superiority in planning for nature and for the use of natural resources.

A classic example of the kind of development which is done for the sake of development is the proposed Storm King project of Consolidated Edison Company. The inspiration for this project was simply the measurement of the mountain.

The engineers of a utility up on the Hudson River near Poughkeepsie were terribly impressed by the potential generation of power at the Storm King site, but thought it was far too impressive a project to meet their power needs. So they called Con Edison's attention to this great resource. At the time, Con Edison's management felt a need for a new and impressive pioneering project in order to boost its image, its stock and its peaking capacity. In 1962, Consolidated Edison announced that Storm King would be the site of the world's largest pumped-storage hydroelectric plant.

Initially the project was designed to be cut into the face of the mountain. It was to be a massive generator facing the river on the eastern shore in a quarry-like cut 600 by 800 by 300 or 400 feet high, connected to an upper reservoir by a 40-foot tunnel through the mountain. The reservoir was to be on a site of a fresh and pure water reservoir serving the village of Cornwall.

The site of the present fresh water reservoir is in a semi-wild forest which has long been a research laboratory for Harvard University, which uses it for silviculture and other forest management projects. It has also been a favored spot for hikers and for local people who want to get away from it all.

The reservoir to be replaced by the utility's basin is the topmost of a series of mountain reservoirs connected by underground water courses. These serve the local community and surrounding countryside, and are part of a mountain water system that has yet to be fully researched.

The planned generating station was originally designed to be cut into Palisades Park property and in private meetings with the park commissioners, led by Governor Rockefeller's brother, Laurence, it was decided that there would be no opposition if the project were moved north of the park property to the base of Storm King Mountain.

Apparently the thought of no opposition delighted the utility so it moved the power plant to the base of Storm King Mountain on privately owned lands, announced that home owners would have to move or face condemnation, and began its preparations. In the meantime, notices were run in the county seat of Orange County and the Goshen newspaper — circulation about 2,000 — that there would be hearings before the Federal Power Commission in Washington.

Almost simultaneously, Scenic Hudson Preservation Conference was formed. The fight was one primarily of preserving a scenic resource. The thought of replacing the rugged face of the mountain with a massive power generating plant and all of its attendant works in a quarry-like gash was more than those who loved the mountain could stand. And they formed an *ad hoc* group to fight this intrusion.

During the early hearings in Washington they were represented as well as they could be, but they were poorly organized and poorly financed. The first 4,000 pages of testimony indicated that the Federal Power Commission and the utility had set about to do a *pro-forma* job and over-ride the usual small storm of protest that attends a major change in nature.

It was apparent that the first hearings were terribly inadequate. But the people whose basic interest was scenic beauty gained strength through public awareness of the project. Those whose interests were resources became aware of dangers as the magnitude of the project was revealed.

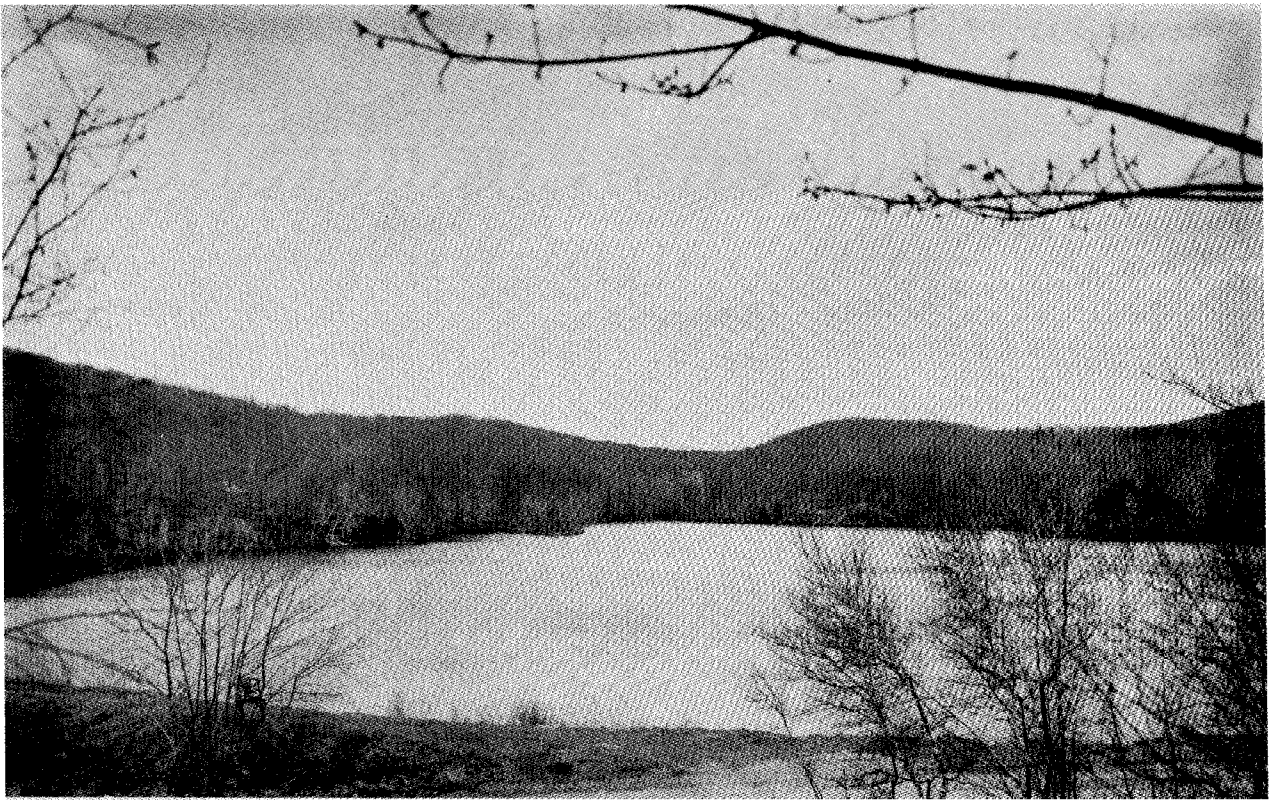
From the very beginning of this country's written history the Hudson River fishery has been important. This portion of the diary of Henry Hudson's First Mate describing their landfall near Storm King Mountain in 1609 was the first written description of the richness of these fisheries:

Sept. 14 . . . The land grew very high and mountainous; the river is full of fish.

The danger to the Hudson River fishery was one of the first to be thoroughly understood since Storm King is in the center of the spawning grounds of the striped bass. This and other fish of the Hudson River are an important factor to local fishermen and to sportsmen up and down the coast who rely on the Hudson River striped bass population for their recreational use as far north as Massachusetts and as far south as Toms River, New Jersey, at least.

In addition to bass, this area is within the spawning grounds of both the short-nosed and the American sturgeon, which are on the Department of Interior's rare and endangered species list and is also an area past which the very tiny juvenile shad drift after their being spawned up-river.

Examination of the record showed that the expert testimony had been skillfully woven to give an impression that the threatened fish were a type which in no way resembled the striped bass or any other Hudson River fish. Instead, Con Edison's expert had taken characteristics from each of the species and created the toughest monster that conceivably could live in the river — and the least valuable — and left the impression that this was the sum and total of the Hudson River fish population.



A view of the upper reservoir, currently a source of fresh, pure mountain water, proposed by Con Ed to be replaced by an eight-billion gallon man-made basin of salty and polluted Hudson River water.

Photo Courtesy of Scenic Hudson Preservation Committee.

These distortions, obvious even to the layman, caused further examination of resource factors. It was soon discovered that the testimony regarding the geology, the hydrology, and the basic ecology of the area – all was lacking in value, and that the only thing that really stood out was the single purpose of the utility and the acquiescence of the governmental agencies whose responsibility presumably is the protection of the public and its resources. Both the Department of the Interior and the Conservation Department obviously were rather regretful that the Hudson River existed at all. The Department of the Interior wrote a letter suggesting that there were faults in the mountain and that there were fish in the river and since this was a pretty nice area Con Edison should treat it gently, but there was no resistance or guidance offered.

The question of the Hudson River fisheries exists and there is still a great deal of doubt as to the extent of the damage. Con Edison is financing studies which are being carried on by the U.S. Fish and Wildlife Service and the State Conservation Department to determine the extent and location of the Hudson River fisheries. These will not be finished until 1969 and will probably not be evaluated until 1970.

However, the utility wants its license long before the results of that survey can be determined. It pacifies anyone concerned about potential fish damage or fish loss with the assurance that it will build a hatchery and replace whatever is damaged or lost.

The State Water Resources Commission, representing all of the state agencies in matters affecting state waterways, simply ruled that it was perfectly all right to destroy a source of local fresh water, but that Cornwall would have to negotiate a tap on the New York Catskill Aqueduct for water to replace that which they allowed to be destroyed as a resource. Apparently the Water Resources Commission at the time had not heard of water shortages in New York.

Upon the issuance of the initial license by the Federal Power Commission, Con Edison was to build its pumped storage plant as initially planned with an exposed generating station in a cut in the mountainside and with minimal protection for Hudson River fisheries. The protest became overwhelming. The Federal Power Commission scheduled further hearings and Congress dug into Con Edison's record of resource protection on the river. Apparently the utility and the State Department of Conservation had been attempting to bury the story of massive fish kills at the Indian Point plant, a nuclear plant on the Hudson which was designed so badly that it created a fish trap with heated discharge water luring fish into the intake area. At times there were such blockages of the intakes with dead Hudson River fish that the utility had to hire divers to go down and clear

the intake area, and dump trucks had to run on a full schedule to fill a local dump, to a depth of approximately six feet, primarily with striped bass.

Extensive photographs had been taken of this prior to the posting of armed guards at the dump and these photographs had been sent to Albany, where they were "lost" in the Conservation Department files. Had it not been for the digging of a *Sports Illustrated* reporter, the story very possibly would never have come to light. However, *Sports Illustrated* did find pictures of the fish kill and the dump and did publish a story titled "The Stink of Dead Stripers" clearly indicating that both the utility and the state authorities had been terribly remiss in their handling.

The ex-Commissioner of Conservation for New York State, in attempting to protect the utility and the Conservation Department, likened an industrial fish kill to an Act of God.

Conservationists were fortunate. Their fight became known to contributors who made it possible for Scenic Hudson Preservation Conference to be represented by Lloyd K. Garrison in federal court action. The federal courts reversed the license and in December, 1965 remanded the case to the Federal Power Commission for further hearings to adduce more information regarding natural resources and the fisheries of the river and other basic areas in which the court found the record to be faulty. The court also required that alternative methods of generation be thoroughly investigated.

Perhaps the most important finding of the court was the citizen's right to be a party in matters regarding natural resources even though he might not have an actual dollar investment. Next in importance was the court's reminder that federal agencies were to represent and protect the public interest rather than simply act as an umpire in a rather unequal action.

In the interim period between the court decision and today, the Federal Power Commission has held further hearings which have created a record now of some 16,000 pages of testimony, ranging from the unique scenic qualities of the Hudson River Gorge, to the natural resource values, to the most sophisticated and technical engineering and electrical concepts.

During this period, the utility, Con Edison, has made many concessions to conservation. They have proposed to bury the plant. Unfortunately the spot on which they propose to bury the plant is directly over an area in which the Catskill Aqueduct failed when it was drilled in 1913. According to geological reports of the 1913 period and the 1920's, this area was too faulty to allow the drilling of a 20-foot hole for the aqueduct, and yet Con Ed proposes within feet of the same spot (almost directly above the area that fractured) to create a cavern some 600 or 800 feet long by 150 feet wide by 180 feet

in height. This will require a permit from New York City. Currently there is a great debate as to the safety of allowing Con Ed to tamper with and possibly even relocate the aqueduct, which carries almost one-half of New York City's daily supply.

In addition to this, there is the legal question as to whether or not a village can sell its water supply to a utility and then simply tap the New York Aqueduct to replenish what they have sold, in essence as industrial waters. This method of destroying and replacing natural water sources could create dangerous precedent. It certainly is an imprudent use of waters.

There is still an unresolved question as to what effect the pressure of eight billion gallons of water in a reservoir perched 1,200 feet on top of a mountain water supply — and on top of a mountain which obviously has faults, cracks and fissures — will have on local water supplies. What sort of reverse pressures will be set up by the added weight of water? Will saline Hudson River water affect the entire mountain system? How far will the pollution go? For at this point the Hudson is both saline and foul. What will be the effect after pressures are released by the draw-down for generating power?

There is a question about seepage, for almost every major reservoir has had a period of important seepage and ultimately controlled seepage. Taum Sauk on the Black River in Missouri is perhaps the most comparable. It's about one-eighth the size of this plant, but built on similar rock under similar conditions. When Taum Sauk was opened it leaked 50 million gallons a day. After completely repaving the reservoir twice and sending divers down to repair leaks caused by reverse pressures when the reservoir was drawn down, the utility has been able to cut the seepage to about twelve million gallons a day.

The difference at Taum Sauk is that it is fresh water and is now a controlled flow into a closed lower reservoir. Were seepage to occur in the case of the Con Ed plant, it would cause salt intrusion in the Highlands area, which is now a hardwood forest. Con Ed has stated that anything that could grow on the river bank will grow at the top. They have ignored the fact that only two or three per cent at most of the species growing on top of the mountain are also common to the river bank. The river bank's ecology is totally different from the upland ecology.

If the plant is built, there will be changes in the physical contour of the Highlands. One of five dams 2,200 feet long by 265 or more feet high will join two peaks visible from Route 9W.

Con Ed says that there will be nothing visible and yet there will be a tailrace cut into the foot of the mountain which will be 600 or 800 feet long, and go back in 100 feet to a sheer face of 60 to 90 feet. The mountain

above this will be cleaned, neatened and landscaped and Con Ed is certain that it will be an improvement. This is a subjective judgment. As a matter of fact one of their expert witnesses said he never saw a work of nature upon which he could not improve. Here he was only referring to terrain and landscape.

The Water Pollution Control Division of the Department of Interior has expressed concern over the mixing of the discharge water in the generating stage, and the Hudson River water which at that point is a rather delicately balanced salt and fresh combination, with the fresh water lying atop the salt water in fingers following tidal patterns. It is from this upper layer that Chelsea, New York City's pumping station five miles north of Storm King Mountain, and Poughkeepsie, some fifteen miles north, draw their fresh water. The Department of Interior witness expressed concern over the possible mixing action, which posed the danger of destroying the fresh water supply for these two areas. He suggested respectfully in his testimony that though the Department would not block the plant they would like to have control over its operation. Of course with any project of this size and scope, the thought that the utility would allow the government to tell it when to run and when not to run, is rather a naive view, particularly since the utility has paid little or no attention to the problems of water quality and resource management to this date.

In its total dealing within this area, the utility has been most forceful. The utility has changed its plans superficially in order to mollify those conservationists who are concerned, those resource people who worry, those fishermen who are afraid. But in no case has it thought of abandoning the plant and using proven alternatives. It now has approximately \$25,000,000 invested and this kind of investment is a bit difficult to abandon and much more difficult to explain to a Board of Directors if it is abandoned.

Con Edison is economically locked into the project and locked into a posture of unrelenting determination. It has not, however, resolved the resource problems. This is still an experiment as far as the effect on the fisheries. Both the utility and the Power Commission refer to using screening devices not yet devised as the ultimate protection. They refer to using a hatchery to ameliorate or mitigate damages. The geology, the fresh water problems, the dams — all are really of an experimental nature. At most they remain inadequately researched "best estimates." There is still no accurate water table of the mountain. There is no accurate knowledge of the water pressures within the mountain. There is no clearly defined knowledge of the natural resources and the net effect on them. The utility, instead, has taken up an approach which has to do with the cosmetic value of

landscaping that which it has altered. It simply and blithely reassures concerned citizens by saying that it will take care of anything unforeseen or unexpected.

It might be worth noting that our present environment is the result of best engineering judgment and most economic use of land. The quality of our water was created by this philosophy, as was the quality of our air, and the quality of our countryside.

Certainly unless this plant, which in essence is an experiment in grandeur on the part of the utility, is proven to be absolutely necessary to New York City, it should not even be considered. There are other methods of generating electricity. This plant would constitute an over-supply of electricity to the point that the utility has agreed to sell power to other utilities on a firm basis.

Despite the utility's estimates, it would not be less costly for New Yorkers than alternatives. For the one thing, the utility has forgotten to include in its cost estimates the overhead transmission lines to tie this to existent corridors. With these added the cost becomes \$250 million for the project and its attendant works.

Though the utility has made much of air pollution alleviation via this project, its own testimony before the Federal Power Commission in the latest hearings clearly states that alternatives would better solve New York City's atmospheric problems.

Recommendations of industry studies and federal agencies all emphasize the balancing of power sources through the utility system to create reliability. Con Ed's proposed developments, including Storm King, would put the vast majority of its own power, plus its New England tie, plus its upper New York State tie, plus its

western tie to the Pennsylvania, New Jersey, and Maryland system — all in approximately the same corridor leading to the Sprain Brook distribution center. This is in itself a violation of sound utility design.

In regard to the subject of this symposium, the project as proposed by Con Edison is the epitome of traditional and destructive water use. In its basic design, it would destroy one fresh water supply and endanger the rest of the adjacent mountain system. It would create a threat to New York City's Catskill Aqueduct supply, while depriving New York of a million or more gallons a day through a required tap on the aqueduct to replace Cornwall water destroyed. The project would constitute a threat to the water supply of nearby towns using Hudson River water.

From a standpoint of marine resources, the potential damage to the fisheries of the river will not be assessable until research is finished sometime in the future.

Actually, the plant constitutes a menace to its surrounding environment primarily because of both poor and reckless use of water resources. On these grounds alone, the project should not come to fruition.

In the final analysis, the present policies of water use are dependent upon public ignorance and apathy. We are now entering an era of awareness. The cost of wetland destruction, the cost of great experiments and massive but narrowly-oriented works, is becoming apparent. Our degraded environment is the price we must pay for overexploitation of basic resources.

The preservation and use of water depends upon a properly balanced exploitation with respect for irreplaceable natural resources.

HYDRO POWER FOR NINE MILLION PEOPLE

By George J. Delaney

Assistant Director, Community Relations
Consolidated Edison Company of New York, Inc.

It is a particular pleasure to talk with this group at The University of Connecticut about Consolidated Edison's proposed pumped storage hydroelectric station at Cornwall, New York. We believe this is an outstanding project which offers substantial and unique services to the public. It would provide significant benefits that so-called "alternatives" cannot.

Distinguished physicist Dr. Edward Teller declared in testimony to the Federal Power Commission last year: "Cornwall is the only existing or planned project, of an energy storage nature, whose physical scale and potential time responsiveness is at all appropriate to the size of the electric grid to which it is connected"

Economist Leon H. Keyserling testified: "Delay or defeat of the Cornwall project as now proposed would do damage to both residential-consumer and business interests in the New York City metropolitan area I yield to none in my desire to preserve and defend the rich scenic and natural beauty of this country . . . Those who come forward as champions of this cause are entitled to respect and attention. But, in my view, they are sometimes prone to attach more weight to the cultivated tastes of the few than to the pressing needs of the many. I am old fashioned enough to try to adhere always to the maxim of the greatest good to the greatest number."

Con Edison announced its plans for the hydro project in September 1962 at a press conference in New York. There was a front page story in *The New York Times* and widespread coverage in other papers, too.

The Federal Power Commission in March 1965 granted Con Edison a license to build, after comprehensive hearings that extended over a period of fifteen months. In December 1965 an Appeals Court set aside the license and ordered the Commission to conduct new hearings. They started in New York City on November 14, 1966 and thereafter shifted to Washington where they continued until May 23, 1967. There were additional hearings on September 7 and October 16, 1967. The parties are now awaiting the decision of the Federal Power Commission Hearing Examiner. There now are more than 16,000 pages and 4 1/2 million words of testimony about the Cornwall project.

Experts tell us that the population of the United States will increase by 70 per cent by the year 2000. Think of it — a population that will approach being twice what it is today — and only 32 years from now. It is in that context that our country must consider the

intelligent and prudent use of the resources that nature has given us. That means thoughtful planning for improvement and change, while preserving what is best in what we have.

In our opinion, there is one economical, practical and reliable type of power generating unit that can satisfy the need of nine million people in New York City and Westchester for power during peak load periods and in time of emergency. That is the pumped storage hydroelectric station, of the type Con Edison proposes to build at Cornwall north of Storm King Mountain.

Let me give you an idea of how the system would work.

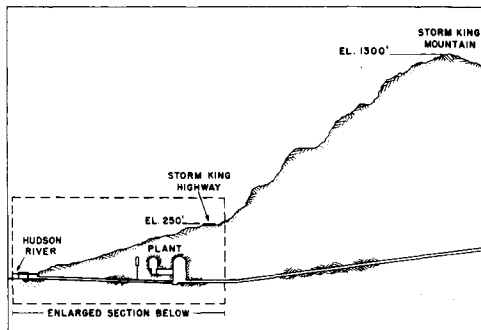
A pumped storage hydroelectric site has certain unique requirements. It must have a large supply of water at a low level. It must have a reservoir at a high level — the higher the better. The high-level reservoir must be close geographically to the low-level supply of water, and there must be a means of connecting the two bodies of water. The Cornwall site meets all of these requirements, and indeed is perhaps the finest pumped storage site in the world, all things being considered.

Along the Cornwall waterfront, serving as an inexhaustible water supply, is the Hudson River, which at this point is actually not a river, but an estuary, an arm of the sea. About 1,160 feet higher up, and two miles to the west of the plant, is a natural basin set between Mount Misery and White Horse Mountain. The existing reservoir located there is concealed from view unless you hike right up to it or happen to be in an airplane. This is the ideal spot for the project reservoir.

So with an underground plant along the Hudson at the bottom and the enlarged reservoir at the top and a tunnel hidden deep beneath the mountain connecting the two, you have the power generating effect of a waterfall six times the height of Niagara Falls.

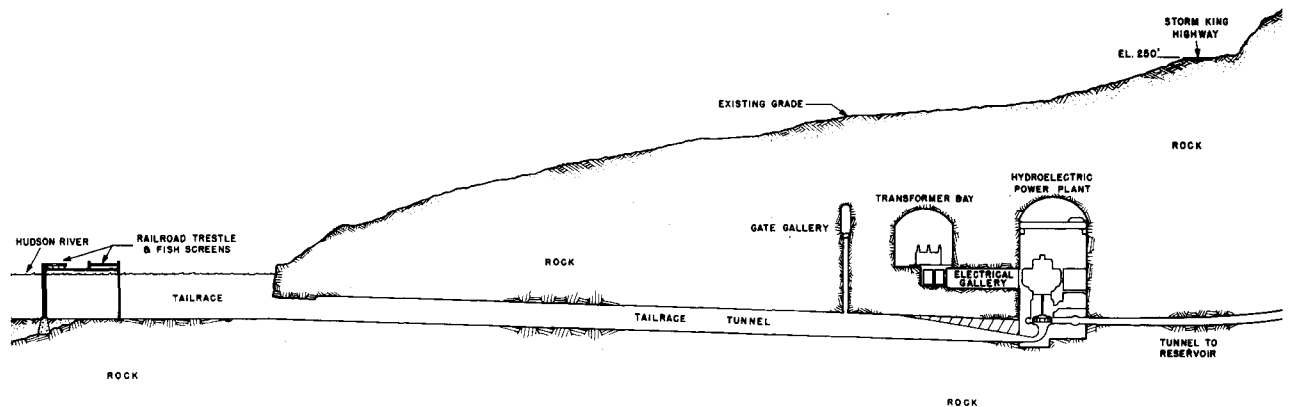
At night when power demands are low, low cost energy — normally from nuclear generation — would be used to pump water through the tunnel from the river to the reservoir. During the day, when the demand for power is high, some of this water would be released to generate electricity. An added advantage of this system is this: with water power we don't have to start fuel burning, or speed up the burning, to make generators pick up load. Hydroelectric generators need no warm-up time. In short, we can turn out large amounts of electricity in less than a minute.

We have discussed the plant and how it works. Now



CORNWALL PUMPED STORAGE HYDROELECTRIC GENERATING STATION

PROFILE OF PROPOSED UNDERGROUND CONSTRUCTION



Cross section view from the north shows proposed underground location of Con Edison's two million kilowatt hydroelectric generating project at Cornwall, N. Y. Water from the Hudson River (left) would be pumped through the tailrace tunnel by the pump turbines in the power plant gallery and through the tunnel at the right to a 240-acre reservoir between Mt. Misery and White Horse Mountain, two miles away. To generate power, water would be released from the reservoir and, by turning the blades of the eight turbines, would produce up to two million kilowatts. The power would be stepped up from 18,000 volts to 345,000 volts by the transformers and carried by underground and submarine cables to Cornwall East Switching Station, three-fourths of a mile inland from the eastern shore of the Hudson in the Village of Nelsonville.

Photo Courtesy of Consolidated Edison Company of New York, Inc.

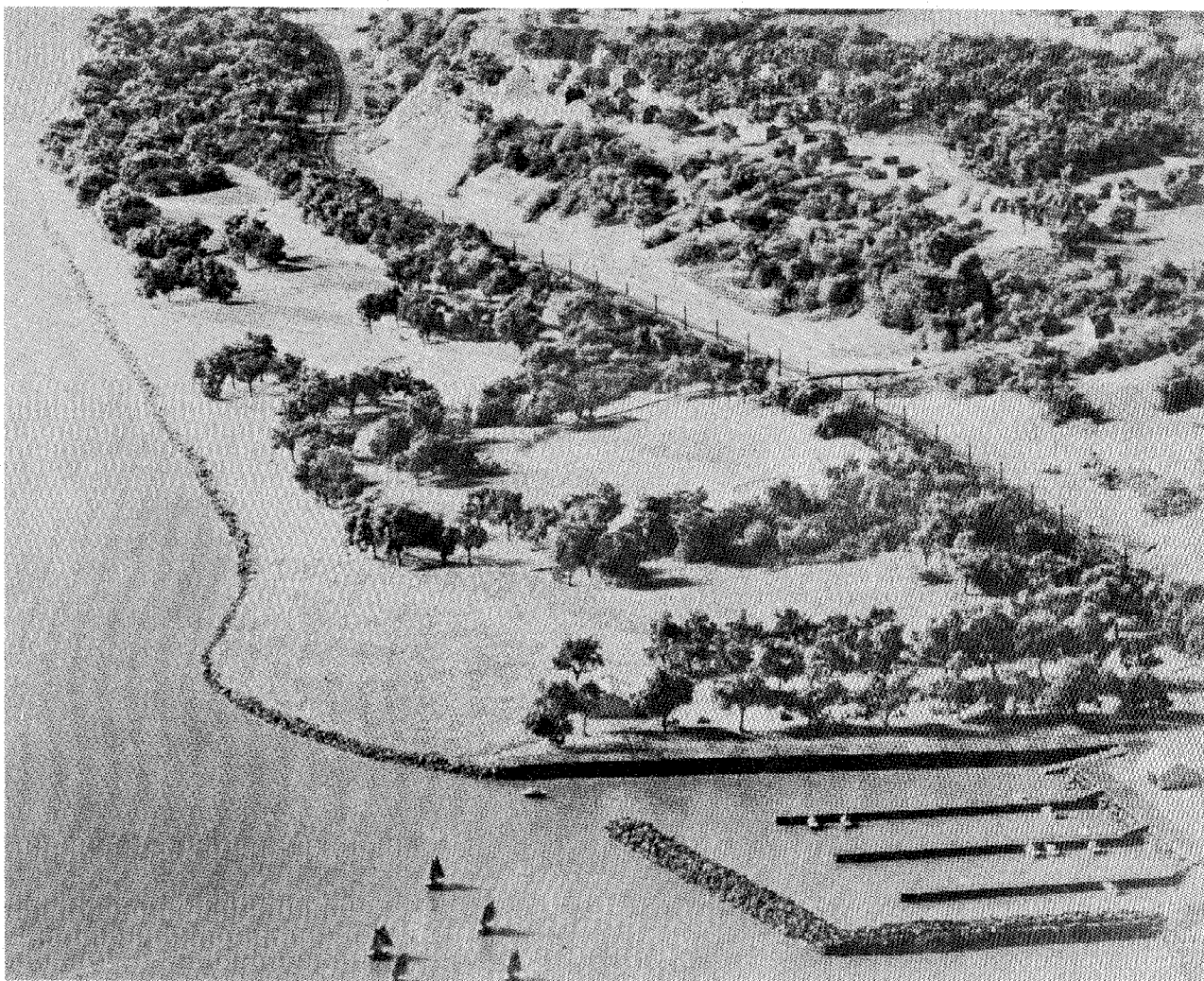


Photo of scale model shows attractive waterfront park and recreation area which Con Edison will build as part of its Cornwall hydroelectric project.

Photo Courtesy of Consolidated Edison Company of New York, Inc.

why should there be any controversy? Con Edison has stressed time and again that our objective is, not only the protection and preservation of scenic beauty, but its improvement as well.

Early in our planning, for example, we decided to run our transmission line under the river instead of over it, and for three-quarters of a mile inland from the shorefront, to avoid any intrusion on the scenery at this site. The extra cost of this submarine and underground transmission line is estimated at \$8 million. Con Edison considers this money to be an investment in scenic beauty, and well spent.

Of the more than 44 miles needed for the transmission route, only twelve miles of new overhead right-of-way would be required. This would be through sparsely-settled country from Nelsonville to Carmel in Putnam County. In Westchester and in other communities the transmission route will use existing rights-of-way, replacing circuits that are already in use, so that no additional lines would be needed.

Now, about these twelve miles, Con Edison has been asked, "Why can't they be run underground?" We wish they could. But the added cost would be at least \$44 million. The Federal Power Commission found that requiring the 345,000 volt transmission line to be placed underground in the area beyond the view of the Hudson River would entail "extravagant additional costs in view of the limited impact the lines would have upon the area involved."

Underground cables are not merely overhead lines dropped into a trench. Insulation requirements, heat build-up and other electric phenomena make such cables a completely different and highly complex facility. For example, to make a single underground splice — and this has to be done every 2,000 feet — takes eight to ten days working 24 hours a day at a cost of more than \$29,000 per splice. Other costs also are enormous, and to put all high-voltage lines in the nation underground would cost about \$220 billion, more than three times the power industry's total capital investment and more than all other conservation and beautification plans in the United States put together.

The Federal Power Commission's Advisory Committee on Underground Transmission reported in April 1966. This group said there is no easy way to put high-voltage lines underground and still have electric power at low cost. The facts are that the cost to the consumer would double or even treble if existing power lines were placed underground.

I also mentioned scenic improvement. What I refer to is the clearing of an unsightly assortment of partly demolished buildings, abandoned factories, three sunken and rotting barges, a burned-out pier and other blighted structures on the Cornwall waterfront.

In place of this blight from a bygone economic era, Con Edison will provide recreational waterfront parks, over more than a mile-long area, and this will do much to beautify a now blemished area.

With regard to the plant itself, it will be entirely underground along the waterfront north of Storm King Mountain, not on the mountain as some people have been led to believe.

Excavation during construction will take place underground, and rock will be removed through a tunnel that will become a permanent means of access to the plant. When the underground plant is completed, the area around the installation will be cleared of the foundation of old houses and other structures and restored to its natural landscape. And, of course, since no fuel will be burned, the plant will have no stacks of any kind. This is hardly blasting the face of Storm King Mountain, as some critics have charged.

At the site of the underground plant, Con Edison will build an attractively landscaped visitors' information center along with picnic and shelter areas. Paths and lookout points will enable visitors to view and enjoy the panorama of river and mountain.

Gilmore D. Clarke, leading regional planner and landscape architect, said in testimony before the Federal Power Commission that the Cornwall project would make the Hudson Highlands "even more beautiful." "No one's touching Storm King," he said. He noted that the mountainside facing the river had been "scarred" many years ago when Storm King Highway was built. Beautification of rundown areas in the vicinity of the plant site, as well as landscaping of visitor areas, will be under the direction of Clarke & Rapuano, headed by Mr. Clarke, and the same firm that landscaped the nearby Palisades Interstate Parkway and the St. Lawrence hydro project.

Some two miles inland from the generating station, at the site of the storage reservoir, Con Edison plans to provide picnic sites and a scenic overlook near Route 9W for motorists to view the natural beauty of the surrounding highlands. The reservoir itself will be landscaped to blend into the natural scenery. All five dikes will be curvilinear to make them resemble natural hillsides. The exterior of the dikes will be covered with topsoil and landscaped with shrubs and bushes native to the region.

The reservoir will be built on extremely competent and hard granite, capable of bearing many times the weight of the water that will be stored there. Geologists and independent engineering authorities of highest world-wide reputation have reviewed the geology of the reservoir area and participated in the design of the dikes. They have testified under oath at Federal Power Commission hearings that the reservoir and dikes will be safe and that no significant seepage will take place either through the underlying bedrock or the enclosing dikes.

One scientist testified that it would take more than nine years for a drop of water to pass through the dikes. Another scientist testified that any dike seepage probably would be so slight that it would evaporate before it could be measured at all. Our consultants tell us that there have not been any active faults near Cornwall in more than 200 million years.

In operation of the hydro project, Con Edison will use the most modern fish-protection devices available to insure that the plant will have no adverse effect on the river's fish population. The Company is financing a fish life study which started in September 1965 and will cost over \$400,000. It is being conducted by the Department of Interior's U. S. Fish and Wildlife Service and the New York State and New Jersey Conservation Departments and with a representative from the State of Connecticut as an observer. The study is expected to supply further technical information on the most effective protective devices to use. It will also provide valuable information on Hudson River fish life in general.

Scientists and fish and wildlife authorities have testified repeatedly that: 1. No measurable effect on

Hudson River fish resources would result from the plant; 2. Since a hydro plant does not burn fuel, there would be no warming of Hudson River waters to attract fish; 3. The chief concern expressed by the opposition has been over striped bass spawning, possibly because those two words "striped bass" arouse all of the fishing clubs. However, extensive Hudson River samplings indicate that spawning of striped bass extends over 50 miles, and the area affected by the plant would be a minute portion of that spawning region.

In a statement filed for the Federal Power Commission hearings, the U. S. Department of Interior, Bureau of Sport Fisheries and Wildlife, said: "No avenue of fishery resources damage would remain that could not be compensated by practicable means." This is a reference to artificial propagation of fish. Con Edison has said that it stands ready to restock the river if, despite the mass of evidence indicating no danger to fish life, any significant loss occurs through some remote, completely unforeseen possibility.

Now to another subject of interest — the blackout. As you know, the question that is still uppermost in many



Model built to exact scale shows site of generating plant north of Storm King Mountain and in a low-lying area on the Cornwall riverfront. The hydro plant is completely underground. Existing railroad in foreground crosses water channel leading to plant.

Photo Courtesy of Consolidated Edison Company of New York, Inc.

minds is this: "What can be done to minimize the possibility of a recurrence, and to quickly restore power if one should occur?"

The answer is Cornwall, because of the rapidly accessible reserve of power that the hydro project would provide. This view is shared by power experts throughout the nation. The Federal Power Commission said in its report to the President of the United States on the Northeast power blackout of November 9, 1965: "...the industry should re-evaluate the comparative usefulness of hydroelectric units, including pumped storage, and other fast-starting generators for use in emergencies, and place a greater value on them as compared to the slow-starting types, such as steam power plants, either conventional or nuclear."

There is another aspect of this case that deeply concerns Con Edison. That is the problem of air pollution. And it is another reason why we would like to get this project under way as quickly as possible.

As has already been confirmed by the Federal Power Commission, a committee of the Council of the City of New York, the New York City Department of Air Pollution Control, and other experts, the Cornwall plant would do much to reduce the amount of air pollution in New York City. Once Cornwall is built, Con Edison will be able to complete its plans to shut down 1,500,000 kilowatts of our oldest generating capacity.

It will also enable us to use nighttime power from nuclear facilities to help provide the City's daytime needs. Beyond that, the new plant would serve to meet the load fluctuations that occur during the course of the day. We would thus not be forced to repeatedly start up and shut down our city generating units as we must do today, and this is a key factor in the control of stack discharge.

Finally, of prime concern to Con Edison is our

objective to provide reliable service for our millions of customers. That is why we stress the importance of locating the plant where it would be an integral part of our basic power system. Cornwall is ideally situated.

It would serve first to help us meet rapidly increasing power demands. And, equally important, a huge reserve of power would be quickly available to cope with peak electric demands or sudden power disturbances. If we had to rely on a facility not under our control, the power might not be available at all when it is needed.

The issue at stake is not a simple one. Two equally vital considerations are involved. One deals with the practical use for the benefit of man of a major natural resource — the Hudson River. The other involves the preservation of scenic beauty.

Perhaps Con Edison's case is summed up most effectively by the testimony to the Federal Power Commission by Reverend William T. Hogan, Director of Industrial Economics and Associate Professor of Economics at Fordham University:

The proposed construction of a power plant at Cornwall represents the maximum use of a natural resource since it provides economic benefit while preserving aesthetic values. To have a waterway such as the Hudson River and an elevation of land such as the Hudson Highlands and allow them to go unused in the face of the demand of millions of people would be unfortunate, for it would not be consonant with the best interest of those who live in the Hudson River Valley and in the City of New York. This is a most unusual opportunity to use the resources of nature without leaving any scar on its face. As a matter of fact, the beauty of the river at this point will be enhanced by the commitment of the Company to improve a waterfront that has been allowed to deteriorate over a number of years.