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Protecting Rainbow Bridge

A study of dangers to Rainbow Bridge from water of Glen Canyon Reservoir brings surprising answers.

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When the Development Program for the Upper Colorado River Basin was passed by Congress, 11 April 1956, conservationist pressure forced inclusion of a provision to "preclude impairment of the Rainbow Bridge National Monument." The same act also established a policy that "no dam or reservoir constructed under the authorization of this act shall be within any national park or monument." In conformity with these provisions, plans have been made by the Bureau of Reclamation and the National Park Service for protecting Rainbow Bridge.

The essence of their proposals is given in Figs. 1 and 2, which show plans superimposed on aerial photographs of the region. Figure 1 gives a general view of the remote and rugged area where this huge bridge is located and indicates the principal points of interest in the proposed program of protection. Figure 2 shows a more detailed view of the area around the monument, including adjacent areas where the protective works designed to prevent impairment of the monument would be located.

In the remarkable erosional setting shown in Fig. 1, the bridge is a mere detail in the rugged landscape, but when approached from the ground by someone coming either up or down Bridge Canyon, in which it is located, it is found to be a tremendous arch with an inside span 278 feet wide and 309 feet high, shown in Fig. 3. It is an integral part of an exceedingly scenic region lying between the 10,000-foot Navajo Mountain and the 3200 foot Colorado River bed in Glen Canyon. The streams draining from the mountain have cut deeply entrenched meandering canyons in the colorful sedimentary rocks, mainly in the spectacular red and white Navajo sandstone through which they flow on the way to the river. This big bridge is a remarkable piece of natural architecture situated in a stupendous setting of cliffs and canyons, in which it is the center of interest (Fig. 4 and cover picture). The Western editor of *National Wildlands News*, J. F. Carithers, says (June 1960), "the country surrounding the national monument is unbelievably spectacular. The great stone arch itself is one of the most inspiring wonders we have ever seen. It is the exclamation point at the end of a beautiful sentence."

The bridge itself has substantial foundations. One end arises from a massive cliff. The other end of the span rests on a broad platform of solid rock. Midway between these two adequate foundation supports is a narrow canyon or inner gorge (indicated in Figs. 3 and 4 but shown in greater detail in Fig. 5). This gorge is sunk about 70 feet into the solid rock, and through it the normally small stream descends rapidly. In times of occasional heavy runoff the stream may become a torrent that leaves its high-water mark along the sides, about 6 to 10 feet above its bed. The projected Glen Canyon Reservoir (Lake Powell) will catch high water and hold it until it is released in a regulated stream through the dam. This will produce irregular fluctuation in the level of the lake and, in turn, induce noticeable fluctuation under the bridge. Without a restraining or barrier dam, the water in Glen Canyon Reservoir would back up the narrow inner gorge under the bridge to a depth of about 46 feet when the reservoir is full. At this level, the water would stand about 24 feet below the top of the inner gorge or about 40 to 50 feet below the bridge abutments and would extend upstream a considerable distance, even beyond the limits of the monument, as shown in Figs. 2 and 6. It has been estimated that the lake would be full 13 percent of the time and that there would be no water under the bridge 23 percent of the time. In order to reach the foundations of the bridge, a wall of water nearly 50 feet high would have to pour over the top of Glen Canyon dam. In fact, the sediment deposited in the inner gorge will actually protect those foundations by reducing erosion in the gorge that would otherwise eventually undermine them. The principal effect of the reservoir in the monument would be the eventual filling of the inner gorge with sediment to the upper level of the reservoir—that is, to within about 25 to 35 feet of the top—one third of the gorge being left unfilled.

Barrier Dam

The proposals for preventing water from backing upstream into the monument are founded primarily upon the idea of constructing a restraining or barrier dam somewhere below the monument. Two sites for such a dam

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Fig. 1. Aerial photograph of the region around Rainbow Bridge, looking south up Aztec Creek. The principal features of the plans for protecting the national monument are indicated. [U.S. Bureau of Reclamation]

Fig. 2. A detailed aerial view of the national monument with superimposed outlines of construction planned to protect Rainbow Bridge from damage from the projected Glen Canyon Reservoir (Lake Powell). [U.S. Bureau of Reclamation]

have been studied, one in Bridge Canyon at site *B* (shown in Figs. 1, 2, and 7), located 3200 feet below the monument, and another, much larger site, where construction would be much more expensive, in Forbidden Canyon below the mouth of Bridge Canyon (site *C* in Fig. 1). Site *B* has been selected by the Bureau of Reclamation and the National Park Service as most suitable.

While a barrier dam would keep water of the reservoir from backing upstream into the monument, it would also keep the water from Bridge Canyon from flowing downstream into the reservoir. In order to prevent this water from making a lake on the upper side, it would have to be pumped over the dam. Above this point, drainage from about 7.59 square miles of the steep rough slopes of Navajo Mountain flow into Bridge Canyon, bringing, during snowmelt and summer thunderstorms, torrents of muddy water and flood debris that would settle against the upstream side of the dam. Within a quarter or a half century this sediment would back upstream into the monument.

To alleviate this danger of sediment build-up in the monument, it has been proposed to make a diversion dam above the monument and turn the drainage from 6.54 square miles above this dam through a 0.9-mile tunnel into Aztec Creek. This would divert most of the mud and debris from Bridge Canyon, leaving only the sandy sediment brought by drainage from 1.05 square miles below the diversion dam to accumulate above barrier dam *B*. It is estimated that there is adequate storage for sediment up to the year A.D. 2140.

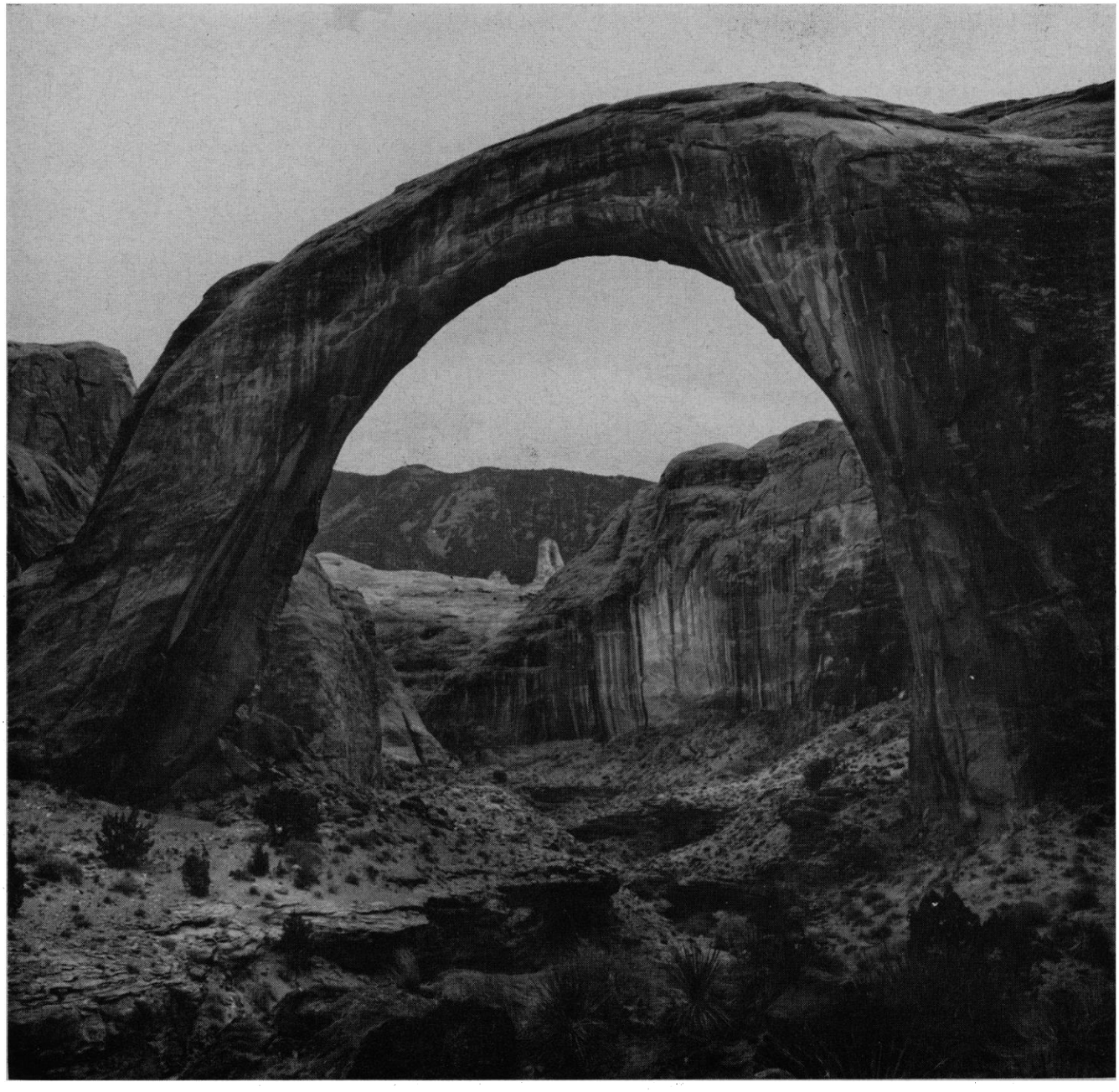


Fig. 3. Rainbow Bridge, arising from a massive cliff on the right and resting on a broad platform of rock on the left. A partial view of the inner gorge is shown in the center foreground. [U.S. Bureau of Reclamation]

Although construction of a barrier dam at alternate site *C* has been considered, it was excluded from the present proposal. From Fig. 8 it can be seen that this would be a much larger and more expensive dam than one at site *B*. It would require much larger pumping operations and would involve other complicating problems which need not be discussed here.

To build the diversion dam and tunnel and the barrier dam at site *B*, local materials obtained near the sites would be used. Both dams would be earth-and-rock-fill structures. The diversion dam would be 40 feet high, 275 feet long, and 47,000 cubic yards in volume; dam *B* would be 183 feet high, 500 feet long, and 1 million cubic yards in volume.

Obtaining rock from the canyon walls is not difficult, but getting impervious materials for the earth fill in the dams is a serious problem. The only source of such material for dam *B* is on top of a 1200-foot mesa, shown in Figs. 1, 2, and 4. This dirt would have to be lowered from the north end of the narrow neck of the mesa to the dam site. Fortunately there is a feasible route for constructing chutes or conveyor belts for lowering materials and personnel from the mesa top to the dam site. This route is indicated in Fig. 2 and may be seen in Figs. 1 and 4 but is shown in more detail in Fig. 9. The site selected for workmen's camp and construction facilities is located in Bridge Canyon, above the dam.

Material for the diversion dam would come from borrow areas identified in Fig. 2. The builder would have a choice of talus material near the dam or of impervious material from another mesa top. Excavated material from the tunnel would be dumped in Forbidden Canyon, not far from a small area selected as a site for workmen's camp and construction facilities. After completion of the tunnel the excavated material would be hauled back through the tunnel for use in construction of the diversion dam.

Construction Problems

One wonders, on looking at Fig. 1, how the builders of these proposed works would provide access for men, equipment, and supplies in such a remote and rugged area. It would certainly be a difficult and expensive procedure. Three alternate approach routes are under consideration—by air, land, or water. Large cargo-type helicopters may be called into service if the air route is used. Land vehicles could come by road down Forbidden Canyon along Aztec Creek, or up the canyon from the Colorado River, as shown on the map (Fig. 10). For the water route, the use of barges on Lake Powell, after the reservoir has begun to fill, has been considered.

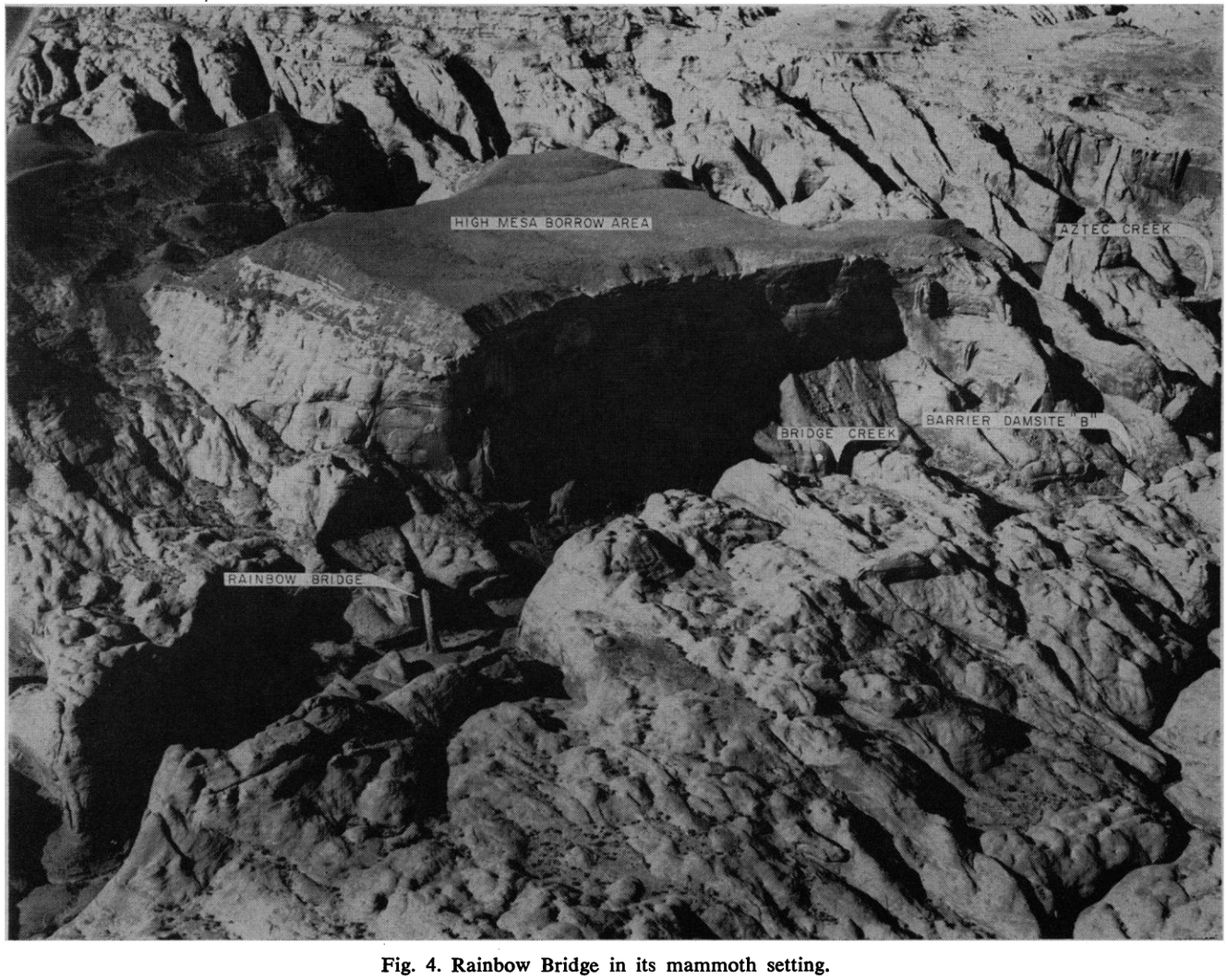
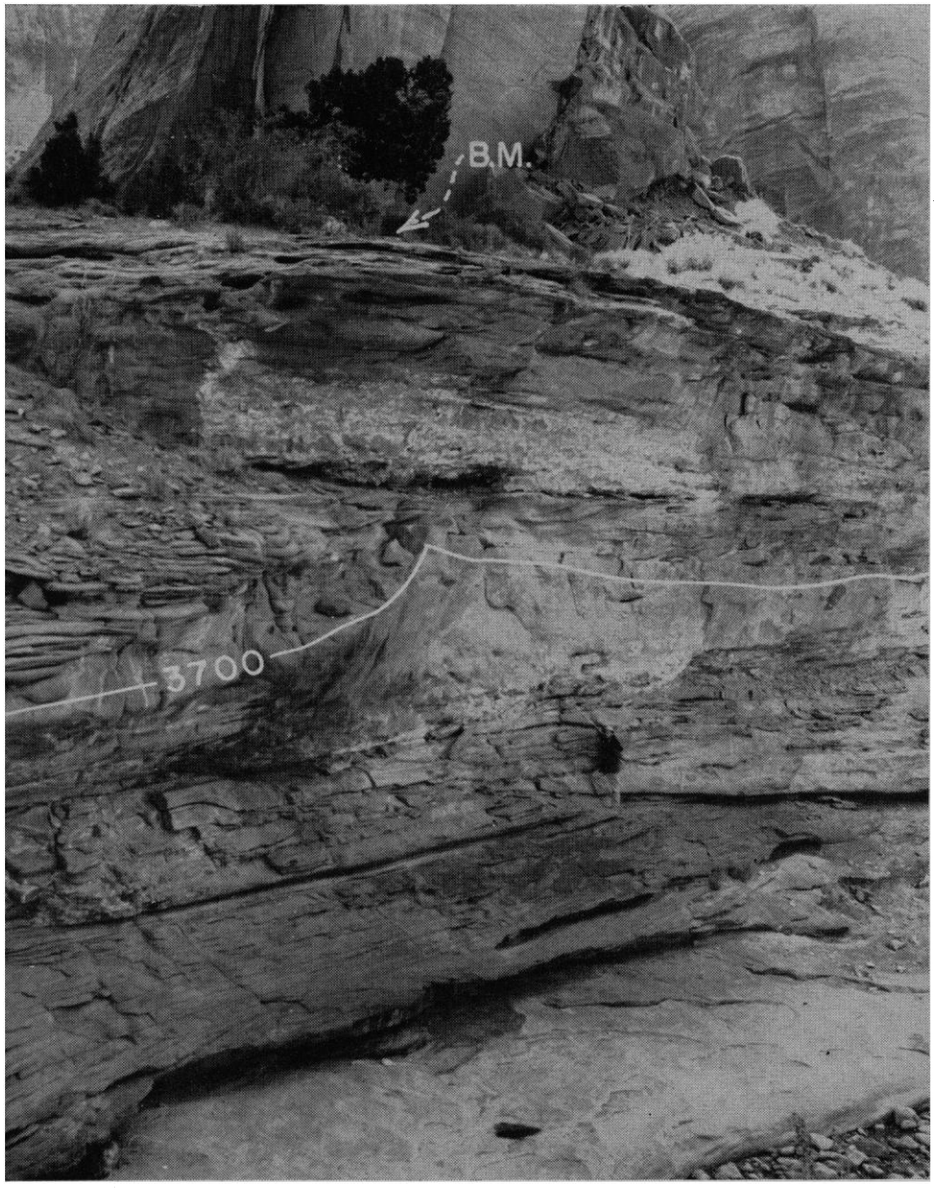
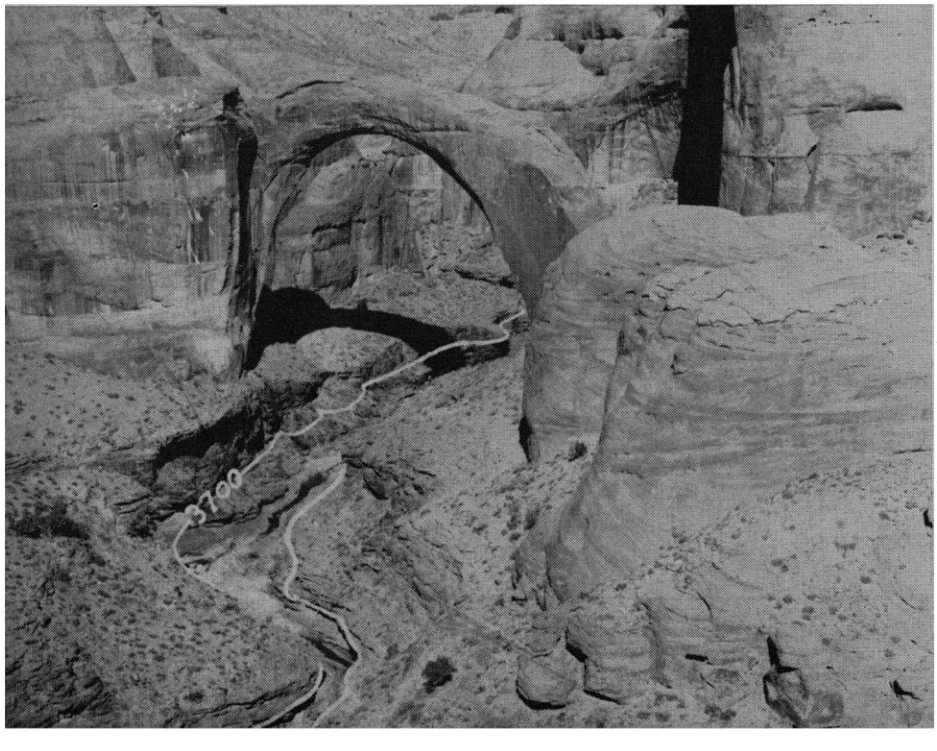


Fig. 4. Rainbow Bridge in its mammoth setting.



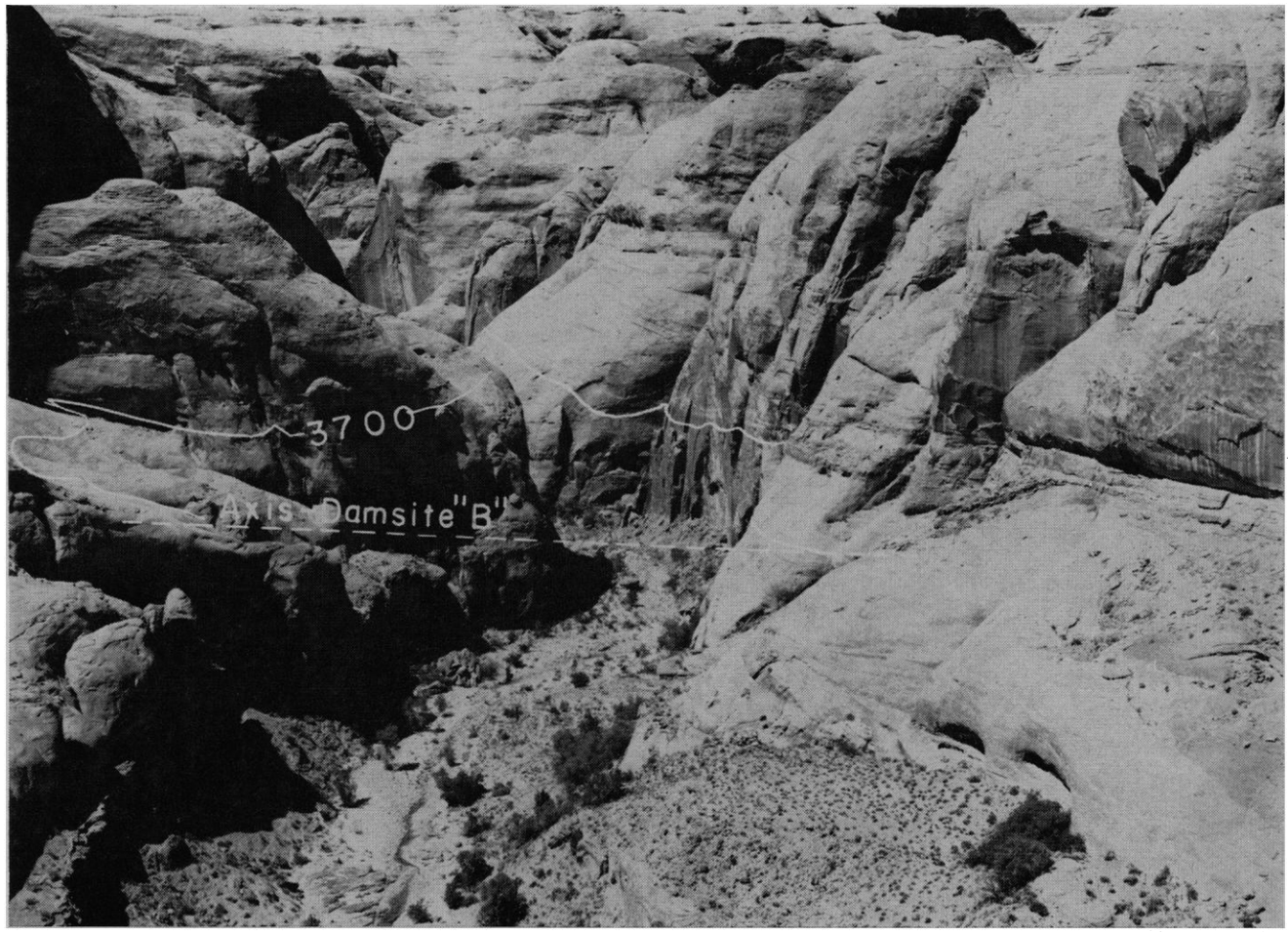


The costs in the case of the first two routes would be enormous. There is a question whether approach by the third route would be within the requirements of the law. The ground route from the south would be approached from Tuba City, Arizona, over 82 miles of rough, unimproved, fair-weather dirt road to the Navajo Indian school at the base of Navajo Mountain near the Utah-Arizona border; from there about 22 miles of new road would have to be made through fantastically rough country (Fig. 1, top center).

The road from the Colorado River would have to follow Aztec and Bridge creeks for almost 10 miles through terrain which is peculiarly difficult for road making. Figure 11 shows a particularly narrow and twisting section along lower Aztec Creek where there is no room for a road and where much of the road would have to be cut into the cliff face. Some of the turns in the canyon would be too sharp for certain types of large vehicles and equipment, and tunnels would be required. After dead-water storage was started in Glen Canyon, this road would be under water almost to dam site *B*; thus, it would have to be used before that time.

To reach the mouth of Aztec Creek would require a bridge or ferry across the Colorado River and new access roads on the northwest side of the stream. Here there are two possible routes—one from the Glen Canyon dam site and one from Escalante, Utah. The first would require about 115 miles of new road through exceedingly rugged terrain—a project too expensive to contemplate. As for the second route, about 65 miles of rough, unimproved, fair-weather road now extends from Escalante to "Hole-in-the-Rock," on top of the cliff rim above the river; about 27 miles of new road would be required to get down through the cliffs to reach the river opposite the mouth of Aztec Creek.

Fig. 5 (top left). A close-up view of the north wall of the inner gorge, showing the height to which water from the reservoir would back up in the gorge if it were not restrained. The north base of the arch, resting on a broad platform of rock, is shown at top. Fig. 6 (bottom left). A view of Rainbow Bridge looking downstream, showing the prospective high-water mark when the reservoir was full. Fig. 7 (top right). A view of barrier dam site *B*, looking downstream, showing the prospective high-water mark. Fig. 8 (bottom right). View of barrier dam site *C*. [U.S. Bureau of Reclamation]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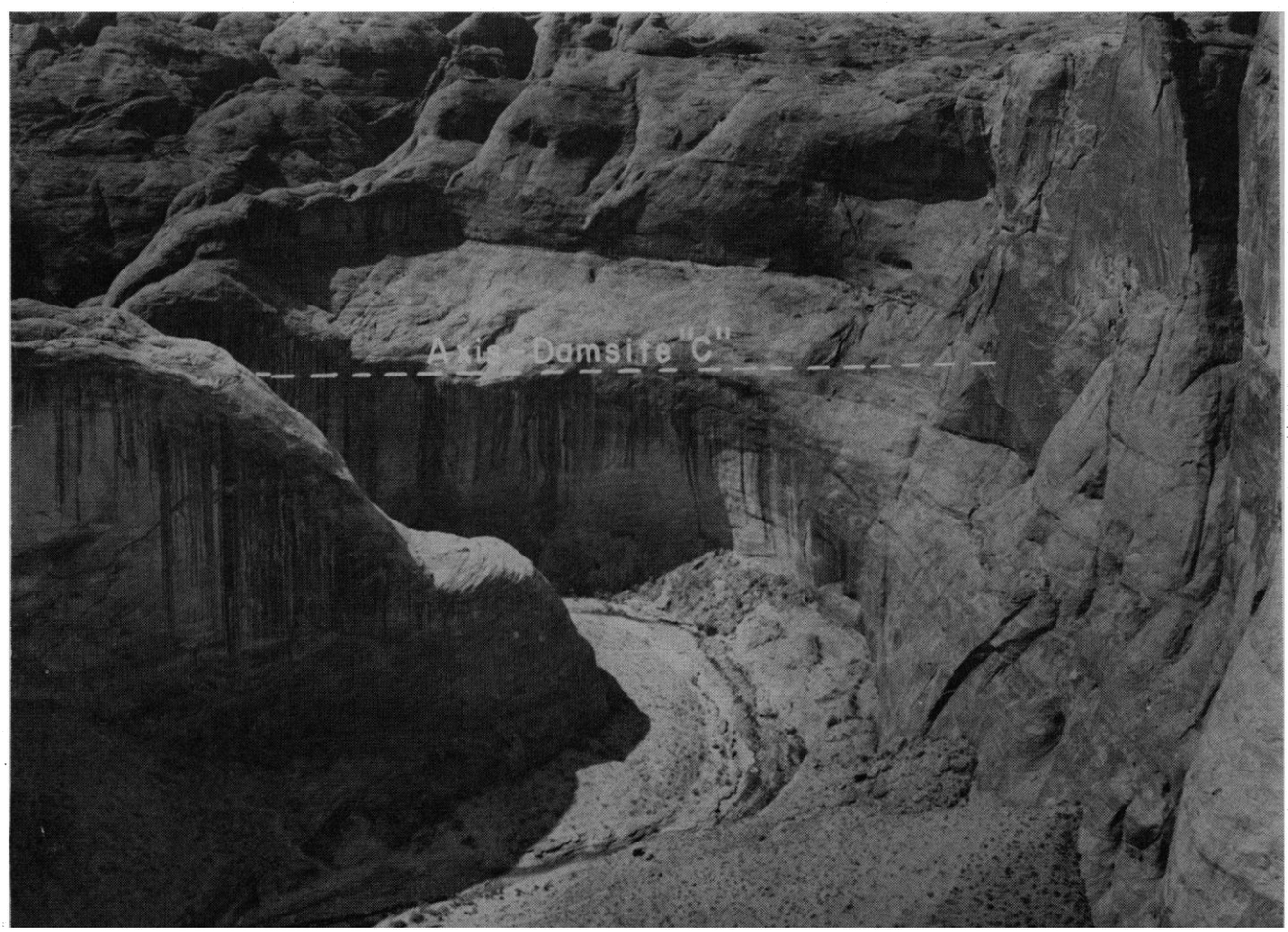
Axis Damsite "B"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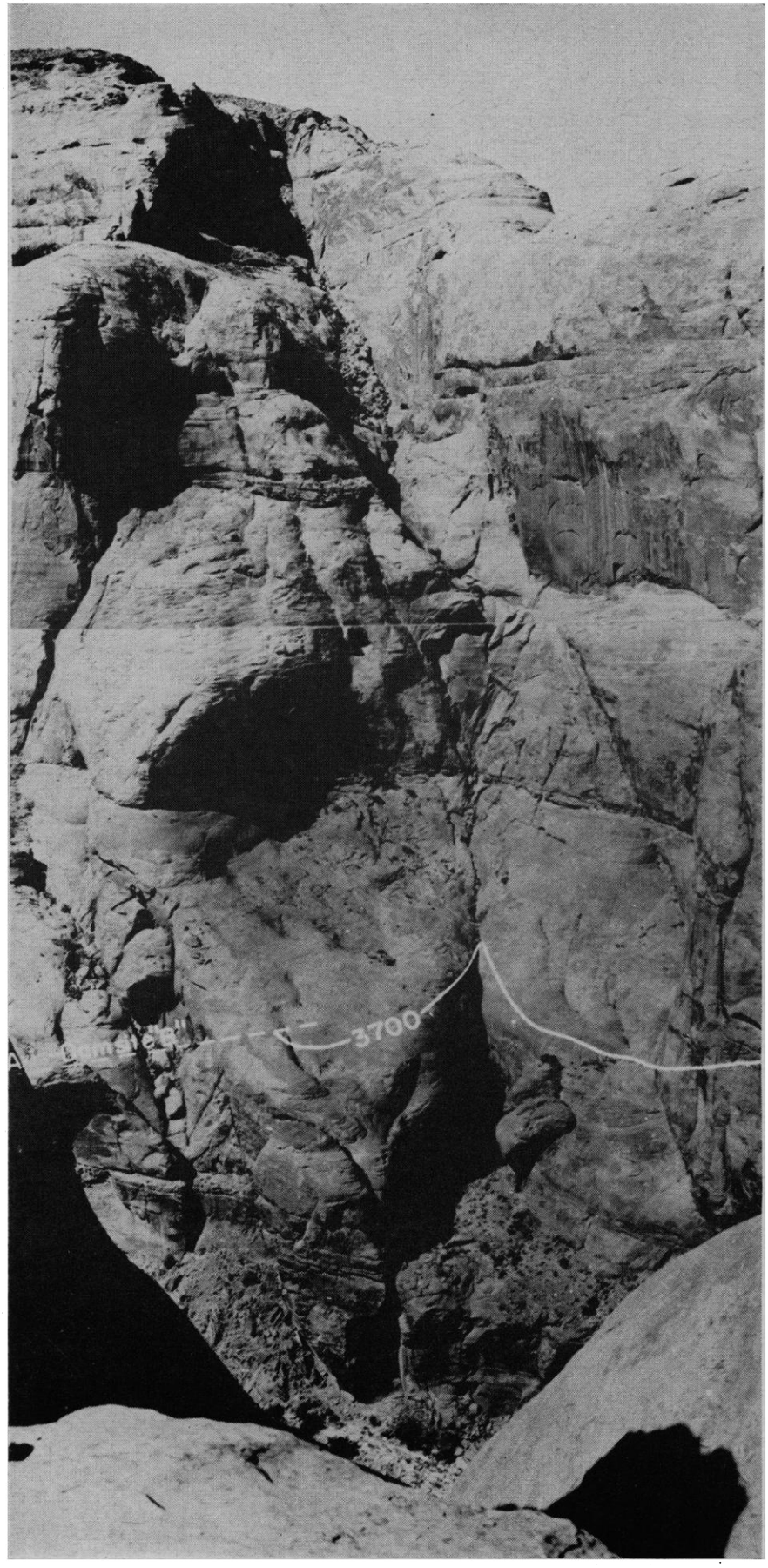


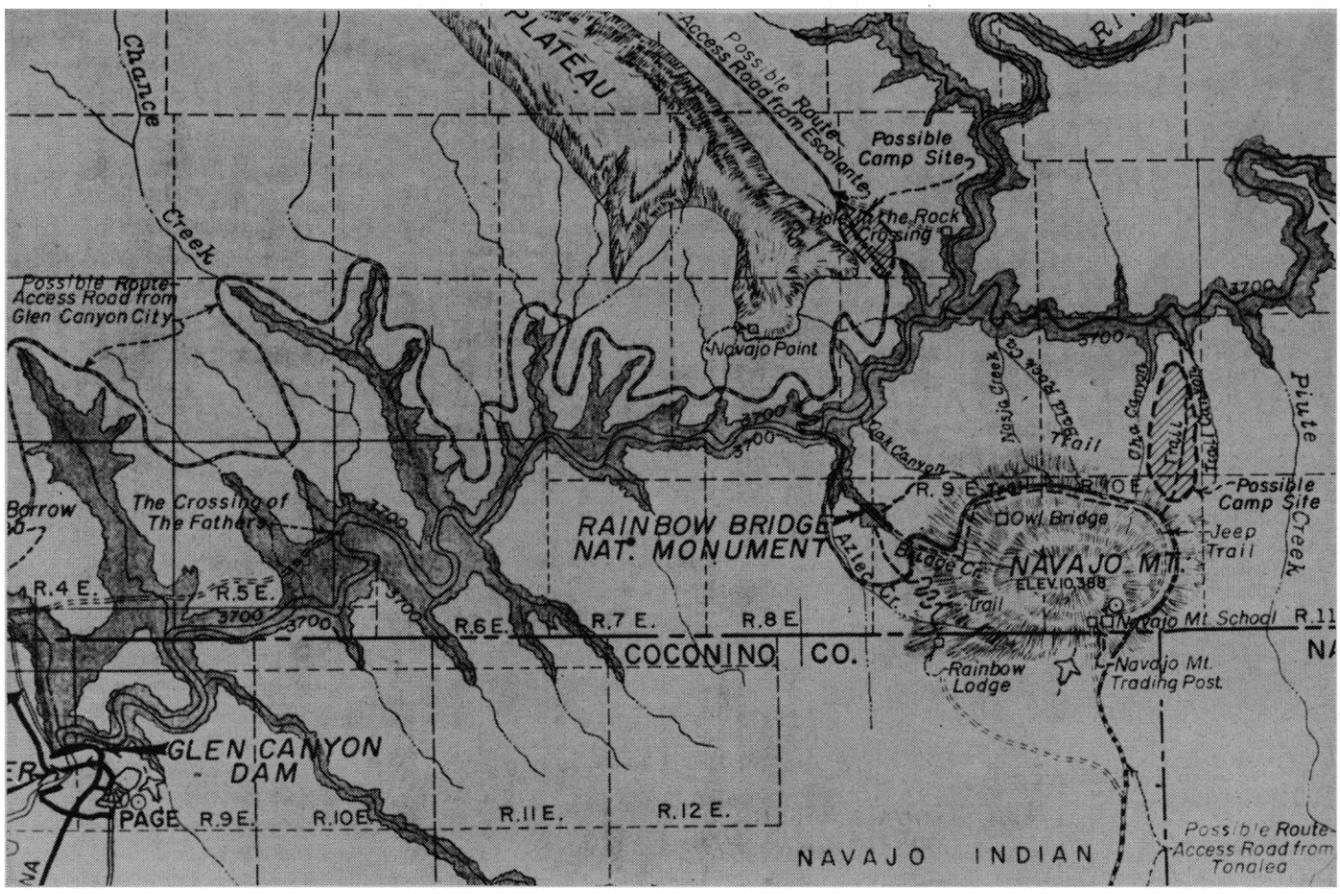
The Alternative

If no protecting works are built, the water, as the reservoir filled, would gradually back up into the monument and pass under the bridge and up the canyon, even beyond the monument. If muddy, silt-laden floods or high water from Bridge Canyon entered the reservoir, the coarse sediment would be deposited where the force of the current was checked after it entered the clear water of the lake. When the reservoir was full, the sediment would be deposited in the canyon, mainly in the narrow gorge above the bridge. As the water level fluctuated in the reservoir, the sediment would tend to be pushed toward the lower water levels farther down in Bridge Canyon, where a delta would gradually accumulate.

In succeeding years, the delta thus formed would slowly grow up Bridge Canyon until, given time and sediment enough, the inner gorge under the bridge would be filled by the delta to the highest level of the reservoir. At this stage of development, probably 50 to 100 or even more years in the future, there would be no water under the bridge. Instead, the small stream would wind through the narrow gorge on top of the sediment, bordered by heavy stands of stream-side vegetation, probably willows and tamarix that would grow there naturally except where the stream kept the channel clear.

During the period when the inner gorge was filling with sediment there would be a zone of fluctuation within that gorge, where the water level would rise and fall. Visitors to the bridge during this period might notice, at times when the lake was not full, a high-water mark at the 3700-foot level and a zone of sediment in the bottom, denuded of vegetation. There might be some unattractive areas during the early stages of sediment deposition, but these would be covered as the inner gorge

Fig. 9 (left). The route over which materials from the mesa top would be lowered to dam site *B*; disfiguring scars would be left on the face of the cliff. [U.S. Bureau of Reclamation] Fig. 10 (top right). Map showing alternative possible routes of access roads to Bridge Canyon protective works. [University of Utah] Fig. 11 (bottom right). A narrow winding section of Forbidden Canyon, along lower Aztec Creek, where road-building would be difficult. [U.S. Bureau of Reclamation]


PLATEAU
Possible Route Access Road from Escalante
Possible Camp Site
Hole in the Rock Crossing
Chance Creek
Possible Route Access Road from Glen Canyon City
Navajo Point
Navajo Creek
Trail
Clay Canyon
Piute Creek
Borrow
The Crossing of The Fathers
RAINBOW BRIDGE NAT. MONUMENT
Owl Bridge
Jeep Trail
Bridge Cr.
Aztec Cr.
NAVAJO MT.
ELEV. 10,388
Trail
Navajo Mt. School
R.4 E.
R.5 E.
R.6 E.
R.7 E.
R.8 E.
R.9 E.
R.10 E.
R.11 E.
R.12 E.
COCONINO CO.
Rainbow Lodge
Navajo Mt. Trading Post
GLEN CANYON DAM
PAGE
NAVAJO INDIAN
Possible Route Access Road from Tonalea
3700

filled. When that happy time arrived, there would be nothing about the appearance of the little brook meandering through the stream-side vegetation to remind the visitor of the former presence of the reservoir in the monument.

The Dilemma

A real dilemma is posed for all concerned. In order to treat this problem objectively as a matter of total conservation, the bridge and its setting in the spectacular canyons must be considered together, regardless of how much of the area is actually included in the national monument. From the air, the whole area is a scenic marvel, and the mammoth bridge is hard to find because its size is insignificant as compared with that of the stupendous setting (Figs. 1, 2, 4, and the cover picture). No matter who administers it after the reservoir is established, there will be public concern over the whole area.

In considering the whole magnificent region, here are the alternatives that must be faced. Should the present law be enforced and adjacent scenic features be permanently scarred and injured in order to protect one small but important sector of the over-all scenic features? Or, to set it in another frame of reference, which would be preferable: (i) backing water up the inner gorge under the bridge and gradually filling the gorge with sandy sediment for about two-thirds of its 70-foot depth without in any way affecting the bridge itself, or (ii) permanently marring the natural scenic beauties of the region, including both approaches to the bridge, making it impossible for anyone to reach the central scenic attraction without passing these unnatural and distracting "protective" works?

To restate it in still another way: To do nothing would allow the area to heal itself naturally within a century and leave no scars; to build the protective works would entail permanently marring the remarkable landscape, not only with the dams and tunnels but also with the construction and equipment accessory to the main work, such as excavations on mesa tops and talus slope, cables, belts or roadways for transporting materials to the dam sites, equipment sheds and camp sites, and accessory roads cut into the faces of narrow canyons. The second alternative, in short, would entail doing exactly what conservationists are trying to avoid—bringing the jarring and marring scars of construction activities into stupendous natural landscapes. In addition, it would require a fantastic investment, estimated to range from $15 to $25 million, and a continuing annual maintenance expenditure.

It is obvious from these comparisons that building the protective works is not a good solution to the dilemma, but conservationists may hold that the principle of protecting the national parks and monuments is at stake and that it is worth the cost in order to preserve the principle. And so it might be if there were not another and better solution to the problem which requires no sacrifice of principle and which requires no change in the present protective law.

This alternative solution must be based upon the concept of protecting the whole area and not alone the Rainbow Bridge National Monument. I here propose that a plan be developed to include the remarkable scenic region adjacent to the monument in a national recreation area to be administered by the National Park Service. It is just as important to protect this surrounding area from desecration as it is to protect the monument. Progress is already being made in this direction. The National Park Service is now preparing a master plan for a Glen Canyon National Recreation Area similar to that now in effect at Lake Mead. The proposed recreation area includes the entire shoreline of the reservoir, 1830 miles in length, and some other, adjacent areas. The area surrounding the Rainbow Bridge might well be included.

By incorporating the monument in the proposed recreation area, the National Park Service would be relieved of treating the two as separate projects and could administer them as a single unit, with a suitable policy for the whole area. The Park Service would then be able to determine what should be done. It is not likely that the answer would be defacement of major features of the landscape.

This is a case which calls for conservationists to do a little soul searching. The fallacy of joining a crusade without a realistic appraisal of the facts should be obvious by this time. It is a fact that the presence of the Glen Canyon Reservoir will open up to the general public, by way of boating on Lake Powell, a thousand enchanting nooks, glens, and alcoves in the tributaries that lead into Glen Canyon, many of which are practically inaccessible without the lake. It will open the vast scenic resources of the interior of the rough country of the Southwest to regulated use under the control of the National Park Service.

Conservationists recognize that in a world faced with a "population bomb" there is as great a need to conserve water for the arid lands of the earth as there is to conserve scenic landscapes. They also realize that there are many other resources that should be conserved and that the relative values must be weighed carefully. They should support both the movement for conservation of water in Glen Canyon and the National Park Service in developing the by-products of the lake as national recreational resources. In addition to opportunities for boating, fishing, photography, and the like, construction of the lake will provide access to areas of magnificent scenery, and all these opportunities are bound to be appreciated in the years to come.

As the years pass into centuries, deltas at the mouths of incoming streams will help to fill the reservoir with sediment. Long before it is completely filled, the lengthening deltas may be used for some purpose or other. What use will be made of these newly made lands remains for the future to decide. If they are maintained as parts of national recreation areas, they may well serve as centers from which visitors can explore the thousand side canyons and scenic attractions that radiate from the main Glen Canyon. Without any barrier dams in Bridge Canyon, Rainbow Bridge would be as accessible as any of the other scenic marvels of the Glen Canyon tributaries.

The major objective of sincere conservationists is to leave the people of the future with a heritage of wisely used resources which will continue to serve mankind through many additional generations.