Grand Canyon: Colorado Dams Debated

The Grand Canyon, carved by the Colorado River over a leisurely 9 million years, is indisputably one of nature's great masterpieces. The politicians of the Pacific Southwest, in something of a hurry, have been at work on a masterpiece of their own—a multi-billion-dollar water project which, while offensive to some tastes, is drawn to a scale impressive by human standards.

Besides two dams in the Grand Canyon, which are the project's most celebrated feature to date, it would include the Central Arizona Project, consisting principally of a large aqueduct running hundreds of miles across Arizona, from Lake Havasu on the Colorado to Phoenix and Tucson; a number of reclamation and water supply projects in other Colorado basin states; and—ultimately the project's keystone—an aqueduct system to bring to the Colorado millions of acre-feet of water from some other river basin, probably the Columbia. The project's initial cost is estimated at $1.6 billion; its ultimate cost is not known, but it would run into additional billions.

Legislation to initiate the project is now before the Interior Committee of the U.S. House of Representatives. The bill, H.R. 4671, will, if ever enacted, be a remarkable achievement of basin diplomacy to which Representative Morris K. Udall of Arizona, the Metternich of the Colorado, will have contributed much.

The proposal represents an intricate, delicate meshing and balancing of the interests of the Upper Colorado Basin states—Colorado, Utah, Wyoming, and New Mexico—with those of the Lower Basin states—Arizona, Nevada, and California. Moreover, it harmonizes the interests of Arizona and California, whose relations with respect to use of the Colorado have been marked by much disharmony. It retains certain elements, such as the canyon dams and the concept of water importation, of the Pacific Southwest Water Plan submitted to Congress in 1964 by Secretary of the Interior Stewart L. Udall, the congressman's brother.

The feeling of honest compromise inspired by H.R. 4671 within the Colorado basin is not the feeling the bill has always produced outside the basin. Its provisions for a water importation study have generated fears in the Northwest that the Columbia's now abundant waters may be seriously diminished by demands from the Southwest, a region whose political power has been growing as rapidly as its thirst.

Nationally, conservationist groups have become alarmed by the proposal to build the canyon dams. The conservationists, led chiefly by the Sierra Club, have had some success in contributing to the atmosphere of doubt and criticism that seems to have enveloped H.R. 4671. Indeed, the opposition appears strong enough to make passage of the bill without major alterations doubtful—yet any important change in the measure could cause the compromise among the basin states to fall apart.

The intricacies of Southwest water politics, fully revealed in H.R. 4671, are best explained by the history of the region's policies regarding use of the Colorado. The "Law of the River," as developed through two interstate compacts, several acts of Congress, a treaty with Mexico, and court decisions, apportions the Colorado's water among the various basin states and Mexico. The apportionments are based on an assumed annual flow of 17.5 million acre-feet a year—7.5 million for the Upper Basin, 7.5 million for the Lower Basin, and 1.5 million for Mexico.

However, from 1906 to 1965 the river's total yearly flow averaged only 15 million acre-feet, with annual flows ranging from the record high of 24 million in 1917 to the record low of 5.6 million in 1934. Thus far, the deficit has existed solely on paper because only California has in fact been withdrawing its legal quota. California, entitled to 4.4 million acre-feet, has been withdrawing 5.1 million by dipping into the unused share of other states.

As other basin states begin withdrawing their full allowances, through future reclamation and water supply projects, the need to conserve and augment the Colorado's flow will become critical. Estimates as to when the critical moment will arrive vary, but it is believed to be not more than a generation away.

The purpose of H.R. 4671 is to "make the river whole" by increasing total water available as well as to authorize, for immediate construction, the Central Arizona Project (CAP) and five reclamation projects in Colorado and New Mexico. The canyon dams and the importation of water from outside the basin are both viewed by the bill's sponsors as essential to their long-range objectives. The dams would serve no water storage function, but, once having paid for themselves from the sale of the electricity that they would generate, they would be expected to contribute to a new Lower Basin Development Fund. This fund, which would also receive the proceeds from water sales and part of the power revenues from Hoover dam and other existing dams on the Lower Colorado, would be used to reimburse the federal treasury for about 90 percent of the $525 million to be spent on CAP and for part of the much larger sums to be spent on the aqueducts, pumping stations, and other works needed to import water to the Lower Colorado.

The bill would direct the Secretary of the Interior to study various possibilities for augmenting the Colorado basin's water supply. These include water salvage and conservation, weather modification, and desalinization of sea water; but, in the sponsors' judgment, the most promising possibility is water importation.

The study would contemplate importing, initially, up to 6.5 million acre-feet of water a year (including 2 million acre-feet to the Upper Basin), which would make up the deficit under present quotas and provide for additional needs that arise. Another 2 million acre-feet might be withdrawn from the exporting basin (or basins), but diverted to water users along the route to the Colorado. The bill was amended last week to have the study cover West Texas, which is not part of the Colorado basin but is potently represented in Congress. The deadline for completion of the importation plan, together with the supporting feasibility studies

and cost estimates, would be 31 December 1970.

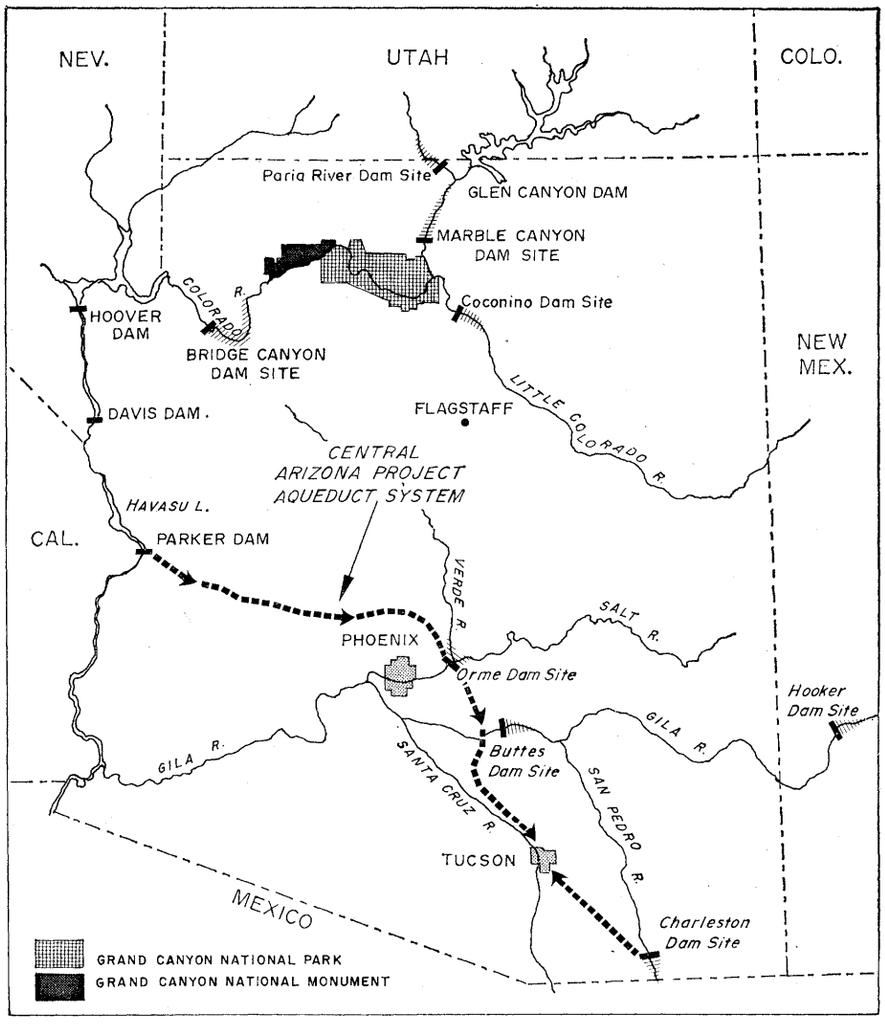
Arizona's need for CAP, deemed urgent because of the steady loss of existing farm land as ground-water supplies decline and pumping becomes uneconomic, is the great driving force behind H.R. 4671. Representative Udall concedes that CAP might be financed without the canyon dams, but he contends that the dams, dubbed "cash registers" for the Development Fund, are needed to help finance the importation system and other Lower Basin projects of the future.

In any event, if either the provision for the dams or that for the importation study were struck from the bill, the Arizona delegation might find that its basin allies, who were expected to support the provision for CAP, had vanished, like Indians into the wilderness. In fact, even with the revenue-producing dams and the importation study provided for in the bill, Arizona has had to make a major concession in order to obtain California's support for CAP. Arizona has agreed to give California's quota of 4.4 million acre-feet priority over its own quota of 2.8 million acre-feet, which the U.S. Supreme Court confirmed in 1963 after 12 years of litigation.

The five Upper Basin reclamation projects—three of them too marginal to get Bureau of the Budget approval—have been included in H.R. 4671 as part of the price Representative Udall has had to pay for the state of Colorado's support for CAP. Udall is not hostile to reclamation in the Upper Basin, but inclusion of the five projects, which would be built at a total cost of $361.4 million, does not make his bill more attractive politically. Colorado can speak softly on such matters and still be heard. One of her citizens, Representative Wayne N. Aspinall, is chairman of the House Interior Committee.

The foregoing sketch of basin politics does not do full justice to the complexities of the subject but is to be taken as a primer from which one may safely conclude that Colorado water policy is not arrived at by pure reason. Plans made for one part of the basin must take into account the desires and interests, legitimate and otherwise, of every other part of the basin.

Moreover, water project development in the West is characterized by a high degree of institutional rigidity. The policies of the Interior Department's Bureau of Reclamation, and the laws which govern those policies, are such



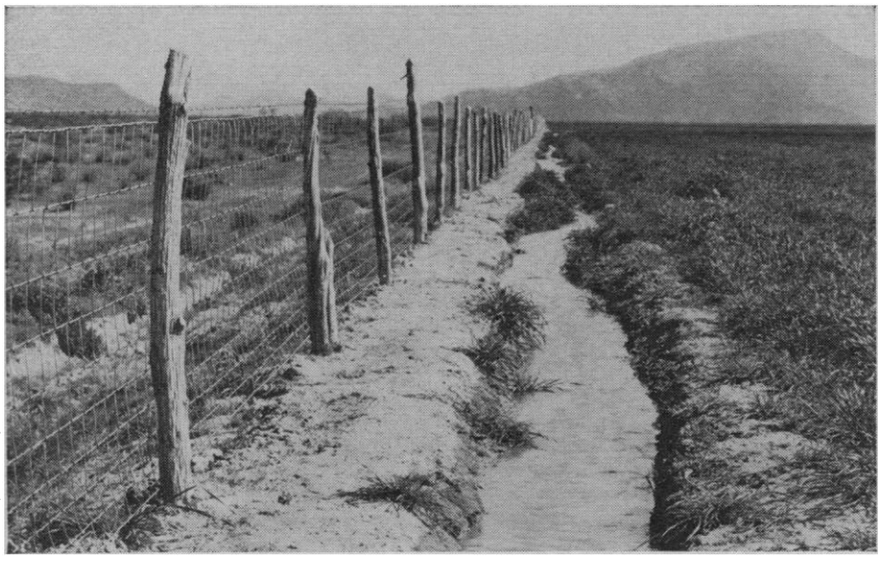
Central Arizona Project aqueduct system, to bring water to the Phoenix and Tucson areas, would be financed in part from water sales, in part from power revenues expected eventually from the proposed Bridge and Marble Canyon dams, and in part with funds from the existing Hoover, Parker, and Davis dams. The Little Colorado and Paria dams would serve only to catch silt. Orme Dam, near Phoenix, would create a storage and flood-control reservoir at the end of CAP's main aqueduct. The Buttes, Hooker, and Charleston dams, all part of CAP, would regulate the flow of the Gila and San Pedro rivers.

that decisions on water projects are made within a rather narrow range of choice. The Bureau's contribution to the development of the West, as in the Salt River Project which has made modern Phoenix possible, cannot be gainsaid. But the Bureau cannot be expected to render objective judgments when faced, say, with a choice between recommending the construction of power dams in the Grand Canyon and recommending the construction of steam plants fired by the Southwest's abundant coal or by nuclear fuel.

The Bureau never has built thermal plants. It is not eager to start a fight with the private utility industry by proposing to build some. In fact, Secretary Udall has been making peace with the utilities by finally reaching agreements, after long controversy, for the sharing of cost-saving interregional transmission networks.

Traditionally, the Bureau has looked, with the blessing of Congress, to hydroelectric plants as the revenue-producing units for its "basin account," a device sometimes used to encourage acceptance of water projects which would have trouble standing on their own. Representative Aspinall and many of his colleagues on the Interior Committee, which is dominated by Westerners, have, or think they have, a vested interest in continuing to have things done in the traditional manner.

To no one's surprise, when the Pacific Southwest Water Plan was proposed in 1964, the Bureau of Reclamation recommended the construction of the Bridge Canyon and Marble Canyon dams.



Central Arizona farms depend on life-giving irrigation.

Although H.R. 4671 would authorize both dam projects, the Johnson administration has recommended the construction now of only one—the $238.6-million Marble Canyon dam. This dam is planned for a site 12.5 miles north of Grand Canyon National Park but still within the area known to geologists as the Grand Canyon.

The Bureau of the Budget, speaking for the administration, has said that a decision on Bridge Canyon dam, which would cost an estimated $511.3 million, should be deferred. The Bureau has recommended the establishment of a national water commission and indicated that this commission should study the dam's effect on Grand Canyon National Monument and National Park, along with the dam's relation to regional water needs and the various alternatives for meeting those needs.

Bridge Canyon dam would be in the Grand Canyon's lower reaches, well below the monument and the park, but its 93-mile-long reservoir would extend through the entire length of the monument and through 13 miles of that part of the canyon's inner gorge which forms the park's northwest boundary. Rising to a height of 736 feet, the dam would have a generating capacity of 1.5 million kilowatts, compared to the 600,000-kilowatt capacity of the 310-foot Marble Canyon dam. Having better than twice the other dam's potential for production of power and revenue, the Bridge Canyon dam is the one the Bureau of Reclamation and the sponsors of H.R. 4671 really want.

The Bureau is, to say the least, doing nothing to discourage an idea, which has been circulating among the bill's sponsors, that a deal should be struck with the conservationists. The proposition would be (i) to abandon the proposal to build Marble Canyon dam and to have the National Park's boundaries extended northward to take in Marble Canyon, and (ii) to build Bridge Canyon dam with the agreement that this dam would be the last Grand Canyon dam ever to be built. But there is virtually no chance that the conservation groups—certainly not the Sierra Club—will concede that Bridge Canyon dam should be built. They can be expected to continue denouncing the Bridge Canyon proposal as contrary to the Grand Canyon National Park Act. The act would permit dams and reservoirs necessary for reclamation projects to be built in the park, but only when such construction is consistent with the park's primary purpose of preserving the canyon's scenery, wildlife, and "natural and historic objects."

Representative John P. Saylor of Pennsylvania, the Interior Committee's ranking Republican member and a caustic critic of the Bureau of Reclamation, has introduced a bill drafted by the Sierra Club that would enlarge the park to take in the entire Grand Canyon from Lee Ferry at the beginning of Marble Canyon to Grand Wash Cliffs at the head of Lake Mead. The bill would prohibit construction of any dams in the park.

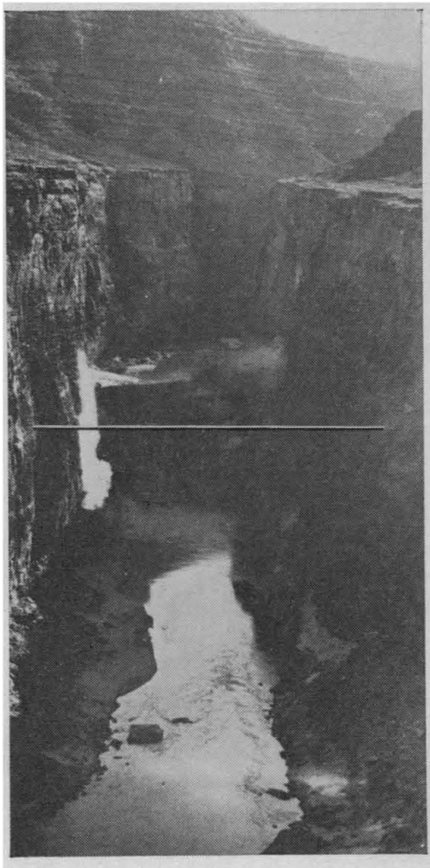
Ironically, the Sierra Club and the Bureau of Reclamation both revere, as a spiritual antecedent, John Wesley Powell, the one-armed Union Army veteran and geologist whose Grand Canyon expedition of 1869, by small boat, was one of history's great adventures.

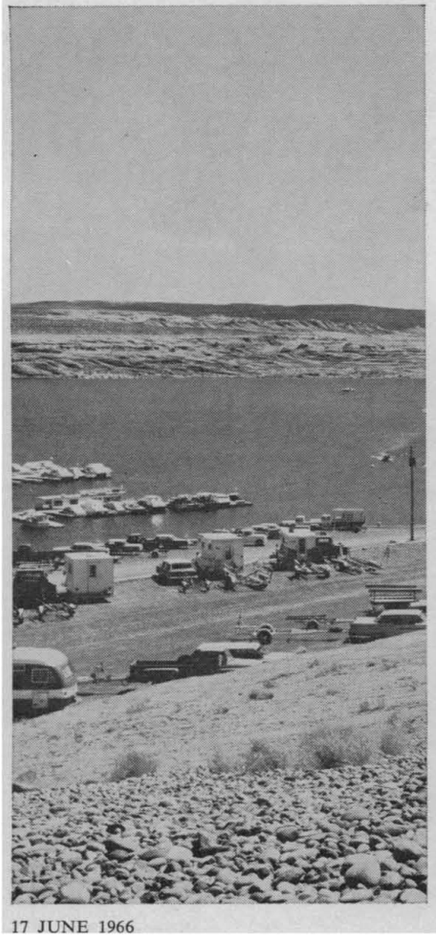
"We are three-quarters of a mile in the depths of the earth," wrote Powell in his journal, "and the great river shrinks into insignificance, as it dashes its angry waves against the walls and cliffs, that rise to the world above; they are but puny ripples, and we are but pigmies, running up and down the sands, or lost among the boulders. We have an unknown distance yet to run; an unknown river to explore. What falls there are, we know not; what rocks beset the channel, we know not; what walls rise over the river, we know not. Ah, well! we may conjecture many things. The men talk as cheerfully as ever; jests are bandied about freely this morning; but to me the cheer is somber and the jests are ghastly."

Powell's journal provides a classic account of a journey down a "wild river"—a term much used by conservationists, including the Secretary of the Interior. According to Georgie White, a white-water adventurer who has gone down rivers in Alaska, Canada, and Central America as well as in the Southwest, the Colorado, on its 280-mile course through the Grand Canyon, is the wildest river of them all. The only point of contact with the outside world is at Phantom Ranch, the Park Service camp on Bright Angel Creek for hikers and mule riders who take the Kaibab or Bright Angel trail to descend into the canyon from the South Rim.

The Sierra Club wants to preserve the free-flowing river—all of it, not just the 116 miles that would be left between the foot of Marble Canyon dam and the upper end of the reservoir behind Bridge Canyon dam. The club wants the inner gorge left undisturbed, preserving a unique geological record and the river which helped to write it. The club is outraged that spots such as Vasey's Paradise, a place of mosses, ferns, and flowering plants below a fountain that gushes from the side of Marble Canyon, would be drowned by the water rising behind Marble Canyon and Bridge Canyon dams.

The National Park Service, in a 1963 report, also criticized the Bridge Canyon dam proposal. Edwin D. McKee, now with the U.S. Geological Survey, was quoted as saying, in a paper prepared in 1942 when he was a Park





Bridge Canyon dam, a 736-foot-high concrete-arch structure shown by an artist on the photograph above, would create a reservoir which, in its lower reaches, would nearly fill the Grand Canyon's inner gorge. Marble Canyon dam, as indicated by the line in photograph at upper left, would stand 310 feet high—its top nearly 400 feet below the rim of the inner gorge. This dam would back water upstream for almost 55 miles to the tail water of Glen Canyon dam (below). New roads and the entire new town of Page, Arizona, had to be built before construction of the Glen Canyon project, authorized in 1956 and recently completed, could be started. Marinas (lower left) are springing up as increasing numbers of motorboaters, water-skiers, and fishermen visit Glen Canyon's huge reservoir, Lake Powell.

Service naturalist, that the Bridge Canyon project, which was already being considered, would obscure important geologic features. The greatest losses, McKee said, would be in and to the west of Toroweap Valley, in the National Monument, where the rising waters would conceal features illustrating local volcanism and the early stages of canyon cutting, as well as remnants of lavas that flowed down the river channel and sediments showing that, in two places, lakes had formed behind lava dams.

The Park Service observed that the upper reaches of the reservoir would lie between Havasu Creek and Kanab Creek, an area deemed by some to be among the most scenic in the National Park. Silt and debris would accumulate in this section of the park, the report predicted.

A Diplomatic Silence

Strangely, however, the report said the Marble Canyon dam would have little effect on the National Park. This judgment conflicts with the view held by Park Service men now serving at Grand Canyon. It is fair to say that for the National Park Service, an Interior Department agency, to give no quarter in criticizing proposals favored, or likely to be favored, by the Bureau of Reclamation, the Secretary of the Interior, and the House Interior Committee would not be playing the game in the most prudent bureaucratic manner.

Bureau of Reclamation officials insist that the objections to construction of the two dams that have been raised by the Sierra Club and its allies in the Park Service and elsewhere have been wildly pessimistic. For example, the Bureau discounts predictions that construction of Marble Canyon dam and of Coconino dam, which would be built on the Little Colorado River to keep Bridge Canyon reservoir from silting up, would leave the Colorado a tame river—too tame, even during spring runoffs, to flush out the boulders and other debris that wash into the river from side canyons to form natural dams and rapids.

The Bureau also contends that releases of water for power generation during hours of peak demand would keep the channel scoured and the river flowing freely. Siltation below Kanab Creek, where the Bridge Canyon reservoir would begin, would be minimal because the Coconino dam, together with Marble Canyon dam and the de-silting dam on the Paria River, would turn the now silt-laden Colorado into trout water, the Bureau says.

The Bureau regards conservationists of the Sierra Club type as people who are possibly sincere, but impractical and not a little selfish. Why, otherwise, would they oppose dam projects which, besides serving as "cash registers," would open up the inner canyon to tens of thousands of sightseers who would take boat trips on the reservoirs? Many of the conservationists, for their part, look on the reclamationists as Philistines who would gladly count in "fishermen man-days" to improve a project's cost-benefit ratio but who sneer whenever anyone mentions natural beauty.

The Sierra Club says that the dams, besides being a desecration, would not be the best means of producing revenues for the Lower Basin Development Fund. One club study uses the Bureau of Reclamation's own figures as a basis for concluding that the Central Arizona Project could be paid for without any new revenue-earning facilities at all—just by using the future earnings of Hoover and other existing dams.

One expert witness to testify for the Sierra Club at recent House hearings on H.R. 4671 was Alan P. Carlin, a Rand Corporation economist. He said that neither Marble Canyon nor Bridge Canyon dam, despite the admitted flexibility of hydroelectric power in serving peak demands, would be as efficient as a nuclear plant, or a nuclear plant combined with a pumped storage plant, which would use the same water repeatedly by pumping it from a lower to an upper storage basin and running it through the turbines at hours of peak demand. Not only would these plants be cheaper to build than the power dams but transmission costs would be lower, Carlin said. They would be built, not in the bowels of the earth, but in or near urban areas of high power demand.

Representative Udall and the Bureau of Reclamation have, of course, contested Carlin's findings. But Udall himself has said that the most significant problem raised by proposals to build nuclear or coal-fired generating plants as an alternative to the dams is not economic but political.

Udall has contended, moreover, that, if the federal government doesn't build the dams, they will be built by nonfederal interests. License applications by the Arizona Power Authority and the City of Los Angeles are now pending before the Federal Power Commission, which 2 years ago was directed by Congress not to grant licenses for the two sites before 31 December 1966. Even with the expiration of the licensing moratorium, however, the commission may find itself under restraints. Last December a U.S. Court of Appeals told FPC it would have to reconsider its decision to permit construction of a pumped storage plant at Storm King Mountain on the Hudson River. The preservation of natural beauty should be a basic concern in comparing the desirability of the proposed plant with possible alternatives, the court indicated.

Because the water importation study is essential to the compromise on H.R. 4671, resistance by the Northwest to the bill's provision for such a study may prove as great an obstacle to passage as the conservationists' opposition to the Grand Canyon dams. This study is not easily reconciled with the study which the proposed National Water Commission would undertake. A bill to create the commission, submitted by the administration and sponsored by Senator Henry M. Jackson of Washington, chairman of the Senate Interior Committee, and 48 other senators, was passed by the Senate on 9 June.

The commission, to be made up of seven private citizens, would have 5 years to study water resource policy problems in a national perspective. Its mandate, as defined in the Interior Committee's report, would be to consider alternative solutions to water problems "without prior commitment to any interest group, region, or agency of government."

Coolness in the Committee

The commission bill has struck few sparks of enthusiasm in the House Interior Committee, where its fate now rests. Supporters of H.R. 4671 are understandably reluctant to trust such a commission to come up with a water importation plan for the Colorado basin. Yet, unless they can agree to do so, the reclamation states will be seriously divided on the bill, for there is little chance that Senator Jackson and the Northwest ever will agree to the importation study. It is now proposed that the study be placed under the aegis of the new interagency Water Resources Council, which Secretary Udall chairs, but this supposedly mollifying gesture isn't likely to soften the opposition. Indeed, Jackson has rejected even a proposal to have the

national commission give priority consideration to the Southwest's water needs.

For Secretary Udall, who must feel some anguish at the criticism he has received from his friends in the conservation movement over the dam proposals, the National Water Commission might well prove a blessing. The commission, if it ever receives House approval and is set up, could search for ways to loosen the regional and institutional rigidities that now bind water resource development planning. It is a large task, but the commission might even discover a solution to the Southwest's water problems that would keep dams out of the Grand Canyon and allow Colorado basin politicians to keep their heads above water.—LUTHER J. CARTER

International Science Activities: Some New Vistas Open

The axiom that science knows no frontiers seems to have been respected in a literal way until the Napoleonic era, at least in the Western world. During the American Revolution Benjamin Franklin was playing by the accepted rules when he wrote a safe-conduct letter addressed to captains of American naval vessels and privateers in behalf of Captain Cook, who was sailing off to explore the South Seas.

England and France were at war with each other as often as not during the 18th and early 19th centuries, but British and French men of science corresponded freely, passed through the lines to visit one another and conduct scientific business, elected each other to their academies, and mutually deplored the work of the politicians.

But the rise of the national state, the increasing importance of science and technology in warfare as the long day of the musket and massed formation passed, and the growing efficiency of communications and police techniques blurred the old civilized distinction that science is strictly the affair of scientists and war the affair of politicians and professional soldiers.

For most scientists in the United States today, however, the spirit of the Enlightenment still, in some form, survives. The credo that science is international owes something as well to the practical belief that there can really be no secrets in basic research and that more is to be gained from the open exchange of ideas and mutual cooperation than from scientific isolationism. A good many scientists unquestionably also see the international dialogue among scientists as one way open to them in the nuclear age to help prevent catastrophe.

It is unquestionably much more difficult now than it was 200 years ago to separate science from politics. Old-fashioned nationalism has been exacerbated by ideological differences which complicate relations particularly between the United States and Western European nations on the one hand and Communist countries on the other. Forces which propelled a generation of great theoretical scientists to the United States from Germany, Italy, and Hungary also produced Pontecorvo, Klaus Fuchs, and the fictional Dr. Strangelove.

The Soviet Union, with its old academic ties to Western Europe, coexists with the West more comfortably scientifically than it does politically. Mainland China, with its cultural pride, its sense of outrage over injuries and insults inflicted by the West, and its special hatred of the United States for being the most powerful Western nation and so deeply involved in Asia, is something entirely different.

In the United States, the international activities of American scientists have been to a major degree institutionalized. The apparatus, however, has not yet fully developed, although it is clear that the most important organizations, from both the policy and the administrative standpoints, are the State Department, the Office of Science and Technology (OST) in the Office of the President, and the quasi-governmental National Academy of Sciences.

The United States does not have the equivalent of the minister of science found in the cabinets of many European countries. Our closest approximation is the director of OST, who is also the President's science adviser and often represents the President at international meetings. But the OST staff is currently small and fully occupied with domestic problems. A committee now, however, is looking into the possibility of OST's engaging in greater activity in international scientific matters.

For at least a decade the State Department has been seeking, without great success, to acquire the scientific competence it needs in the second half of the 20th century. State's difficulties in this sphere have been dramatized by a failure over the past year and a half to fill the top scientific job in the department, that of director of the Office of International Scientific and Technological Affairs.

One difficulty is that the role of the science director has not been well defined. The department badly needs to be able to understand the significance of scientific and technical developments, in this country and abroad, relevant to foreign policy decisions. Lately, the department has taken steps that indicate it is more serious about increasing its competence than it has been before. But it is still not clear whether the science director, who is also science adviser to the Secretary of State, is to be an administrator running the science attaché program and overseeing our activities in international organizations and other functions of the department in which science is involved, or whether he is to act primarily as a policy adviser and scientist-diplomat. Problems of science in the State Department and recent developments will be discussed in another article in this space.

The scientific community has not rallied energetically to the aid of State, perhaps because of a feeling that science has, up to now at least, not been taken seriously in Foggy Bottom. It is probably true that in international matters scientists have preferred to work through the Academy, which the scientists regard as their own and as essentially nongovernmental despite the federal source of most of its funds.

Historically, the academies have been the instruments of international activities. The Royal Society and the French Academy of Sciences, both founded in the 1660's, set the style. And our own National Academy of Sciences, established 200 years later, followed the lead zealously from the start, since the Unit-