enough air to allow oxidation of HC and CO but not enough to encourage formation of NO_x.

Currently occupying center stage in the standards disputes are sulfates and NO_x. Sulfates became a matter of great concern in 1973 (*Science*, 26 October 1973) when it was discovered that sulfur from gasoline was oxidized by catalysts into sulfuric acid. Sulfur dioxide from tail pipes eventually turns into sulfuric acid anyway, but usually in the upper atmosphere. With catalysts, it comes straight out of the tailpipe in amounts up to ten times as great as in cars not equipped with catalysts. Sulfuric acid is bad for people with respiratory and lung problems.

For a while some people thought the oxidation catalyst might turn out to create more evil than it eliminated, but now, according to an EPA researcher at Research Triangle Park, North Carolina, it's beginning to look as

Antarctica's Future: Will Oslo Talks on Resources

The global sweepstakes for scarce fuel and minerals could one day change the character of Antarctica, which has been reserved hitherto by treaty for scientific and environmental activities. Since the energy crisis began, interest has been growing both here and abroad in Antarctica's minerals and its untouched continental shelf, which could contain large reserves of oil and natural gas. This week in Oslo, Norway, the 12 nations who are parties to the Antarctic Treaty, which governs the area but says nothing on the question of resources, will debate the subject.

Embarrassingly, the United States will probably go to the Oslo meeting with no position on the question of Antarctic resources. The U.S. government is divided as a result of internecine warfare among agencies, some of which want the United States to press for an international solution. The federal energy agencies want this country to keep open the option of unilaterally recovering the resources. It is still a tossup in government circles as to whether political pressure generated by the energy crisis will succeed in reshaping American policy toward the icy, almost deserted, South Pole continent.

The current meeting is a preliminary session to a regular biennial meeting, scheduled for next June in Oslo, of the parties to the treaty. By then, the 12 governments involved must decide their own positions. They could seek to rule out any exploitation of Antarctic resources in the near future on the grounds that the continent should be saved for environmental and scientific uses. Or they could decide to open the door to eventual resource development by working toward an international regime or some other mutually acceptable arrangement. But if these countries fail to agree, there is some chance that nations having territorial claims, which the treaty holds in abeyance, will decide to assert them so they can get the resources themselves. Then the treaty would be meaningless and international conflict could break out.

The stakes involved in Antarctica are large. One U.S. government estimate puts the resources of the western continental shelf at 45 billion barrels of oil and 115 trillion cubic feet of natural gas.

There is an environmental stake, too. Waters formed in Antarctica supply nutrients to the oceans of the world as far away as the Northern Hemisphere; the global impact of a series of oil spills could be enormous. Politically, the 12 treaty nations have a stake in maintaining their rather remarkable track record of keeping the continent demilitarized and peaceful.

Even the scientists' stake is significant: Scientists of many nations, including those of the Soviet Union, were engaging in cooperative research in Antarctica long before the present era of détente. If their governments started quarreling over conflicting territorial claims these relationships would deteriorate.

The Antarctic Treaty, which demilitarizes the continent, was drawn up largely at the instigation of the United States soon after the International Geophysical Year of 1957–1958. The treaty makes no ruling on the territorial claims that seven nations, but not the United States, have made in Antarctica.* It states only that "no acts or activities" shall take place asserting or denying territorial claims while the treaty is in force. This freezes the claims, so to speak, and thoroughly blurs the question of property rights on the continent.

On the question of resources, the treaty says not one word. Because of this silence, the New Zealand delegation at the 1972 biennial meeting suggested that the question of resource exploration be put on the agenda for the meeting in Oslo.

The United States, then, has had almost 3 years to formulate its position on the issue. As of this writing, it appeared that no agreement had been reached and hence that the American delegation might go to Oslo with instructions to keep quiet so as not to prejudice any position that the government might take later. In the view of some, silence on the part of the United States would be harmful, since other nations are used to this country's taking the lead in Antarctic Treaty meetings. "We are already arousing the suspicions of other countries," says one source.

Interviews with several officials close to the classified discussions prior to the meeting reveal the divisions among agencies. The Federal Energy Administration (FEA) and the Department of the Interior (DOI) seem to argue that the United States can adopt a wait-and-see attitude on the resource issue and on the Oslo negotiations. Leigh Ratiner, Director of the DOI Ocean Mining Administration, who speaks for DOI in the interagency discussions, told *Science* that, in his personal view, unilateral resource activity by one country is unlikely in the next few years. As to the Oslo meetings, "The United States can go to the meetings and listen. No

* They are: United Kingdom, France, Norway, New Zealand, Australia, Argentina, and Chile. The claims of the United Kingdom, Argentina, and Chile overlap and their conflicts over boundaries have never been settled. The other parties to the treaty are Belgium, Japan, the Soviet Union, and the United States.

though the risks have been overblown. The data on sulfates are pretty ambiguous and, he says, "we have only scratched the surface" on sulfate research.

Recent results of research on NO_x, however, are beginning to persuade some people that the dangers of these emissions are greater than was previously thought. Nitric acid is believed to be even worse for the health than sulfuric acid, and recent studies have implicated NO_x not only in respiratory problems but in such other far-flung disorders as nephritis and increase in blood lipids.

What EPA and Congress finally decide about sulfates and NO_x will affect the direction of emission control technology. If an emission standard is created for sulfates, a move that is under consideration at EPA, this would limit the use of oxidation catalysts and force industry to move to the three-way cata-

Mean That Scientists Have to Move Over?

policy is going to be made there, as far as I know," Ratiner said.

On the other hand, the National Science Foundation (NSF), which has the main responsibility for U.S. activities in the Antarctic, and the environment agencies are said to be arguing that U.S. leadership is too important to the functioning of the treaty for this country to just sit back and listen. In a recent speech, James E. Heg, Chief of Polar Planning and Coordination at NSF, warned: "To the extent the United States can continue to maintain . . . its position of leadership in the consultative forum [the biennial treaty meetings] during the consideration of such potentially divisive issues as resource exploitation, the treaty will continue successfully to regulate the affairs of states in this unique and important area."

Apparently U.S. policy-makers were planning concrete suggestions at the Oslo meetings. According to well-placed sources, a 1973 classified National Security Decision Memorandum (NSDM) completed by all agencies involved concluded that the United States should actively seek an agreement that would exclude unilateral action by any one nation—including the United States. The NSDM allegedly also recommended that the United States discourage any exploitation-linked exploration and any exploitation in the near future, until the treaty nations had developed an approach. As of late 1973, all signs were that U.S. policy seemed to be chugging smoothly along toward an "internationalist" solution to the Antarctic resource issue.

The train was derailed, however, when the energy crisis struck the country in the fall of 1973, and the new energy bureaucracy in Washington began looking at the question. Well-placed sources say that the FEA and the DOI became anxious that the United States not close off the option to recover resources from Antarctica unilaterally, and tried repeatedly to have the NSDM amended. Since, the White House has approved the NSDM but there is still enough disagreement among agencies on whether to implement it that the document's impact has been effectively neutralized. On paper, the United States has a policy; in reality, it does not.

Since the New Zealand delegation brought up the subject in 1972, the debate over future Antarctic policy has revolved around two main points. One is the question of how much oil and gas is down there and whether exploiting it is economically feasible. No one, to be sure, has ever found the offshore resources, although the *Glomar Challenger* drilling team found traces of ethane, methane, and ethylene on the shelf in 1972, which could indicate the presence of oil and natural gas. The U.S. Geological Survey, which at one time estimated that 45 billion barrels of oil and 115 trillion cubic feet of natural gas could lie in the western shelf, has issued a new report which does not estimate volume but draws analogies between the Antarctic shelf and the shelves of Australia, South America, and Africa which do produce oil and natural gas.

On the other hand, the coastal waters of Antarctica are 500 meters deep, or more than twice as deep as most offshore drilling sites. Severe storms and huge icebergs would make oil drilling an order of magnitude more difficult than in the North Sea according to one NSF scientist. Moreover, a leak from a hole under the ice cap could take as much as a year to plug up. At what point recovery of oil and gas in Antarctica becomes economically feasible would seem to be anybody's guess.

A second debated issue is the environmental impact of resource recovery on Antarctica's fragile ecosystem. Its coastal waters are the site of the formation of so-called "dense" water, which is very cold and rich in nutrients and which slides downward off the shelf to the deep ocean bottom and then circulates northward into the North Pacific and North Atlantic, feeding organic life in these oceans. Extensive pollution of this dense water could possibly have an impact, albeit an unknown one, on the living resources of other oceans. In addition, the protein-rich crustacean, krill, in Antarctic waters, which is estimated to be equal to the amount of fish protein in the oceans of the world combined, could be affected by oil spills. Russell Peterson, Chairman of the Council on Environmental Quality, says, "It is clear that activities of any kind in the Antarctic must be undertaken with adequate considerations of environmental factors and the needs for environmental protection." However, those who favor facilitating development of the resources claim that the continent already doesn't deserve the epithet "pristine," which is often applied to it. They argue that scientists have done their share to pollute its ecosystem already.

Although government policy is still undecided, this much seems clear. The era when scientists could enjoy Antarctica as their unique playground is probably going to end. In the future scientists will probably have to share the continent with other interest groups, who will be playing a different ball game.—DEBORAH SHAPLEY