who follow him, was profoundly convinced of the intrinsic soundness of this theory, and was perfectly willing to believe that it represented nature better than the error-marred individual observations of his day," says Gingerich.

Newton says that so far Gingerich is the only historian of science who has commented in print on his thesis. It will probably take a lot more discussion to decide the best interpretation of the problem that Newton has documented. One thing is certain: a devastating blow has been struck to the geocentric theory of the universe.—NICHOLAS WADE

Science in Europe/Moratorium Set on Antarctic Oil at October Meeting

A moratorium on oil exploration and extraction in Antarctica, and the first outlines of a convention to govern fishing in the area were the main results of the Ninth Consultative Meeting of the Antarctic Treaty in London, which ended 7 October. Both decisions represent significant developments for the 13 nations with consultative status under the treaty, who between them control the world's most remote and inhospitable continent. The meeting also gave evidence of the quickening pace of change and the need for decision if Antarctica is to be preserved as a peaceful backwater where scientists rather than politicians call the tune.

The pressures are mounting as a resource-hungry world turns its eyes on the fish, oil, and minerals that Antartica could in theory supply. According to the U.S. Geological Survey, the continental margin of Western Antarctica could contain as much as 45 billion barrels of discoverable oil and 115 trillion cubic feet of natural gas. Fish provide an even more tempting resource; stocks of a shrimp-like crustacean known as krill are so vast that they could represent a doubling of the world catch.

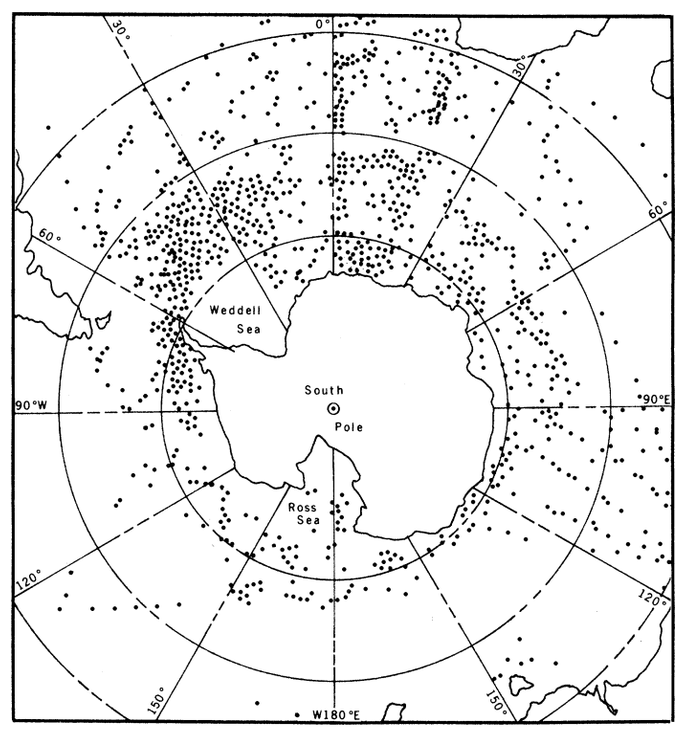
Drilling for oil is probably still years in the future, but exploitation of the krill has already begun. Soviet and Japanese vessels land between them something like 20,000 tons of krill a year, to be marketed frozen as is shrimp, as krill paté, or in such manufactured products as shrimp-flavored butter and cheese spread. West Germany, Taiwan, and Chile are also showing interest in the krill fisheries. In addition, the Antarctic waters contain other more conventional seafoods such as crab, lobster, cod, and hake. As the northern fisheries come under increasing control and coastal states extend their fishing limits, the relatively unpoliced oceans around Antarctica become more attractive.

It is something of a historical accident that the 13 nations of the Antarctic Treaty come to be responsible for managing this resource. The Antarctic Treaty was established after the success of the International Geophysical Year, 1957–1958, which showed that nations were able to work together in programs of scientific research. The original 12 "consultative parties" to the treaty were simply those 12 countries which had been collaborating in the Antarctic—Argentina, Australia, Belgium, Britain, Chile, France, Japan, New Zealand, Norway, South Africa, the United States, and the U.S.S.R. In July of this year, Poland became the 13th member.

That the treaty has held together so well is evidence of the relative unimportance of Antarctica until recent years. The parties by no means represent a cross section of the world community, with only two developing countries, and there are wide differences of attitude among the parties, some of whom claim parts of Antarctica as their own territory. Others, including the United States, the U.S.S.R., and Japan recognize no territorial claims, and have none of their own. To make matters even more complicated, three of the claims (those of Argentina, Britain, and Chile) actually overlap.

The Antarctic Treaty has worked because it sets aside the territorial disputes. In this case, at least, sweeping the problems under the rug has paid off handsomely in 25 years of peaceful scientific cooperation. But once matters of natural resources are discussed, the issue of sovereignty emerges again and becomes more difficult to solve. If there are resources to be exploited, who owns them?

It was this issue that caused the greatest difficulty at the London meeting. De-



Distribution of potential krill fisheries around the Antarctic Continent. Krill fishing has only begun, but the resource may be twice the world's catch. [Map adapted by Eleanor Warner]

spite their differences of policy, the treaty powers are united in wanting to solve the resources problem within the framework of the treaty. As one delegate put it, "If we can't resolve the dispute internally, then Antarctica will fall into the hands of the UN," a result which none of the 13 relish. When the Food and Agricultural Organization committee on fisheries attempted at a recent meeting to set up a subcommittee to examine the question of Antarctic fisheries, the proposal was defeated by the concerted action of the Antarctic Treaty powers. "The only common link in the system" the same delegate remarked, "is that all the treaty powers are afraid of the outside world." Hence the pressure at the London meeting to achieve some formula which would maintain the cohesion of the treaty while also bringing Antarctica's resources under control. The claimant countries (Argentina, Australia, Britain, Chile, France, Norway, and New Zealand) named Australia to represent their interests, while the nonclaimants were represented by Japan. Up to the final day an agreement seemed unlikely; but then Japan, on behalf of the nonclaimants, accepted a formula that would extend the principles of Article 4 of the treaty (the article which freezes all territorial claims) to the new accords governing fishing and mineral exploration.

With respect to mineral exploration, all 13 nations agree that exploration and exploitation of Antarctica's oil is at least 10 and probably 15 years away. Therefore, it cost them little to declare a moratorium on oil development while the environmental implications are examined and while the basis of a mineral regime is worked out. The United States conceded the most in agreeing to the moratorium because it has traditionally taken the view that mineral resources should be open to all—"free non-discriminatory access" in the legal jargon. The majority at the meeting opposed the U.S. view, and Australia and Argentina said they were unwilling even to discuss a mineral regime unless it preserved Article 4 of the treaty. Faced with this united front, the United States capitulated.

The way in which the moratorium was agreed was particularly interesting, according to one delegate. At the previous

Briefing

Breeder's Progress: When a Veto Is Not a Veto

Using for the first time the executive big stick that Gerald Ford once wielded with abandon, President Carter has vetoed funds for the experimental breeder reactor planned at Clinch River, Tennessee. The action is the latest round in a year-long battle between the White House and Congress over the future of the project, which Carter insists is technically outmoded and must be deferred indefinitely to make the American nonproliferation policy credible around the world. Few observers expect Congress to overturn the action, but in this case one veto will not be enough.

The legislation just rejected was the 1978 authorization bill for energy research and development, which included $80 million for the construction of the prototype breeder reactor. Usually, authorization is the decisive step that a project needs as it wends its way through the congressional funding maze, while appropriation is a second step contingent on the first. But the language of the breeder appropriation bill has been written so that the funds are not subject to authorization in this case. The crucial change was made when the chairman of the House Appropriations Committee, Representative Tom Bevill (D–Ala.), successfully passed an amendment to the $80 million supplemental breeder appropriation bill last week. (The Senate appropriation bill is expected to use the same language.) The move not only gave the breeder double protection, but also covered many southern and western water projects included in the same bill.

The White House has consistently maintained the importance of the breeder issue, requesting only $33 million to finish the blueprints and close out the project. But Congress—prodded mightily by the nuclear industry—wanted much more money. At one point, it was suggested that the Administration would veto any bill granting the Clinch River project more than $75 million, a suggestion many on Capitol Hill thought to be a bluff.

The veto materialized, but it has not ended the battle or the project. Carter may have to veto the appropriation bill, with many nonnuclear items, as well.

New Accelerators Making End Runs

As much of the scientific community shows increasing wonder at the lavish funding that high energy physics continues to receive, two accelerators seem to have squeezed through the tightest budgetary strictures.

Brookhaven National Laboratory on Long Island has been championing a $250 million accelerator for 3 years without getting approval from the Executive Branch, but it has done much better with Congress. Although the full budget has not been granted yet, both houses have voted an authorization of $10.5 million and appropriations of $5 million for the Brookhaven ISABELLE project in the fiscal 1978 budget. The Office of Management and Budget reportedly suggested that the funds be withheld until a decision was made on whether to authorize the complete project next year, and Congress asserted its will. On 2 November, the House passed an additional bill prohibiting any deferral of the $5 million amount, which is intended for architectural engineering work on the project. The facility will consist of two rings stacked on top of each other and configured so that the countercirculating beams will collide in eight locations. Each beam will have an energy of 400 gigaelectron volts (Gev). The legislative effort on behalf of ISABELLE has been spearheaded by Representative Jerome Ambro (D–N.Y.).

The other accelerator that is moving rapidly toward full approval is the intended upgrading of the Fermi National Accelerator Laboratory's main ring with a new set of magnets so that the facility will be able to produce a single beam of 1000-Gev particles, doubling the present capabilities. The Fermilab project has been supported on the laboratory's research and development funds for 3 years in increasing amounts ($7.5 million in fiscal 1977 and $11 million in fiscal 1978) which do not get the same scrutiny as new construction proposals. The laboratory hopes to build one-sixth of the new accelerator ring with these funds, and then to receive $39 million in funds explicitly earmarked for construction in the following year to complete the job.

meeting of the treaty powers, in Oslo 2 years ago, six countries had favored the moratorium: Argentina, Chile, Australia, Japan, the U.S.S.R., and New Zealand. This time, only four countries were clearly in favor: Australia, Chile, the U.S.S.R., and to some extent Poland. Yet in spite of the apparent weakening of support for the moratorium, the final result came much closer to a moratorium than to the voluntary restraints originally favored by the United States. One reason for this is the very long timescale envisaged for exploitation—the expert group who advised the treaty nations suggested a timescale of about 15 years—and the second is the shift in the position of the U.S. Administration toward a more conservationist approach since President Carter has taken office.

The next step in the drafting of the mineral regime will be a meeting of ecological and technical experts to examine the problems of exploiting the resource without damaging the environment, followed by a legal and political meeting to start drafting the mineral regime itself.

Fishing presented a more immediate problem, and a more difficult one to solve. The Soviet Union and Japan, the two nations already fishing in the Antarctic, favored a fishing regime which treats each species individually, while the Latin American countries argued in favor of a regime treating the ecosystem as a whole. The Latins argued that the role of the krill as food for larger species should not be neglected, and that any agreement based on krill fishing alone would be inadequate. (The word krill is an old Norwegian whaling term meaning "whalefood.") An accord based on stocks of krill alone would almost certainly produce higher fishing quotas than one based on the entire ecosystem, which is why the major fishing countries favored it. In the end, however, it was the Latin American view that prevailed, and the communique issued after the meeting declares that any possible utilization of Antarctic marine living resources should be conducted "with proper regard to the Antarctic marine ecosystem as a whole."

While the details of a regime to control fishing are being negotiated, the treaty countries ask for adherence to interim

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The Fermilab project is called the Energy Doubler/Saver because the new superconducting magnets are expected to use only half the electrical power required by the present accelerator. The Brookhaven accelerator will also use superconducting magnets. By their distinctly different feats of budgetary legerdemain, both new accelerators appear to be under way.

EPA Rules Out Human Cancer Tests

Explicitly reacting to a minor scandal that was revealed last summer tying two senior administrators of the agency to a plan for testing animal carcinogens on human patients in a Mexican hospital, the Environmental Protection Agency issued new guidelines last week protecting human subjects in a wide variety of tests.

No patients were ever given animal carcinogens under EPA auspices, but in April 1975 the head of the Metabolic Effects Division, Lamar Dale, and the chief of the Evaluation Division, Leonard Axelrod, both approved a plan to test the effects of a group of fungicides, EBDC's, on humans. The tests were to have been made at the Gineco Obstretricia Hospital in Mexico City. Only a quirk in the project led to higher review. Because it was planned to allocate the test funds to the hospital on a sole-source contract, the project plan was sent to the EPA general counsel's office, where it was judged "absolutely shocking." After being alerted by the general counsel's office, the deputy assistant administrator for pesticide programs, Edwin L. Johnson, turned down the proposal.

When the planned project was revealed last summer, the present EPA administrator, Douglas Costle, said that the EBDC proposal showed serious errors of judgment and that he personally found it "unethical and repugnant."

The new EPA guidelines not only bar agency support for any "research to test whether a substance is a carcinogen by testing it on a human subject," but also require that such tests as the effects of noise on human behavior be subjected to increased agency review. The new policy was issued by deputy administrator Barbara Blum.

JET Arrives in England at Subsonic Speed

It took 2½ years to settle on a landing spot, but the European research community finally decided on a site in England, not far from Berkshire downs, as the location for its long-planned fusion research facility, JET (Joint European Torus). After what seemed to be countless meetings, the research ministers of the nine Common Market countries finally agreed on 25 October to put the $220-million project at Culham Laboratory, about one hour away from London.

The decision apparently gives a go-ahead for the project, which some observers thought was in jeopardy during the long debate over location. Funds will not be officially granted, however, until a 16 member governing council is set up, a bureaucratic roadblock that will delay the project at least six more months, according to one member of the international design team that has been waiting out the long political battle. Nevertheless, the team, which has shrunk from 60 to 35 members, is "quite optimistic" and "some of our members are even eager to return," he says.

With its considerable prestige value and future economic impact, proprietorship over the JET project was a matter of hard political bargaining from the beginning. Italy, which has an underutilized Common Market research center to offer, dropped out first, leaving the three countries with prominent national fusion programs—France, West Germany, and England—to contend. France demurred next, and finally in October West Germany allowed the matter to come to a vote and lost. The final selection, Culham Laboratory, is the center of the British fusion effort and is regarded by many as having the strongest fusion team in Europe.

Before the siting brouhaha began, JET was considered to have a slight edge over similar projects in the United States and the Soviet Union. Now it appears to be clearly trailing the U.S. project, the Tokamak Fusion Test Reactor, for which ground was broken in Princeton, New Jersey, 2 weeks ago.

William D. Metz

guidelines, which call on the countries engaged in fishing to take the greatest possible care in harvesting so as not to reduce stocks or endanger species in Antarctic waters. In February and March next year a meeting will be held in Canberra, Australia, to begin the task of drafting the regime. At a subsequent meeting, at which countries other than the 13 consultative members may be present, it is hoped that a final accord will be reached. At the Canberra conference it is expected that several options will be canvassed: a fishing convention with a clearly conservationist emphasis proposed by Australia, an international commission similar to the International Whaling Commission proposed by South Africa, and an Antarctic Treaty Commission proposed by the U.S.S.R.

The London meeting has thus cleared the way to two new international agreements, governing minerals and fish, while leaving enough ambiguities in the air to make it difficult to assess how effective the regimes are likely to be. A few things, however, are clear. First, the treaty nations have made no concessions at all to the view expressed in the United Nations that the Antarctic should be an international heritage. The resolutions on marine resources make no mention of the idea, nor do they support the notion that some proportion of the profits from Antarctic exploitation should be channeled to the Third World.

Second, the sovereignty question remains open. The compromise adopted in London is no long-term solution to this issue. For example, from remarks made by the conference chairman, George Hall of the British Foreign Office, it is clear that the marine resources regime will include figures for total permitted catches but will not attempt to allocate that catch between nations, since to do so would simply imply some judgment of which areas of ocean come within each nation's jurisdiction. There may thus be a danger that the regime, when negotiated, will be too vague to be enforceable. There was no mention of any possible sanctions which might be applied to nations failing to observe the regime.

A further confusion is raised by countries outside the 13; how will the proposed regimes apply to them? There was a clear desire at the London meeting that nations like West Germany and Canada should be brought within the Antarctic Treaty umbrella.

On less controversial topics, the London meeting agreed to improve the telecommunications system in Antarctica and to coordinate the flights of supply aircraft so as to provide the beginnings of an Antarctic air service. They also passed a declaration on the protection of the Antarctic environment, proposed by Chile, but failed to reach agreement on the control of tourism. While all the member states agree that some control of tourism is desirable, some favor strict legal rules and areas prohibited to tourism if they are of particular scientific importance; others think that little more than a code of conduct is necessary.

Most delegates appear to have concluded that the London meeting was a success; at least it brought no breakdown in the smooth system by which the member states have governed Antarctica for the past 18 years. But neither did it solve the awkward jurisdictional problems that inspired the original treaty; those wait for another day.

—NIGEL HAWKES

Ecology and National Security

The traditional equation of national security with military might is becoming increasingly incongruous as resource scarcities, overpopulation, and the ravage of ecosystems are becoming ever more disruptive of economies and social structures around the world.

That is the message of the latest report from Worldwatch Institute, headed by Lester Brown. In the report, entitled "Redefining national security," Brown goes through the usual grim cataloging of disastrous global developments: the imminent end of the petroleum era (world oil production is expected to slide starting in the early 1990's), the spread of deserts, deforestation, soil erosion, overgrazing, and overfishing.

These developments lead in turn to increased poverty, rising food prices, rising unemployment, and resultant social and economic upheavals. There are already plenty of examples of such disruptions, Brown says. In Ethiopia the termination of Haile Selassie's rule was precipitated by a food crisis that resulted from ecological deterioration. The Egyptian government was nearly toppled by riots over climbing food prices. The catastrophic flood in Bangladesh was in large part due to deforestation of watersheds. And "for some countries," writes Brown, "encroaching deserts pose a far greater threat than invading armies."

It is not only in marginal economies that such stresses threaten national stability. At a press conference held to discuss his report, Brown referred to a speech the day before by Defense Secretary Harold Brown, who said that future fuel shortages posed the single greatest threat to national security. Without assured oil supplies, observed the secretary, we will find ourselves with "a useless, encrusted modern-day Maginot Line." Lester Brown also quoted Isaac Asimov to the effect that "even a non-nuclear war cannot be fought because it is too energy-rich a phenomenon."

"The purpose of national security deliberations should not be to maximize military strength but to maximize national security," writes Brown—"the threats to security may now arise less from the relationship of nation to nation and more from the relationship of man to nature."

Despite abundant evidence for this assertion, nations continue to spend more on military defense than on health or education or development of new energy sources. Indeed, "the development of new, 'more effective' weapons systems now engages fully a quarter of the world's scientific talent."

Brown says no way has been found to evaluate military and environmental threats and "translate them into an allocation of public resources that provides the greatest national security." The military has its early warning system and economists have their forecasts, but no early warning systems exist to forestall the collapse of entire biological systems. Hence the surprising disappearance of the anchovy crop a few years ago, and the Sahelian famine, which was brought on by overgrazing and resultant desertification.

According to Brown's thesis, the redefinition of national security will require a broad and entirely new interdisciplinary approach to the matter. But it may take a lot more disaster to forge such an approach. Brown said that at a recent college symposium he tried to get ecologists and economists to communicate with each other, but they mixed like "oil and water."—C.H.