excess fertility are counteracting. The family-size expectations of young wives are subject to change upward or downward as they and their husbands pass through the childbearing ages and experience changes in factors influencing their thinking about family size.

8. Bureau of the Census, *Current Population Reports, Series P-25*, No. 601 (October 1975).
9. _____, *Current Population Reports, Series P-20*, No. 277 (February 1975), pp. 14–15, 17. The distribution of married women under 30 by total number of children expected is as follows: none—4.8 percent; one—10.8 percent; two—53.8 percent; three—20.8 percent; four—6.7 percent; five or six—2.6 percent; seven or more—0.4 percent.
10. Regarding the relation between lifetime and annual trends in fertility, two points merit notice. First, a substantial increase in annual fertility could be a short-term fluctuation (as was the sharp drop during the early 1970's) that would not necessarily imply an increase in lifetime fertility. Second, if a certain level of lifetime fertility is assumed for the long term and movement toward later timing of fertility is assumed for women now in the childbearing ages, a subsequent increase in annual fertility would occur only if there were a return to an earlier timing pattern by women in later cohorts.
11. In one instance Sklar and Berkov noted the similarity between fertility trends in California and in the nation generally (*1*, p. 693). In another instance their discussion of recent fertility trends in states with high abortion rates and states with low abortion rates suggested that the trends have been similar but with a short time lag in the low abortion states (*1*, p. 697).
12. National Center for Health Statistics, *Monthly Vital Statistics Report*, vol. 24, No. 11, suppl. 2 (February 1976).
13. *Ibid.*, vol. 23, No. 12 (February 1975), p. 1.
14. For the model with no time lag, $N = 13$ and $r = .904$. For the model with a 1-year lag, $N = 12$ and $r = .647$. Values of r^2 are given in the text to show the proportion of variance accounted for in each case.
15. The effects of legal abortion on fertility cannot be determined precisely because the number of pregnancies that would have been aborted illegally in the absence of legal abortion is not known. Center for Disease Control, *Abortion Surveillance*, annual reports, 1970 to 1974; J. Sklar and B. Berkov, *Science* **185**, 909 (1974); C. Tietze, *Fam. Plann. Perspect.* **7**, 123 (1975).
16. California Department of Public Health, *Vital Statistics of California, 1970* (1973), pp. 8, 14; _____, unpublished data; National Center for Health Statistics, *Vital Statistics of the United States, 1969*, vol. 1, *Natality* (1974), section 1, p. 6; _____, *Monthly Vital Statistics Report*, vol. 23, No. 11, suppl. (January 1975), p. 6.
17. See especially R. Easterlin, in *Family Economic Behavior*, E. B. Sheldon, Ed. (Lippincott, Philadelphia, 1973), pp. 170–223.
18. Council of Economic Advisers, *Economic Report of the President* (Government Printing Office, Washington, D.C., 1977), p. 218.
19. Bureau of the Census, *Current Population Reports, Series P-60*, No. 101 (January 1976), p. 21, and No. 103 (September 1976), p. 16.
20. Although legal abortion was increasingly available after 1970, it did not account for most of the subsequent sizable decline in fertility (*12*, p. 6; *15*).
21. Trends in average personal income per household and in median family income have been similar in recent years. In constant dollars, each declined 2.5 percent from 1973 to 1974 and 3.6 percent from 1974 to 1975. The estimate of $13,900 reflects the 1.6 percent increase in personal income per household from 1975 to 1976. Sources of data: Table 4; Bureau of the Census, *Current Population Reports, Series P-20*, No. 296 (September 1976), p. 6; (*18*, pp. 212, 241); Bureau of Economic Analysis, *Survey of Current Business*, vol. 57, No. 1 (January 1977), p. S-8.
22. The focus here has been on the recent economic experience of young families; however, the "relative economic status" of young families as conceptualized by Easterlin (*17*)—that is, their economic experience relative to that of their families of orientation—has also been unfavorable in recent years. Easterlin defined relative economic status with a ratio of moving averages of family income and linked the result to fertility about 3 years later (*17*, pp. 181–187). The following figures update table 12, columns 5 and 6, in Easterlin's paper. Sources of data: (*18*, p. 241); Bureau of the Census, *Technical Paper No. 17* (1967); _____, *Current Population Reports, Series P-60*, Nos. 47, 51, 53, 59, 66, 75, 80, 85, 90, 97, 101, 103 (1965–1976).

Relative economic status	Fertility year
66.5	1970
67.2	1971
66.5	1972
64.4	1973
62.1	1974
60.2	1975
58.2	1976
56.0	1977
53.7	1978

23. Bureau of Labor Statistics, *Employment and Earnings*, vols. 16 to 22, No. 7, and vol. 24, No. 1 (January 1970–1977); Bureau of the Census, *Current Population Reports, Series P-60*, Nos. 75, 80, 85, 90, 97, 101, 103 (1970 to 1976).
24. I thank Mary Lynn Allen and Pauline B. Shell for assistance in the preparation of this article, and colleagues at the Census Bureau and elsewhere for their comments on earlier drafts.

NEWS AND COMMENT

Antarctic Problems: Tiny Krill to Usher in New Resource Era

The 12 nations* that are signatories to the 1961 Antarctic Treaty, which dedicates their activities on that continent to scientific, peaceful ones, are moving toward a new treaty to manage Antarctica's living resources. These consist primarily of a species of 3-inch long crustacean found teeming in offshore waters, which also happens to be one of mankind's newest and richest sources of food.

The effort to achieve such a treaty, which has been urged by environmental groups for some time, has broad international significance. Other nations of the world have been eyeing Antarctica's resources—its presumed minerals such as iron and gold and its possible wealth of offshore oil and gas. But the resource most likely to be exploited soon is the krill (*Euphausia superba*). Krill abound in such huge swarms in surface waters that recently a West German ship, using a new technique likely to find wide application, is reported to have scooped up 8 to 12 tons in a single hour!

The sudden move by the Treaty nations signals a growing realization by the 12 governments, and by the scientist-diplomats who specialize in the arcane field of Antarctic policy, that, as one says: "People are realizing that Antarctica is a huge bank of resources that may have to be tapped, that it is something more than an oddity in the earth's crust."

J. H. Zumberge, chairman of the National Academy of Sciences' Polar Research Board, goes on to say, "The idea that Antarctica can be held forever as a scientific laboratory is losing ground." The group of 12 who have had Antarctica more or less to themselves for nearly 20 years, will recognize this new interest formally, soon, when they admit their 13th member, Poland, a nation frankly interested in krill fishing as well as in Antarctic research.

The Antarctic Treaty does not discuss resource exploitation, and thus does not expressly prohibit its signers—or anyone else—from exploiting the region's wealth. At present, any nation, exercising its high-seas freedoms, can fish for Antarctic krill. Likewise any nation could prospect for minerals or drill for offshore oil—although both would be highly impractical at this time. However, the Treaty does obligate its signers to conserve the continent's resources and protect its environment, and because of this obligation, the Treaty nations seek a new agreement on krill.

Therefore, at the recent meeting in London from 14 to 18 March, the Treaty powers moved to address the problem of managing the krill. The thinking among diplomats there, according to U.S. and Western sources, was that an agreement to manage the krill would be relatively easy to achieve. It could set a useful precedent for addressing the more difficult problem of oil, gas, and mineral exploitation. Such a treaty, some diplomats admit, could stave off the periodic rumblings at the turbulent, 120-nation law of the sea conference about including Antarctica's riches within its purview.

So it has fallen to the humble krill, which has gone almost unnoticed in the

*The 12 countries are Argentina, Australia, Belgium, Chile, France, Japan, New Zealand, Norway, Union of South Africa, Soviet Union, United States, and United Kingdom. Seven other nations have acceded to the treaty but have no say in deliberations. These are Brazil, Czechoslovakia, Denmark, East Germany, Netherlands, Poland, and Romania.

world's diet—let alone in international geopolitics—to become the vehicle for reconciling the 1961 Antarctic Treaty, whose clear aim is the preservation of Antarctica for scientific research, with the realities of a resource-hungry world.

Krill are tiny crustaceans (see photo p. 505), barely capable of swimming, that drift in huge masses near the surface of Antarctic waters (see map p. 504). They feed on phytoplankton; and, in turn, they are eaten by most higher life forms in the area, such as whales, seals, birds, fish, and others. Thus they are the cornerstone species of all Antarctic life.

Moreover, because decayed krill enrich Antarctica's coastal waters and continental shelves, they may be important to the spread of nutrients throughout the world's oceans by northward-flowing Antarctic bottom water currents.

But the most important fact about the krill is that they comprise a vast natural source of protein, and hence to many nations are a tantalizing new source of food. Gerard Bertrand of the Council on Environmental Quality says that a 70-million-ton annual harvest of krill would equal no less than the entire fish catch from the rest of the world's oceans. Yet today, well under 1 million tons are caught by the few nations that conduct "exploratory fishing" for krill: Japan, the Soviet Union, Taiwan, West Germany, and now, Poland. Only Japan and the Soviet Union market krill for human consumption, and in Japan, krill tempura is said to be tasty. But breakthroughs in the technology of krill fishing, largely by the West Germans, will make larger scale harvesting more practical, indeed, some say, inevitable. Says Bertrand; "The pressure will come. The world need for protein will require the utilization of krill."

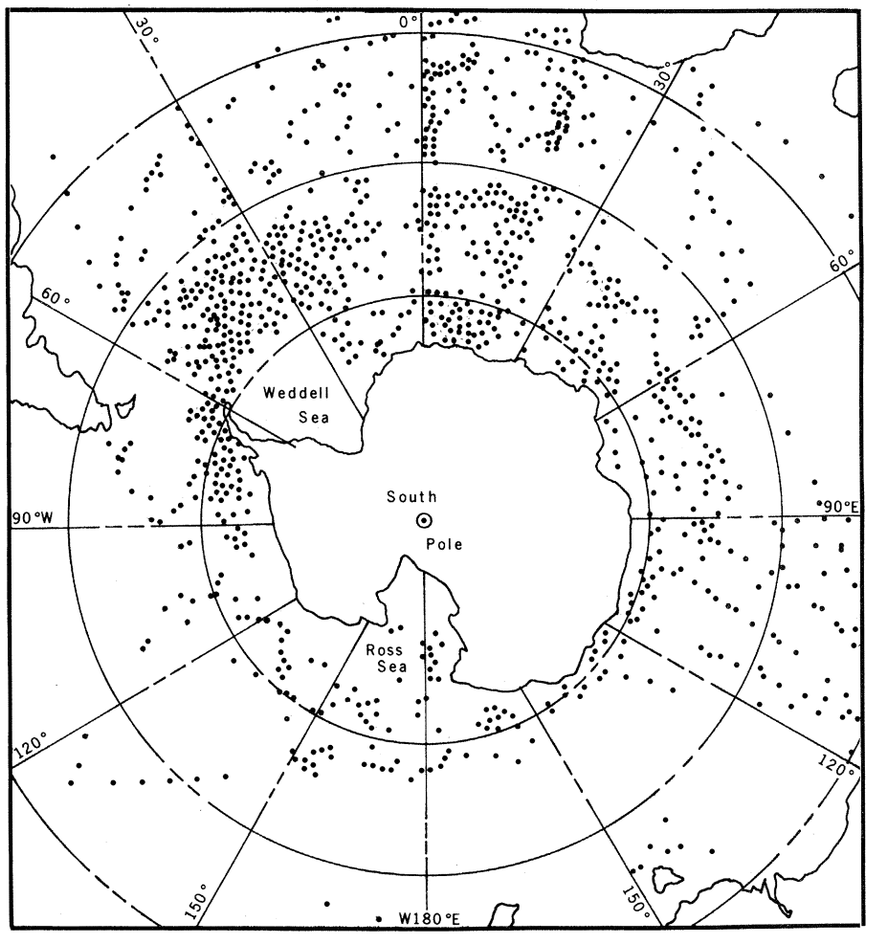
According to Robert C. Brewster, deputy assistant secretary of state for oceans and international environmental and scientific affairs (OES), the United States raised the issue at the London meeting. Then Australia put forward seven alternative approaches to the problem, and the United Kingdom tabled a draft treaty. The group voted unanimously to take up the question at a forthcoming, formal meeting of the powers in September—with no objection from either Japan or the Soviet Union, the two krill-fishing nations that are also parties to the Treaty. "Frankly," Brewster says, "we were surprised. That's a lot of progress for a group that usually takes years to decide far smaller questions." (Brewster was referring to the fact that, until the resource question came up a few years ago, the Treaty powers had little to do except exchange information on scientific activities and serve as a kind of international landmarks commission to name topographical and geographical features of the region.)

The details of a future treaty are not yet clear. Its initial objective, however, would be to set some limit on the amount of krill that could be harvested, while gathering information to use as the basis of long-term management of the krill stocks. Estimates of how much can be harvested safely vary wildly—from 10 to 100 million metric tons; indeed no one knows the size of the total standing stock, which may be as much as 1 billion metric tons. Says CEQ's Bertrand, "Nobody knows how many krill there are. Less than 5 percent of the area has been sampled in a highly detailed way, and only in the last 2 years has anyone systematically tried making such samples."

Krill are primarily eaten by whales, but with the decline in the whale stocks in the last decade, some people have concluded that there must be a resulting "surplus" of krill that can be fished commercially. However, scientists and ecologists doubt that such a krill "surplus" even exists—and want to know more about the krill stocks before large-scale operations begin. The object of a treaty, therefore, would be to begin managing the resource before—rather than after—commercial fishing gets under way.

But the Antarctic Treaty powers are moving on the krill question not simply out of zeal for the environment. They have been under considerable political pressure to recognize the fact they, as well as other nations, want to exploit the krill and perhaps other, nonliving Antarctic resources. In today's international setting—for example at the law of the sea conference where the unclaimed seabeds are to be managed by 120 nations—the fact that 12 nations (principally of the developed world) can dominate this "oddity in the earth's crust" seems odd indeed.

In the past, Treaty nation diplomats at law of the sea meetings have worked energetically behind the scenes to head off attempts by members of the "Group of 77" developing countries to formally introduce the issue of Antarctica and its resources. So raw are the sensibilities of



Map adapted by Eleanor Warner

Krill have been found at sites indicated above by dots. But ecologists know little about their breeding areas, movements through Antarctic waters, and even their natural life spans.

the Treaty nations on the subject, for example, that State Department officials have pleaded with journalists not to mention the possibility in print. Explained one official in a typical admonition, "Off the record, Antarctica could blow the conference right out of the water. Antarctic claimant nations would rather not have a sea law treaty than one that impaired their sovereignty in Antarctica."

However, Brewster, in an on-the-record interview with *Science*, was candid. "There is no doubt," he said, "that fear that the Group of 77 will bring this up in some forum at the law of the sea conference is one of the factors which is leading the Antarctic Treaty powers to focus on the issue of living resources."

A second pressure on the Antarctic Treaty nations is the fact that many nations, themselves included, are extending their own coastal fishing zones to 200 miles from shore. Seven of the 12 Treaty powers have territorial claims in Antarctica, which they maintain in principle, although the Treaty itself holds all such claims in abeyance.

When these nations extend their own fishing zones, they have a delicate choice: they can either also declare 200-mile exclusive fishing zones off the coasts of Antarctica, and thereby reassert their claims in violation of the treaty; or they can choose to *not* declare such a zone, implying that they are relinquishing their claims. A new international agreement on Antarctica's living resources will help these countries resolve this dilemma.

While under pressure to act on the resource question, the Treaty nations are anxious to avoid creating an image of themselves as a club that considers the continent its exclusive preserve. Thus,

The open belly of a whale, disgorging a recent meal of Antarctic krill. In season, many whales will eat approximately 1 ton of krill per feeding, and four such feedings daily. [Photo courtesy of the National Science Foundation, Office of Polar Programs]

they want the krill treaty to include Taiwan, West Germany, and other nontreaty nations that plan to fish for krill in Antarctic waters. In addition, the group of 12 is getting ready to admit Poland probably within a year—and bracing itself for the fact that other resource-hungry nations may wish to follow.

The Treaty says a nation qualifies for admission if it "demonstrates its interest in Antarctica by conducting substantial scientific research activity there." Poland is completing a 20-man station in the Antarctic, having an estimated value of $3 million. And, following the pattern set by the other Treaty powers, Poland has a scientific committee set up as part of her national academy of sciences to oversee Antarctic research. "The United States is satisfied that Poland qualifies to join," says Brewster.

Poland's other interest in the region, however, is krill. The chief Polish Antarctic scientist, S. R. Suszczewski, has made clear his country's interest in the "exploratory" catching of krill. And, since Poland has been recently shut out of her traditional fishing grounds in the North Sea and elsewhere by the 200-mile-exclusive fishing zones of other countries, such an interest is logical.

The Treaty powers expect that other nations, perhaps Brazil among them, will try to enter the Antarctic club and many of them, like Poland, will have more than an academic interest in resources. One Western diplomat illustrated the problem this poses for the current Treaty powers in assessing the newcomers' interest. "If General Idi Amin goes down there, and puts a couple of thermometers up, and a rain collector, and says he should have consultative status with the Treaty, should we take kindly to it?"

Zumberge, of the academy's polar research board, hopes that other countries also will want to work through the Treaty, and that the Treaty in turn will accommodate them. Referring to the days of the International Geophysical Year in the 1950's when the concept of Antarctica as a "great beautiful laboratory" gained acceptance, Zumberge says, "We were always afraid that once there was anything of real economic interest found in Antarctica the Treaty would be terribly stressed. Scientists would have liked to maintain the purity of Antarctica for scientific purposes only, but that's no longer realistic."—DEBORAH SHAPLEY

Rupert Cutler: The Environmentalist in the Farmer's Back Yard

There is a strange new face at the U.S. Department of Agriculture, and it's no mouthpiece for the Department's usual utterances.

The new face belongs to Rupert Cutler, Assistant Secretary of Agriculture for Conservation, Research, and Education. A conservationist and former lobbyist for the Wilderness Society, he now occupies a senior position in a department that has traditionally put farmers' and corporate interests above others.

Cutler should be a figure worth watching, because in order to serve the needs of his new clients and remain true to his own beliefs he will have to perform a balancing act of some delicacy.

He has already succeeded in neutralizing, at least for the moment, those who have most reason to be alarmed by his appointment. Both the forest products industry and the deans of agricultural colleges lobbied against him, but they have now acquiesced in his appointment. At his confirmation hearing on 6 April before the Senate agriculture committee Cutler was spared the roasting he might have expected, being required only to repeat each Senator's shibboleths after him. Approved unanimously by the committee, and by a voice vote on the Senate floor with only one dissenter, Cutler now presides over five agencies—Agricultural Research Service, Forest Service, Cooperative State Research Service, Extension Service, and Soil Conservation