pure metal in a compound form, the report says. Preventing criticality—the energy-liberating fission chain reaction—is achieved by limiting the plutonium concentration in each part of the ORNL process.

The report does not describe how much time is needed to melt plutonium into a form that can be machined into bomb parts or describe how to develop the rest of the bomb-production process.

The study has served to fuel antinuclear sentiment, however, by suggesting that commercial power reactors are a risk to nuclear proliferation. A June 1976 report by the Joint Committee on Atomic Energy listed only nine countries which it said did not already have nuclear weapons but appeared technically capable of developing and detonating one within three years of deciding to do so. Those countries are Canada, Israel, Italy, Japan, the Republic of China, South Africa, Spain, Sweden and Switzerland. The ORNL study expands this list to include any country that operates a commercial or experimental reactor or has access to such a facility. Normally the somewhat lengthy development time necessary to safely produce a weapon that could be reasonably assured of producing a sizable yield would allow "timely warning" of that capability. ORNL's process eliminates assured "timely warning."

However, the Energy Department's Dennis Spurgeon told SCIENCE NEWS that the ORNL concept is not much of a real proliferation threat. First, any country that imports nuclear technology in the form of a power reactor does so because it feels it needs nuclear power to assure its energy future. By pirating fuel for weapons it would violate nonproliferation policies of the countries that supplied the fuel or equipment and thereby sacrifice any hope of receiving future supplies, Spurgeon said. Second, he said that it is still very difficult to make a good nuclear bomb, and that it was highly unlikely that "bandits" would have the necessary nuclear sophistication. Except for the possible scare value associated with nuclear weapons, bandits would be better off stealing conventional weapons for a real tactical advantage, he said. Finally, stealing spent fuel is difficult. Commercial fuel rods weigh one-half ton each and are highly radioactive. Thieves would likely die after only minutes of exposure, he said, and one or two rods would be necessary to get enough plutonium for a single weapon. Casks normally used to transport spent fuel would also have to be stolen, and their size, weight and availability would make the action hard to conceal. Since the reprocessing itself is also "dirty," or radioactively unsafe, the lives of the proliferators are threatened.

It appears that what the report best illustrates, then, is that nuclear proliferation need not be especially difficult, but it still requires important, and what may turn out to be unnecessary risks and costs to those involved. □

The cold seas of 18,000 B.P.

Concern about possible future climatic change has led to new scientific efforts to better understand past climates. One of the more intriguing of these activities is the CLIMAP program, a National Science Foundation-sponsored effort to chart climates at specific times in the past. CLIMAP investigators are trying to get as detailed a picture as possible of what the climate everywhere in the world was like exactly 18,000 years ago, at the peak of the last glaciation.

Ocean conditions for February and August 18,000 B.P. (before present) for two widely separated parts of the earth, Antarctica and the eastern Mediterranean Sea, were reported recently at the annual meeting of the Geological Society of America in Seattle. Both showed greater differences from the present than were expected.

The analysis of the waters around Antarctica shows that, in the Atlantic sector, winter sea ice extended as far north as 46 degrees south latitude, a full 10 degrees farther than it does now. Thus the extent of the sea ice in the Southern Hemisphere was as great as the extent of the continental glaciation in the Northern Hemisphere. During summer the surface temperatures then in the southwest Atlantic were 8°C (14°F) colder than they are now.

The Pacific sector of Antarctic waters underwent smaller-scale changes. Sea ice extended 3 degrees farther north than it does today, and temperatures averaged 2°C cooler.

The Antarctic temperature maps were reported by James D. Hays, David W. Cooke and three other colleagues from the Lamont-Doherty Geological Observatory. The maps and data represent the official report of CLIMAP's Antarctic task group. The information in them was gained from analyses that are "very new and not yet published," says Cooke. A variety of evidence was used to produce the paleoisotherm maps. The extent of sea ice during August (winter), for instance, was based on the occurrence in precisely calibrated deep sea cores of fossil remains of a particular diatom (algae) that lives only in near-ice waters.

Although the Antarctic data show that the southern polar regions were undergoing extensive ice conditions at the same time as the period of maximum glaciation in the north, 18,000 years B.P., they also show that these conditions apparently abated faster in the south. By 14,000 years ago, Cooke says, the southern waters had reached much the same ice-free condition as today. By comparison, the major retreats of northern hemisphere glaciation did not take place until about 11,000 years ago.

The reconstruction of the climate of the eastern Mediterranean Sea was reported by CLIMAP investigators Robert C. Thunell and James P. Kennett of the University of Rhode Island. The greatest differences between present-day and 18,000-B.P. sea surface conditions existed in the Aegean Sea and immediately south of Crete. Winter temperatures in the Aegean were as much as 6°C cooler than at present; summer temperatures south of Crete were 5°C cooler than at present. The Aegean Sea was also less salty than it is today, by about 5 parts per thousand, although near the Strait of Sicily that difference decreases to 1.5 parts per thousand.

All these patterns of differences, Thunnell and Kennett say, are probably due to changing drainage patterns during glacial times and the diversion of cool, low-salinity water into the Aegean Sea.

"The magnitude of the observed oceanographic changes within the eastern Mediterranean," they say in summary, "are greater than those previously reported." □

Child altruism: Saving Johnny not mommy

What would you do if two tigers escaped from the zoo, and one leaped for your mother, the other for your best friend—and you had a gun with only one bullet? You might say it depends on how you feel about your mother and your friend, but one school of sociobiology (SN: 11/29/75, p. 347) says your choice is largely predetermined by genetics.

According to the "kin selection" or "kinship genetics" theory, your altruistic action would be directed toward your mother because social organisms instinctively spring to the defense of relatives before they would do so for nonrelatives. The theory suggests that a person will altruistically defend not only offspring—to insure the promotion of their genes into succeeding generations—but parents, siblings, cousins, nieces, nephews and other relatives as well. Supposedly, the closer the relative, the more likely it is a person will come to his or her aid. In most cases, a non-related individual would be the recipient of aid when the costs to the benefactor are low, and when the non-related individual is not in competition with a relative's need for aid, according to the kin selection theory.

Although this view has been confirmed in field studies of animals, "To date, no empirical evidence has been gathered either in support or refutation of human altruism based on kin selection," says Harvey J. Ginsburg of Southwest Texas State University. Ginsburg, along with co-researchers Sandra Hense and Brian Bielefeld, recently tested the kin selection theory with 70 children, 3 years to 10 years of age. He reported the