shock wave implodes the material. According to Mark, an expert in this area, the status report "indicates a fairly early stage in their progress through a series of updates."

While they were working on the theory, Iraqi scientists were also conducting direct tests of the behavior of materials under extreme temperature and pressure, and the report says they had conducted 20 tests of explosive lenses "aimed at measurement of the homogeneity of the wavefront." A smooth wavefront is essential to compress the core evenly, otherwise it would blow apart. Concludes Mark: "It doesn't sound like they've got nice, smooth wavefronts yet." They also appear to have lacked a flash x-ray machine needed to take pictures of the material as it compresses, though the report indicates they were working on such a system.

Iraqi researchers appear to have been doing well, however, in their production of key materials. The report states that they had produced 6 milligrams of polonium-210 by irradiating bismuth in a small Soviet-supplied reactor—more than enough for one initiator, according to Mark. They had also produced small amounts of plutonium isotopes, apparently for studies of alpha-emitters, by processing irradiated fuel. And 254 kilograms of uranium metal had been produced in the laboratory and researchers had drawn up plans for a production facility.

As for the crucial electronic systems to fire the detonators, the report says a miniaturized version of a cabling system to provide power simultaneously to 32 detonators had been developed. That's the same number of detonators used in the Nagasaki bomb, according to physicist Thomas Cochran, a nuclear expert at the Natural Resources Defense Council. Researchers were also working on the development of high-speed switches and capacitors that could not be obtained commercially because of export controls.

There is one element of the Iraqi plan that may offer a small measure of relief to its neighbors. Even if Iraqi scientists had solved all these problems, the device they were planning would have been hefty, perhaps weighing as much as a ton, Cochran estimates. That would make it too heavy for Iraq's Scud missiles, which means it would probably have to be delivered by a bomber. The difference may not be trivial: While Saudi Arabia and Israel both possess effective antiaircraft defenses, an Israeli expert is now claiming that, contrary to press accounts, not a single Scud warhead was intercepted by U.S. Patriot missiles loaned to Israel during the war. ■ COLIN NORMAN

With reporting by Karel Knip and Felix Eijgenraam of NRC Handelsblad *in Rotterdam.*

Ozone Loss Hits Us Where We Live

The news about Earth's ozone layer just keeps getting worse. Three weeks ago, NASA researchers reported that the ozone hole over the Antarctic hit a record depth this year (*Science*, 18 October, p. 373). Now comes the United Nations Environment Program, together with the World Meteorological Organization, with an even more distressing assessment of the state of the ozone layer. For the first time, the 80-member UN panel said, measurements show the ozone shield is eroding over temperate latitudes in summer, exposing crops and people to a larger dose of ultraviolet light just when they are most vulnerable.

For a small group of atmospheric modelers, though, the bad news is bittersweet. Four months ago, in the 11 July *Nature*, Jose Rodriguez, Malcolm Ko, and Nien Dak Sze of Atmospheric and Environmental Research (AER) in Cambridge, Massachusetts, predicted summertime ozone losses of just the magnitude the UN panel has now reported: about 3% over the past decade for northern temperate latitudes. Ozone modelers are encouraged by the agreement, particularly because other models are now yielding the same result, according to Michael Prather of the NASA's Goddard Institute for Space Studies in New York, who wrote the UN report's chapter on modeling.

The AER modeling effort was spurred by earlier measurements showing a serious erosion of ozone at midlatitudes, mainly in winter. In 1988, an analysis of data collected from the ground showed that ozone levels at the latitude of the United States were dropping by about 1% to 3% per decade; last April, an analysis of measurements from the satellite-borne Total Ozone Mapping Spectrometer (TOMS) boosted that figure to between 4% and 5% (see *Science*, 12 April, p. 204). Those findings raised the question: What mechanisms could be driving the midlatitude losses?

The fact that the losses seemed to be concentrated in winter suggested one possibility. The winter ozone losses at the poles are driven by chemical reactions taking place on the surface of ice crystals in polar stratospheric clouds. Such clouds don't form at temperate latitudes. But some researchers suggested that masses of air already depleted in ozone or enriched in reactive chlorine by the chemistry in the polar clouds might be escaping to temperate latitudes during the winter.

Laboratory experiments, though, suggested another possibility: that some of the reactions that destroy ozone at the poles could also take place on tiny droplets of sulfuric acid, like the ones that form a thin haze in the global stratosphere. Could it be that these sulfate particles, which originate from volcanic eruptions and other sources, were filling the same niche in the temperate latitudes as the ice particles at the poles?

The answer, according to the AER team, was yes. When the researchers worked the laboratory findings into their computer model of stratospheric chemistry and dynamics, they found that the sulfate-hosted chemistry could account for about half the wintertime losses of ozone in midlatitudes. That still leaves room for mixing out of the pole to be contributing, notes Rodriguez.

Then came a surprise: While the model results for winter were not unexpected, those for summer were. Contrary to existing data, the model predicted substantial ozone losses. "When we submitted the paper to *Nature* we felt almost apologetic," Rodriguez recalls.

No longer. By combining the data sets from TOMS and from ground-based detectors, the UN panel was able to detect a clear signal of summertime ozone losses, a success that panel member Michael Kurylo of NASA attributes to the longer span of the measurements and improved calibration of the TOMS instrument. The 3% loss over the past decade at the latitude of New York may sound bad, but Buenos Aires and Sydney have it even worse, with losses of about 5%. And based on projections of how fast chlorine will continue to build up in the stratosphere in spite of the Montreal agreement to phase out ozone-destroying chlorine compounds, the report predicts additional losses of about the same magnitude by the turn of the century.

Ozone specialists point out that the agreement of the model results with the trend seen so far doesn't mean the models are really mimicking the chemistry responsible for the ozone loss. "It doesn't prove cause-and-effect," says panel member Richard Stolarski of NASA's Goddard Space Flight Center in Greenbelt, Maryland. Nevertheless, it is a gratifying result for the modelers, who have a history of scrambling to explain observations—not of anticipating them. Says panelist Susan Solomon of the National Oceanic and Atmospheric Administration in Boulder: "For once, we were ahead of the game." ■ TIM APPENZELLER