and food production for years. Since the world has enough food in storage to last only about 70 days, Miller and Smith urge that scientists and policymakers explore the scientific, economic and social issues revolving around the stockpiling of food.

Perhaps the most violent but least likely natural event would be a collision with a large asteroid. Eugene M. Shoemaker of the USGS in Flagstaff, Ariz., and Alan W. Harris of the Jet Propulsion Laboratory in Pasadena, Calif., estimate that the chances of an asteroid 0.5 kilometers in diameter hitting the earth in the next century are about 1 in 1,000. Such an asteroid could be detected decades before impact, they say, leaving some time for evacuating the target area or perhaps for deflecting the asteroid's orbit or breaking it up in space.

"In my mind, the most significant hazard is . . . from smaller bodies whose dimensions are about 10 to 20 meters and which enter the earth's atmosphere once every few decades," says Shoemaker. These meteoric fireballs would not reach the ground, but would deposit into the atmosphere energies equivalent to 1 to 10 megatons of TNT. Shoemaker's and Harris's greatest fear is that the resulting blast would be mistaken by less technologically savvy countries as a nuclear explosion and trigger the more violent action of humans. *— S. Weisburd*

'Weird' crocodile

Jeff Lane/Nat'l. Geo. Soc.

The bone structure shows this to be the skull of an ancient crocodile, but the teeth look oddly mammalian. So the geologists who found this previously unseen head have dubbed it the "weird" crocodile.

Louis L. Jacobs of Southern Methodist University in Dallas and Zefe Kaufulu of the University of Malawi in Africa picked up two of these skulls in southeast Africa in 1984, while looking for mammal fossils in northern Malawi. Kaufulu estimates their age at about 135 million years.

The find is significant because so little is known about the evolution of reptiles or mammals in the Southern Hemisphere during that part of the Mesozoic era, Jacobs says. The scientists — whose work was funded primarily by the National Geographic Society — did not find mammal remains, but they intend to look again in the same area. "It would be silly to think that there weren't mammals living there at the same time," Jacobs says.

Ocean-ridge chemistry at new heights

Some geophysicists would love to cut open the earth like a melon in order to see, once and for all, the inner workings of the mantle. But instead, scientists must be content to study the outer rind for clues to what lies beneath. At the spring meeting of the American Geophysical Union in Baltimore last week, researchers presented dozens of papers intent on trying to decipher and use the complex patterns in the surface topography, gravitational and magnetic fields and chemistry of new ocean crust to understand the underlying mantle movement.

One paper particularly intrigued researchers at the meeting because it shows for the first time a global relationship between the chemistry of new ocean floor and its depth under the sea surface, a relationship that holds regardless of where the young ocean rocks were found. Moreover, from their chemical analyses, the petrologists who did this work can derive the temperature of the underlying mantle from which magma arose at spreading ridges to create new seafloor.

Geochemists had previously explored the link between the chemistry of ocean crust and its depth, but only in a few, isolated sites. In the recent study, Emily M. Klein and Charles H. Langmuir at Lamont-Doherty Geological Observatory in Palisades, N.Y., measured the content of sodium and other elements in the glasses that coat basalts dredged from a number of tectonically different sites around the globe. These include: the major ridges in the Atlantic, Pacific and Indian oceans; "axial hotspots" at Iceland, the Azores and the Galápagos Islands, where large mantle plumes had arisen; spreading ridges in the small seas behind subduction zones, where one plate plunges beneath another; and small, isolated ridges such as the Cayman Rise in the Caribbean. When the researchers plotted the average values of chemical content versus the average depths of ridges in an area, their data fell along a remarkably clear line.

The chemical content gives Klein and Langmuir a way to estimate how much the now-solid magma had melted. They reason that the greater the extent of melting, the hotter the material had been and the greater the production of melt reaching the crust's surface. More melt would result in thicker crust, which would extend higher than its thinner counterparts and hence would have a shallower depth, being closer to the ocean surface. For example, says Langmuir, "when the mantle is hot it melts more, leading to low sodium content, and thick and shallow crust — that's Iceland." In places like the Cayman trough, which lies 5 kilometers deeper than Iceland, the crust is thinner and contains more sodium.

"Qualitatively, all those features of the ocean crust — depth, thickness and chemistry — correlate with one another in a way that makes common sense," says Langmuir. "But [the correlation] had not been established previously."

Langmuir notes, however, that their scenario of how more melting results in shallower depths, while being "a major contributor," is not the only process governing the depth of the ridge axis. At axial hotspots, for example, other effects — such as uplifting forces of mantle convection — might also play a role in making the crust more shallow.

With their recent finding, Klein and Langmuir think they can create a map of mantle temperatures that would provide an important test for any model of mantle convection. They have already charted temperature variations around the world's ridge systems and have found that the temperature under new crust can change by as much as 200° C over about 1,000 km.

Moreover, says Langmuir, "the chemistry and thickness of [old] ocean crust may tell us the temperature in the mantle at the time the crust was made during the past 150 million years." The researchers tried out this idea at one site in the western Atlantic, where drill hole measurements and seismic studies gave them information on the chemistry and thickness of the crust. They found that when the crust was at the Mid-Atlantic Ridge more than 65 million years (Myr) ago, the mantle may have been much hotter than it is today.

Before the researchers can apply their results to older crust, they need to test their theory at many more sites. They would also like to see if they can link chemistry and depth on much smaller scales — along individual segments of mid-ocean ridges, for example. In addition, Langmuir says, they want to use measurements of sodium and other major elements to a much greater extent than they have been used in geochemical studies in order to help estimate the degree of melting in the mantle.

Finally, Klein says they are using their findings to test an idea about old ocean crust. Scientists have noted that ocean crust gets deeper as it cools. But this process stops at 80-Myr-old crust, suggesting to some that the crust there is conductively heated and uplifted. Klein is now looking at the sodium content of this crust to determine if, instead, the crust 80 Myr ago was simply much thicker. *— S. Weisburd*