

Commotion Over Caribbean Impacts

Among the topics that made a splash at this year's meeting of the Geological Society of America was the search for the site of the giant impact that marked the end of the dinosaur age 66 million years ago. A new candidate site in the Caribbean was put forward, even as debate surged on the merits of two other recently proposed Caribbean sites. Many researchers now seem convinced that the killer asteroid or comet hit in the Caribbean region, but none of the locations identified so far fits the bill unequivocally.

The rush to the Caribbean started last spring when Alan Hildebrand of the University of Arizona and his colleagues announced in the 18 May issue of *Science* the discovery in Haiti of debris ejected by a large impact, one apparently close by, about 66 million years ago. At the time, Hildebrand favored a site in the ocean near Colombia. But at the Geological Society meeting, he and his colleagues announced a possible alternative: Chicxulub, on the north coast of Mexico's Yucatan Peninsula.

The idea that there was a crater there was not news. In 1978, while conducting an airborne magnetic survey for oil for Pemex, the Mexican national oil company, geophysicist Glen Penfield of Intera Technologies, Inc., in Houston stumbled across a huge geologic structure centered beneath the coastal town of Chicxulub. At the 1981 meeting of the Society of Exploration Geophysicists in Houston, Penfield and Pemex's Antonio Camargo suggested that, among other possibilities, the Chicxulub structure might be a gigantic impact crater. Reporter Carlos Byars picked up on the idea and in a news story for the *Houston Chronicle* connected Chicxulub with the then new theory that an impact had killed off the dinosaurs.

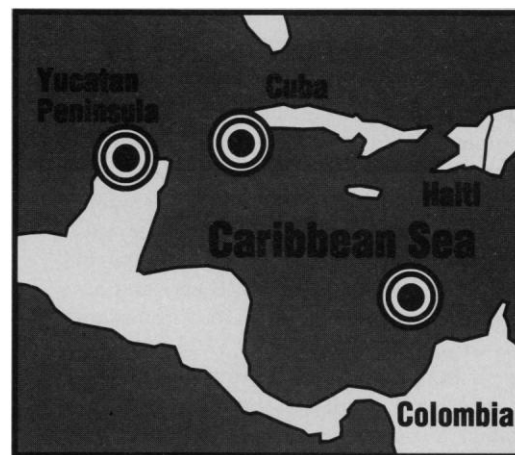
Few took notice of the idea, in large part because Penfield didn't promote it. He could not release the survey data, which was the property of Pemex, and all the rock samples from Pemex's exploratory drilling had apparently been ruined in a fire. Hildebrand, for example, did not learn about the Chicxulub structure until this March when he met Byars at another meeting in Houston. Then the Arizona researcher and his colleagues, Penfield now included, got lucky. They were able to locate a few samples from Pemex drill holes that had been shipped to geologist Alfred Weidie at the University of New Orleans before the fire struck.

The examination of those samples and of Penfield's survey data suggested to Hildebrand and his colleagues that the Chicxulub struc-

ture is probably an impact crater and an excellent candidate for the long-sought site. Some samples look like the ground-up debris of an impact, not ash from a volcanic eruption, they say. And within that debris they have found grains of quartz bearing the distinctive marks of intense shocking found only in rock blasted by giant impacts. The researchers' major problem is that the age of the apparent impact cannot be pinned down precisely, although they think that it's greater than about 60 million years.

Not everyone agrees, however, that the Chicxulub structure is a crater, much less the site of the killer impact. Planetary geologist Virgil Sharpton of the Lunar and Planetary Institute in Houston has studied drill core samples from the New Orleans cache, but not Penfield's survey data, and he differs diametrically from Hildebrand on almost every interpretation. "If it is an impact crater, it's not the crater Alan Hildebrand wants it to be," says Sharpton, although he notes that it might have been caused by a smaller impact. And, he adds, work in Weidie's lab suggests that the structure, whatever it is, is older than 66 million years.

By the time the Geological Society meeting was over, the credentials of the two other leading Caribbean candidates had also been attacked. One of these, suggested by Bruce Bohor of the U.S. Geological Survey in Denver and Russell Seitz of Cambridge, Massachusetts, on the basis of a literature search,



is nestled under the western arm of Cuba. But impact geologists Robert Dietz and John McHone of the University of Arizona reported that they found no evidence of an impact when they visited Cuba last June to attend an international meeting. Bohor maintains that the Arizona researchers were shown the wrong rock outcrops.

The ocean site off Colombia that was originally proposed by Hildebrand also took a serious blow, administered by Glen Izett of the U.S. Geological Survey in Denver. He has found fresh glass in the impact ejecta in Haiti whose chemical composition, unlike that of altered samples analyzed previously, accurately reflects the nature of the rock where the impactor struck. The composition of the unaltered material "rules out an ocean target" for the impact, says Izett. The Chicxulub site, being continental, would still be a possibility.

Nevertheless, Hildebrand is not ready to give up on his first site. Two impacts, one oceanic and one continental, might be the answer, he says. ■ RICHARD A. KERR

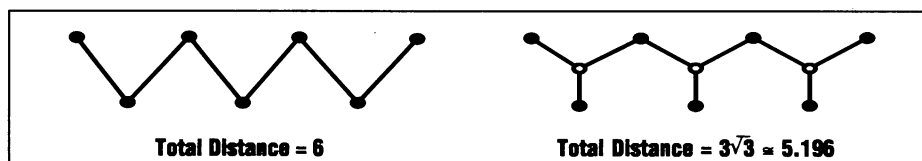
In Math, Less Is More—Up to a Point

With the political season just over, the familiar politician's promise—to expand services while cutting costs—is fresh in everyone's mind. In politics that promise is generally hot air. But in mathematics it's entirely possible. Mathematicians have long known of a problem in geometry, with significant applications to communications and transportation, where doing more can cost less. For mathematicians the question was not whether such a savings was possible, but just how much could be saved. And now

they have the answer to that as well.

Frank Hwang of Bell Laboratories in Murray Hill, New Jersey, and Ding Zhu Du, who is visiting the computer science department at Princeton University from Beijing, have established the limit on the savings that can be realized when a two-dimensional network is redesigned to include extra points. Their proof confirms a conjecture mathematicians have been struggling to prove for 22 years.

A mathematical network is a system of



Networking. A "shortest" network (left) can be shortened by introducing extra points (right). The savings shown here—13%—is the maximum possible.