

Cuban Fossils Offer Support for Meteor's Role in Dinosaur Extinction

By WILLIAM J. BROAD

No guns materialized. Even so, the scientists kept a low profile while digging, eager to avoid security forces from the nearby air base — an important military site that helped provoke the Cuban missile crisis. The diggers had no permit and no interest in being asked to explain their presence.

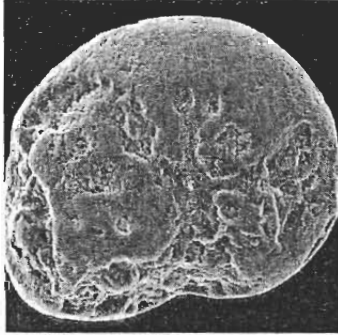
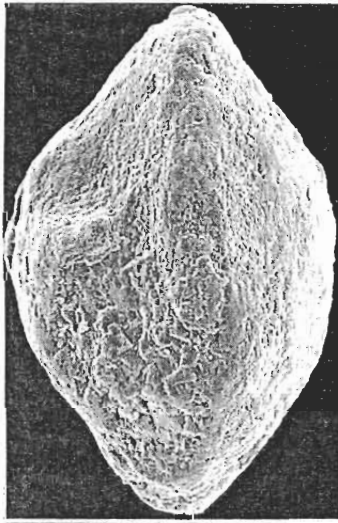
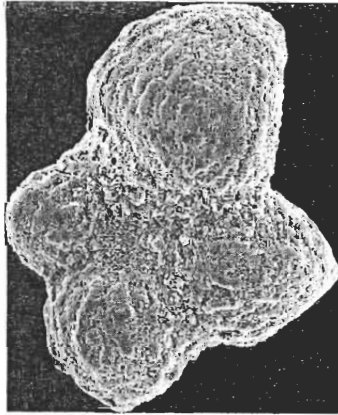
In the end, they found rare fossils that are shedding new light on what wiped out the dinosaurs at the end of the Cretaceous period 65 million years ago.

For more than a decade, the standard view has envisioned a speeding object from space that crashed into the earth and kicked up enough dust and rock around the globe to blot out the sun. The smoking gun seemed to be the discovery beneath the Yucatán peninsula of Mexico of a 110-mile-wide crater called Chicxulub, after a nearby town.

But lately, doubters have argued that Chicxulub formed 300,000 years before the mass extinction — too early to have played a role in the demise of the dinosaurs and hundreds of other plant and animal species that vanished at the end of the Cretaceous.

The team of scientists zeroed in on Cuba as an ideal place to seek clues, having heard from Cuban colleagues of a possible trove of fossils of the right age. The Cuban zone was 600 miles from the Mexican crater.

Now, in the September issue of *Geology*, the scientists, from Spain, Cuba and Mexico, report that they have discovered a highly disturbed bed of fossils that bears numerous signatures of Chicxulub's mayhem. The date of the disturbance, 65 million years ago, is exactly at the end of the Cretaceous.



Courtesy of Dr. Luis Alegret

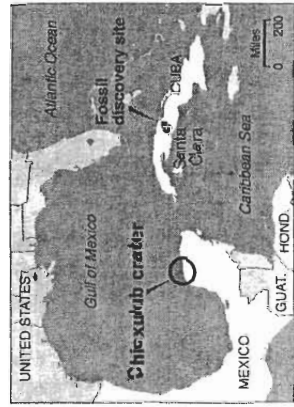
Tiny fossil creatures found in Cuba, notably foraminifera, date from 65 million years ago, the end of the Cretaceous period. At right, shells surround material from fireball.

"It's basic" to resolving the debate, Laia Alegret, a team geologist at the University of Zaragoza in Spain, said in an interview. "But it was difficult. The site is located opposite a military base. So it's almost impossible to get a work permit."

The discovery was outside Santa Clara, a city in central Cuba whose nearby air base drew scrutiny in 1962 when American spy planes spotted Soviet jets and anti-aircraft missiles. It turned out that the base held Soviet bombers and a half-dozen atom bombs.

"It was definitely a hot spot," said Timothy Naftali, a cold war historian at the University of Virginia.

Starting around 2000, Dr. Alegret and her European colleagues repeatedly sought work permits for a nearby hill but always met with stultifying delays, if not outright rejections. Finally, they slipped into the site with their Cuban colleagues, going in late



2000, 2002 and 2003. At other times, the Cubans went in alone.

A rocky outcrop on the hill showed an exposed bed of sedimentary rock made up of broken bits of minerals and fossils. It was more than 30 feet thick. The team took 66 samples. Examination with microscopes

showed numerous signs of cosmic violence, including quartz deformed by high temperatures and pressures, as well as tiny spheres of glass, both clearly debris from a spectacular fireball.

Microscopic study also revealed the presence of thousands of tiny fossil creatures, most especially foraminifera. Those one-celled animals have a bewildering array of minuscule shells. Forams, as they are known, evolve so fast that geologists, paleontologists and oil companies use their shifting appearance as reliable guides to geologic dating.

"They told the age of the sediments," Dr. Alegret said. "So we've definitely confirmed the age of these deposits."

At the end of the Cretaceous, the rocky bed now in Cuba formed on the ocean bottom at a depth of perhaps 3,300 feet, over a few days or weeks as tons of debris rained

down from the sky and huge waves generated by the Chicxulub event washed land out to sea.

"It was geologically instantaneous," Dr. Alegret said of the deposit's formation.

Earth movements over the ages turned that part of the seabed into land.

Dr. Alegret's co-authors include Ignacio Arenillas, José A. Arz, Alfonso Meléndez, Eustoquio Molina and Ana R. Soria of the University of Zaragoza; Consuelo Diaz of the Institute of Geology and Paleontology in Havana; José M. Grajales-Nishimura of the Mexican Institute of Petroleum in Mexico City; and Reinaldo Rojas of the National Museum of Natural History in Havana.

Dr. Alegret said that because of the site's importance, her Cuban colleagues were talking with the government to have it protected from rain and erosion. The aim is to save the outcrop for scientific study.

Challenged by Creationists, Science Museums Start to Answer Back

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terial world, and they understand that all scientific knowledge is provisional — capable of being overturned when better answers are discovered.

"Is it against all religion?" he asked. "No. But it is against some religions."

There is more than one type of creationist, he said. "Thinking creationists who want to know answers, and they are willing to listen, even if they go away unconvinced" and "people who for whatever reason are here to bother you, to trap you, to bludgeon you."

Those were the type of people who con-



program, said that within the last year or so efforts to train museum personnel and volunteers on evolution and related topics had substantially increased. "This seems to be a cottage industry now," Dr. Scott said.

Robert M. West, a paleontologist and former science museum director who is now a consultant to museums, said several institutions were intensifying the docents' training "so they are comfortable with the concepts, not just the material but the intellectual, philosophical background — and they know their administrations are going to support them if someone criticizes them."

At the Denver science museum, the staff and docents often encounter groups from

some of the misconceptions they come in with." She hopes to combat the idea that people must choose between science and faith — "that you are either a good Christian creationist or an evil atheist evolutionist."

"It's your job," she told docents, "not to slam the door in the face of a believer." At the American Museum of Natural History, which is about to open what it describes as "the most in-depth exhibition ever" on Darwin and his work, curators and other staff members instruct volunteer "exhibitors" on the science behind its exhibitions, according to Stephen Reich, a spokesman. If visitors challenge the presentations, the explainers are instructed to listen "and