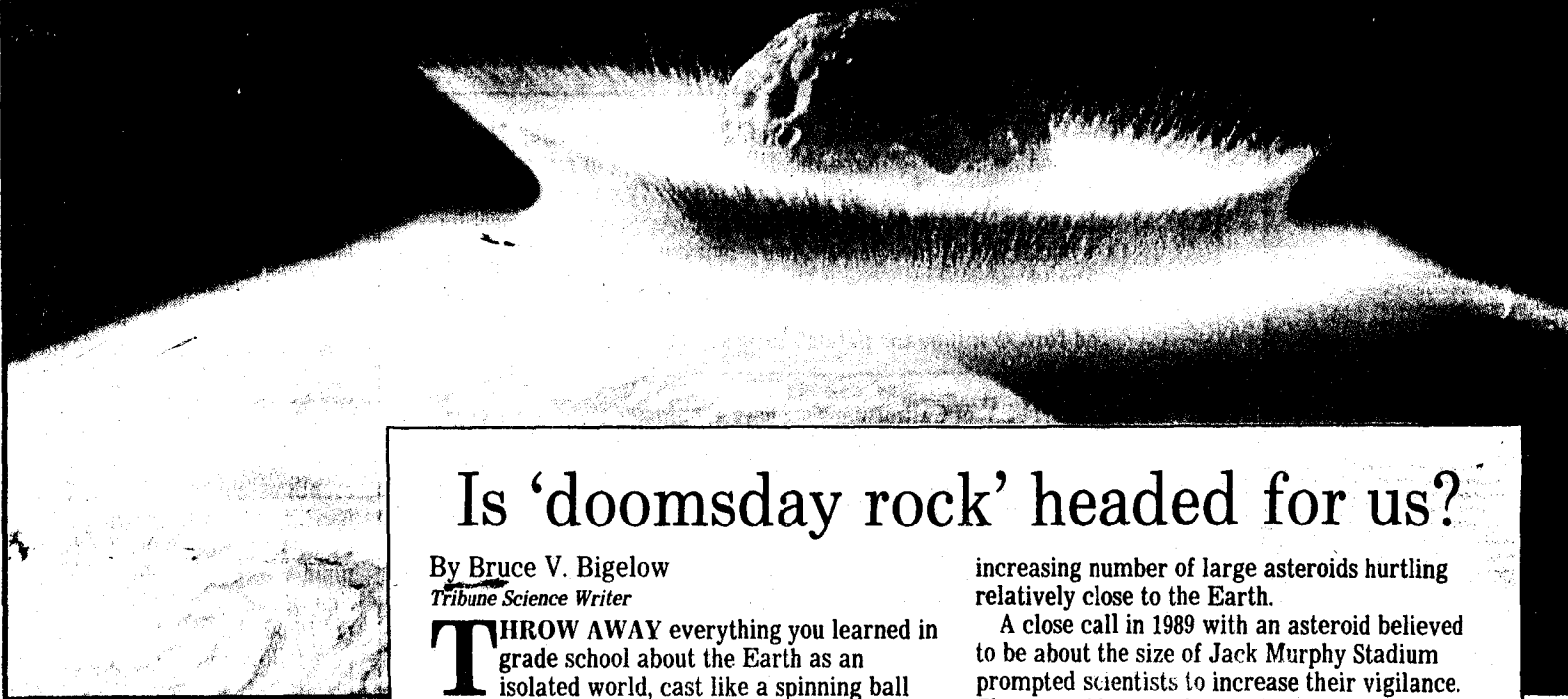


Space debris: Its impact



NASA photo

Asteroids hitting the Earth, as illustrated in above photo, super-impact the planet and may have annihilated all life on Earth 3.5 billion years ago.

Is 'doomsday rock' headed for us?

By Bruce V. Bigelow
Tribune Science Writer

THROW AWAY everything you learned in grade school about the Earth as an isolated world, cast like a spinning ball into an empty, limitless void.

Imagine instead that the Earth is arcing through a hailstorm of galactic debris that has included chunks as big as California.

For the most part, the celestial deluge consists of motes of dust and small rocks that sometimes look like streaks of fireworks in the atmosphere at night. In this way, scientists say an estimated 100 tons of material from space floats to the Earth's surface every day.

Amid the pitter-patter of meteor showers,, however, astronomers are discovering an

increasing number of large asteroids hurtling relatively close to the Earth.

A close call in 1989 with an asteroid believed to be about the size of Jack Murphy Stadium prompted scientists to increase their vigilance. The asteroid, spotted by Palomar observers, sped by the Earth at 46,000 miles per hour, crossing its orbit at a point where the planet had been only six hours earlier.

Many of the objects sighted by astronomers are three-fifths of a mile wide, and evidence indicates that even bigger asteroids have repeatedly struck the planet in the distant past.

Earlier this month, scientists at NASA's Ames Research Center in Mountain View suggested that two "super impacts" by 500-mile-wide
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DEBRIS: *Scientists warn asteroids not to be taken lightly*

Continued From Page 1

"California-size" bodies may have annihilated all life on Earth 3.5 billion years ago.

In other words, life may have begun, been destroyed by a planet-altering impact, and then begun again — with the entire process repeated.

In comparison to the super impacts, even modest-size asteroids today pose catastrophic consequences that still make other natural disasters pale in comparison.

Scientists estimate that the impact of a mile-wide asteroid, for example, would be comparable to the explosive force of 100,000 megatons of TNT — or about 10 times the energy of the world's entire nuclear arsenal. Dust and debris would be ejected into the upper atmosphere, blocking sunlight.

The collision, according to scientists, would create a crater roughly 10 to 20 times bigger than the asteroid itself. The size of the crater would depend on such variables as the asteroid's density, its angle of impact and whether it hit bedrock or landed in the ocean.

The best that astronomers can tell, objects of such size strike the Earth, on average, once every 300,000 years.

But until recently, few scientists gave the subject much thought, even though evidence of repeated asteroid impacts was obvious by the size and number of craters on the moon.

"Until I started our program, nobody was really doing a systematic search," said Eleanor Helin, a planetary scientist at NASA's Jet Propulsion Laboratory in Pasadena.

Helin began scanning the skies for "near-Earth asteroids" in 1973, using an 18-inch-diameter telescope on Palomar Mountain. Almost 20 years later, the skywatch is continuing with just three groups of U.S. astronomers, including Helin.

"It's hard to say how scientists could see all these impact craters on the moon and Mars and not see the logic of what that means for the Earth," said Clark Chapman of the Planetary Science Institute in Tucson, Ariz.

Similar pockmarks have disappeared from the Earth's surface over eons under the shifting influences of mountain building, erosion and earthquakes. Yet Chapman says, "I sure think this is a greater danger than a lot of other things in our society that we spend money studying."

All together, more than 180 objects that pass close to the Earth's orbit have been discovered. A new one is discovered every few weeks, and some astronomers believe the number of big asteroids could reach 1,700 or more.

The problem is that even huge asteroids are hard to detect in the depths of space.

For example, Palomar astronomers spotted the 1989 asteroid only after it had passed the Earth.

The asteroid came no closer than 400,000 miles. Still, it crossed the Earth's orbit at a point where the planet had passed just six hours earlier. If it had hit, scientists believe the force of the explosion would have killed everything within 100 miles.

The celestial close call alarmed Johan Benson of the American Institute of Aeronautics and Astronautics in Washington, D.C., who urged the House Committee on Science, Space and Technology to push for more research on near-Earth asteroids.

Congress instructed NASA to pursue the matter. As one result, the space agency and the Planetary Society are co-sponsoring the first international conference on near-Earth asteroids in San Juan Capistrano from June 30 to July 3.

"Of course these near-misses have been happening all the time," said

Chapman, who helped organize the conference. "It's just that now we're detecting them."

Even so, nobody knows if there is a "doomsday rock" orbiting within the solar system with the Earth's name on it. And nobody knows what to do if a monstrous asteroid was discovered plunging head-on for the planet.

Sure, it's conceivable that nuclear missiles could be launched to intercept an Earth-bound asteroid. But the technical problems might require a decade to solve. For example, what if nuclear blasts only break up an Earthbound asteroid into smaller chunks?

Among the first to ponder such problems was Eugene Shoemaker, 63, a geologist-turned-astronomer with the U.S. Geological Survey in Flagstaff, Ariz.

In the 1950s, Shoemaker showed that a gaping hole in northern Arizona, 600 feet deep and three-quarters of a mile wide, was excavated 50,000 years ago by an asteroid just 150 feet in diameter.

At the time, many geologists believed the crater was volcanic.

Shoemaker and others say scientific

thinking about asteroid impacts changed dramatically in the last decade, mostly because of work by the late Luis Alvarez and his son, Walter, a geologist at the University of California at Berkeley.

In late 1979, the Alvarez team proposed that a huge asteroid struck the Earth 65 million years ago. The impact packed the kinetic punch of perhaps a billion megatons of TNT, and precipitated massive worldwide extinctions that included the last of the dinosaurs.

The Alvarez theory was based on excavations in Italy that showed excessive amounts of an element called iridium in a thin layer of clay that separated rock of the Cretaceous period, the great age of the dinosaurs, from the Tertiary period that followed. Iridium is a rare element on Earth, but has been found in abundance in meteorites.

"Most geologists, especially the paleontologists, treated it as a joke," Shoemaker recalled. "I had to tell my friends at Caltech, where I was teaching at the time, 'This is no joke.'"

Postal Service aims for shorter waits

WASHINGTON (AP) - The U.S. Postal Service is hoping to move its customers a bit faster.

Postmaster General Anthony Frank has directed a group of postal officials to devise ways to speed up the lines in post offices.

Spokesman Frank Brennan said the agency hopes to organize a test of new methods later this summer in Greensboro, N.C.

Neither Frank nor Brennan discussed precise actions to cut waiting times, though Frank told a congressional subcommittee that he would like to see the lines reduced to 5 minutes or less.

Man convicted of butchering wife's lover

WAUSAU, Wis. (AP) — A man accused of dismembering his wife's lover and cutting off the victim's ponytail as a trophy was convicted in the slaying.

A jury found carpenter Dean Allen, 25, guilty of being a party to the 1990 murder of Robert Pogue, a 28-year-old butcher from Colby.

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Patterns of even matter give astronomers something to ponder

Clumps of galaxies defy current creation theories

By John Noble Willford
New York Times News Service

Astronomers have discovered more than a dozen evenly distributed clumps of galaxies stretching across vast expanses of the heavens, suggesting a structure to the universe so regular and immense that it defies current theories of cosmic creation and evolution.

In a report published Tuesday in the journal *Nature*, scientists said the newly found pattern of clumped galactic matter, if confirmed by further observations, dwarfs the extremely long sheet of galaxies, the "great wall" reported last fall to be the largest structure in the universe.

The great wall, in fact, is merely one of the closest of these clumps, or regions, that contain very high concentrations of galaxies.

Astrophysicists said the discovery could lead to a fundamental re-thinking of theories about the early universe.

The discovery raised further doubts about concepts that try to explain how, over time, gravity alone could have produced a universe marked by conglomerations of galaxies.

Two teams of astronomers in the United States and Britain shared more than seven years' data before they felt sure enough of what they were seeing to publish the results.

They were surprised by so many big clumps rather than a more uniform distribution of matter over such a large scale, and to find the

clumps so evenly spaced, each either 400 million or 800 million light-years apart, depending on assumptions of how rapidly the universe is expanding.

"The regularity is just mind-boggling," said Dr. David C. Koo, an astronomer at the University of California at Santa Cruz and an author of the *Journal* report.

"It's as if we pierced an extremely narrow needle through the universe and hit one wall after another."

'It's as if we pierced an extremely narrow needle through the universe and hit one wall after another. The clumps should be randomly distributed and they're not.'

— Alexander S. Szalay,
Johns Hopkins University
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"The clumps should be randomly distributed and they're not. That's the biggest surprise."

In a commentary on the report, also published in *Nature*, Dr. Marc Davis, an astrophysicist at the University of California at Berkeley, said the distribution could be a statistical fluke, not a real pattern.

But he concluded that if the galaxy distribution is regular, "it is safe to say we understand less than zero about the early universe."

Koo said in a telephone interview that he, too, remained skeptical, but the evidence "got so strong

we had to publish what we had."

The other authors of the report are Dr. Thomas Broadhurst and Dr. Richard Ellis of the University of Durham in England and Dr. Richard Kron and Dr. Jeffrey Munn of the University of Chicago.

The scientists said it was too early to speculate on the cause of such a pattern and the theoretical implications.

The survey, of only a small patch of the sky, did penetrate structures about halfway back to the beginning of time.

"If similar patterns appear elsewhere," Koo said, "theorists will have a lot of hard work before them to figure out how the universe could generate bubbles or shells or honeycombs of galaxies and imprint them on such large scales."

A honeycombed universe is the picture that some astronomers draw from these observations.

Each dense clump of galaxies is about the same distance from the next, and in between is a region of equally uniform size that has only a sparse population of galaxies.

Confirmation of these observations, astrophysicists said, would deal a heavy blow to the "cold dark matter" hypothesis for the formation of galaxies.

This postulates that it is the gravitational force of invisible matter, so far undetected, that has caused the universe to be transformed from its initially smooth state to the clumpiness of galaxies and clusters of galaxies.

The observations, Koo said, suggest that the universe may have "an inherent roughness" imprinted a fraction of a second after the Big Bang.

B8 TIMES-ADVOCATE, Escondido, Cal., Tuesday, February 27, 1990

Oblong object is modern stomach stone, not fossil egg

ALBUQUERQUE, N.M. (AP) — An oblong object that officials last year proclaimed to be a fossilized egg up to 16 million years old has turned out to be a stomach stone from a modern mammal, possibly a cow.

"Mother Nature fooled us," said Mike O'Neill, a U.S. Bureau of Land Management fossil expert.

O'Neill said he concluded after

FINAL REDUCTION SHOE SALE

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Whew! That Was Close

Earth's narrowest escape from an asteroid in 52 years

BY MICHAEL D. LEMONICK

Where were you on the night of March 23? Out dancing, perhaps, or attending a PTA meeting or just sitting at home watching *L.A. Law*? If so, you did not realize how close you came to disaster. While you were blissfully unaware of the danger, a huge asteroid whizzed past the earth, coming closer than any other such heavenly body seen in 52 years. If the giant clump of rock—half a mile across by one estimate—had hit the planet, it would have packed the wallop of thousands of H-bombs and possibly killed millions of people. If it had come down in an ocean, it could have triggered tidal waves hundreds of yards high.

Before you become alarmed, however, you should understand that this was a close encounter only in a relative sense. At its closest, the asteroid was about 450,000 miles away, roughly twice the distance between the earth and the moon. Still, in cosmic terms it was virtually a direct hit. No asteroid has been sighted so near since 1937, when *Hermes*, a minor planet nearly half a mile in diameter, passed by at about the same distance.

The new asteroid, called 1989FC in accord with the official numbering system of the International Astronomical Union, was first detected by Henry Holt, an adjunct professor of geology at Northern Arizona University. That was in late March, after it was already moving safely away from earth. Holt spotted the speeding intruder in photographs taken through an 18-in. telescope at the Palomar Observatory in Southern California, during a systematic search for asteroids passing close by, which scientists call earth grazers. Holt figures that 1989FC may be in *Hermes'* league, but other astronomers dispute the claim, saying the new asteroid may be only 100 yds. across. Even if the smaller size is correct, no one would want to have 1989FC land in the backyard. A 100-yd.-wide asteroid hitting the earth at a speed of nearly 50,000 m.p.h. could dig a crater a mile or so across and several hundred feet deep—similar in size to a gaping hole in the Arizona earth, known as Meteor Crater, that was blasted out some 40,000 years ago. Such an impact today would be

enough to wipe out a major population center.

Ominously, astronomers say 1989FC will be back. Like the earth, the asteroid orbits the sun, but it takes about 380 days to do so, instead of 365. When the asteroid passes by again next April, it will probably be at a safer distance from the earth. The next time earthlings need to worry, says astronomer Brian Marsden of the Harvard-Smithsonian Observatory, who

so eventually. It has happened so many times before, in fact, that the earth's surface would be as pockmarked as the moon's were it not for the cosmetic effect of erosion caused by the oceans and atmosphere. Half-mile asteroids are a dime a dozen in the solar system, and they run into the planet once every 100,000 years on average. That means the next one could strike in a thousand lifetimes—before the end of next week.

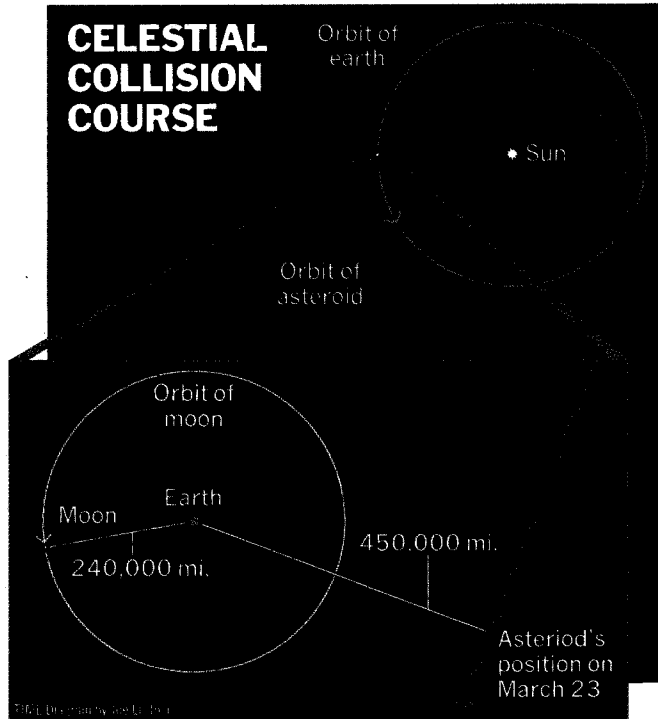
Then there are the really big asteroids—masses of rock and iron five or ten miles across that hit every 10 million to 100 million years. The half-milers are big enough, but these giant ones pose a threat to the entire planet. It was such an asteroid (or an equivalent-size comet) that many scientists believe caused the extinction of dinosaurs some 65 million years ago. The primary evidence, discovered by the late physicist Luis Alvarez and his son Walter, a geologist, is a layer of the element iridium laid down in sedimentary rock at about the time the giant reptiles disappeared. Iridium is rare on the earth's surface but more common in asteroids.

If an enormous chunk of space rock hit the planet, the Alverezes theorized, it would have largely disintegrated, casting a pall of iridium-rich dust and other debris over the world that could have lasted for months. Deprived of sunlight by this all-natural version of "nuclear winter," plants—and the animals that fed on them—would have died in droves. And when the dust finally settled, the iridium it contained would have formed just such

a layer as the Alverezes found.

Is there any way to avoid collisions with asteroids and comets? Perhaps. A nuclear warhead aimed right at a small asteroid could vaporize it, says Alan Harris, an astronomer at the Jet Propulsion Laboratory in Pasadena, Calif. But the warhead might also simply break the rock into pieces that would hit the earth anyway. A better plan, proposed by concerned scientists in the early 1980s, would be to use explosives to deflect an asteroid rather than destroy it. Properly positioned, a bomb could nudge a threatening object enough to make it miss the planet. The catch, says Harris, is that there would not be much time to react to an approaching celestial body. "With an asteroid like this one," he says, "you'd probably get a day's warning at best." In short, the most sensible thing to do about earth-grazing asteroids is try not to think about them. ■

CELESTIAL COLLISION COURSE



calculated the orbit based on Holt's observations, is 2015. "If our figures are correct," he says, "the asteroid will have made 25 orbits to earth's 26, and we will meet again."

That could mean a direct hit or, more probably, another nerve-jangling near miss. But even if 1989FC never strikes earth, a similar asteroid is destined to do



Prehistoric victims of a strike from space?

LIFE PHOTO LAB

Comet Fire

Did it doom the dinosaurs?

The world may someday end with a whimper, but evidence is mounting that the dinosaurs went out with a bang. According to the much debated theory proposed by the father-son team Luis and Walter Alvarez in 1980, an asteroid or comet slammed into the earth at the end of the Cretaceous period, 65 million years ago, spewing so much dust into the atmosphere that sunlight was blocked for months. Temperatures plummeted, plants withered, and many species, including the mighty dinosaurs, perished en masse.

Now chemists at the University of Chicago have added an important new twist to this version of the apocalypse. Edward Anders and his colleagues reported in the journal *Science* last week that they had found evidence of a global firestorm that raged about the time the dinosaurs disappeared. The conflagration, they say, suggests that the consequences of a great Cretaceous impact were even worse than the Alverezes had dreamed.

Like many other spectacular discoveries, Anders' finding was serendipitous. He and his co-workers had simply hoped to

elaborate on the Alvarez hypothesis by detecting trace amounts of rare noble gases, like neon and xenon, in the layer of Cretaceous clay deposited during roughly the same period that the dinosaurs became extinct. They were seeking to identify the nature of the object responsible for the impact. Because noble gases collect in carbon particles, the scientists isolated the carbon in Cretaceous sediment taken from Denmark, Spain and

New Zealand. To their surprise, all three samples contained carbon that had been deposited at a rate 10,000 times as great as carbon in the layers immediately above and below them. It was bunched together in the fluffy patterns characteristic of common soot. Says Anders: "It's like the stuff you see in the flame of a candle." He believes that the soot almost certainly is a remnant of vegetation consumed by fires.

Disaster began when the celestial intruder crashed into what is now the Bering Sea, possibly creating a crater



Last of the Cretaceous: up in smoke

some 100 miles wide. The stupefying force of the impact, estimated at 100 million megatons, would have generated an enormous 3,000° F fireball that would have spread outward at the speed of sound, igniting forest fires from North America to Asia. Several hundred billion tons of plants and animals would have been incinerated, sending great scarves of black smoke to join the impact dust in the stratosphere and circulate around the

globe. What is more, because soot does not rain out as easily as dust, the protonuclear winter would have lasted much longer than it would through obscuring dust alone. Most plants and large animals that survived the blast, the fire and the lethal clouds of carbon monoxide would have succumbed to the climatic changes. But smaller creatures could have slipped into caves and hibernated until sunlight returned and they emerged to repopulate the earth. —*By Natalie Angier. Reported by Robert Buder/San Francisco*

If you

Box: Less than 0.5 mg. "tar", 0.05 mg. nicotine; Soft Pack, Menthol and 100's Box: 1 mg. "tar", 0.1 mg. nicotine; 100's Soft Pack and 100's Menthol: 5 mg. "tar", 0.4 mg. nicotine; 120's: 7 mg. "tar", 0.6 mg. nicotine av. per cigarette, FTC Report Jan. '85. Slims: 6 mg. "tar", 0.6 mg. nicotine av. per cigarette by FTC method.