easily endure such impacts.
For those who stay up at night worrying about using bombs to deflect rogue asteroids from Earth, this is unsettling news. Some astronomers believe that nearly all asteroids larger than a couple of hundred feet across are essentially flying rubble piles, not solid rocks. If these asteroids have a Terminator-like ability to absorb punishment, any that threaten to hit Earth may be impossible to divert.

Asphaug modeled the asteroid Castalia, a mile-long, half-mile-wide body with a peanut shape. His simulation uses each of three proposed compositions for the asteroid: one solid rocky body, two solid bodies touching in the middle, and a pile of boulders and gravel. Asphaug then slammed a 6,000-ton, house-size asteroid into each of the three configurations and watched what happened.

The impact shattered the solid asteroid, leaving behind a flying pile of rubble. And although half of the "touching" model survived unscathed, the solid half that took the hit broke apart.

But the rubble pile took the licking pretty well—its loose structure didn't transmit the energy of impact efficiently.

Asphaug's model suggests that we would need a much longer lead time than most researchers have assumed to successfully divert a threatening asteroid. To redirect an asteroid the size of Castalia, says Asphaug, a rocket would have to reach it 20 years before the predicted impact date.

Emmett Glass noticed something unusual recently when his dust mites escaped from their petri dish. Instead of straying in all directions, the .3-millimeter-long creatures clumped together on the laboratory workbench. Glass, an entomologist at Ohio State, suspected that the mites were trying to conserve water. For years researchers have wondered how dust mites stay moist. In labs, individual mites dehydrate and die when the humidity drops below 50 percent. So how could the allergy-causing pests hang on in homes when moisture falls below fatal levels? Glass believes that the mites help the mites survive. To test his theory, he removed some mites from their clumps and lowered the humidity levels. He then weighed them to see how much water they retained. Those in clusters lost about half the water of the isolated mites. Glass believes he knows how the mites survive. "Dust mites have glands packed with salt on the sides of their head," he says, "that suck water molecules from the air and siphon it into their mouths. When the mites cluster, these glands absorb and recycle excess water excreted by other mites." Glass suspects mites use chemical signals called pheromones to communicate the need to huddle, and he hopes to work out the chemical makeup of the pheromones. "Our ultimate goal," he says, "is to figure out ways to eliminate the pests."

Dry as a Dust Mite

BIOLOGY

Prenatal Competition

ABOUT 150 YEARS AGO Darwin proposed that the different developing body parts of an organism might compete with each other for resources as they grow within an egg or a womb. That competition, Darwin believed, would determine the final size of the body parts. More recently biologists have favored the idea that genetic constraints, not competition, determine the size of developing organs. But now it seems that Darwin may have been right after all.

Biologists Fred Nijhout of Duke University and Douglas Emlen of the University of Montana have been studying metamorphosis in insects. A caterpillar, for instance, has small clusters of cells destined to become the wings, legs, and mouthparts of a butterfly. The cells don't grow much as the caterpillar eats leaf after leaf. But when the caterpillar stops feeding, just before metamorphosis, the cells "suddenly grow like gangbusters," says Nijhout. This peculiarity, he realized, gave him the perfect opportunity to
test Darwin’s theory. Since the caterpillar wasn’t eating, Nijhout could observe
the development of body parts when a
limited supply of nutrients was available
for growth—the perfect condi-
tion for competition.
The researchers first anes-
thetized caterpillars and re-
moved the cells that would or-
dinarily become hind wings.
When the butterflies emerged
from their cocoons two weeks
later, their front wings were
larger than those of normal but-
terflies. The mass of the front
wings had increased by the
same amount that would have
been in the missing wings. Next
Nijhout and Emlen looked at
treated beetle larvae with a hormone that
horned beetles. When they
curbs horn growth, the beetles grew bigger eyes. They also noticed
that beetles bred to grow big horns invariably had smaller eyes than beetles bred to
have small horns (compare photos).
Was Darwin right after all? “The simple explanation would be that these things are truly competing for
nutrients,” Nijhout says. But it’s
also possible, he adds, that
each part interferes with the
others’ growth, producing
substances that stunt other
tissues. “We know very little
about these higher-level
physiological controls.”

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GEOLOGY

A Billion Years of Stability

IN THE EVOLUTION OF LIFE, cooperation among organisms is
probably at least as important as competition. The first
complex single-celled creatures—eukaryotes—probably
appeared when a host bacterium engulfed a smaller bacterium,
perhaps one that could use photosynthesis to turn sunlight into
energy. But to make such a symbiotic relationship permanent—
to make one new organism out of two—is no easy task. “If you
get more nutrients into the environment, from upwelling or
pollution, the little photosymbiotic plants living in the host will
swim away,” says geologist Martin Brasier of Oxford. When
nutrients aren’t scare, there is no reason for them to maintain
the symbiosis.

Even 10 million years probably isn’t long enough to cement
the relationship, says Brasier. The organisms must be subjected
to hundreds of millions of years or more of unvarying
conditions. Was there ever such a time on Earth? Brasier and
his colleague John Lindsay of the Australian Geological Survey
Organization say there was—a billion-year period in the
Precambrian. Not coincidentally, say the researchers, the first
eukaryotes appeared near the end of that billion years.

Brazier and Lindsay studied cores drilled from ancient
ocean sediments in north central Australia. They looked
specifically at the ratios of two carbon isotopes, carbon 13 and
carbon 12. Oceanic plants tend to absorb more carbon 12 than
13, leaving more of the heavier isotope behind in seawater,
which eventually becomes incorporated into rocks. So the
amount of carbon 13 in the ocean core samples indicates how
much plant life was once present. Geologists expect to see big
fluctuations in the carbon-isotope record, especially over a
billion-year period, because plant populations would be
expected to rise and fall in response to events like mountain
building. When mountains rise, erosion accelerates,