GERALD BORGIA

Come see my etchings. A male bowerbird built this walled avenue for courting females.

Thus, the male spotted bowerbird (*Chlamydera maculata*) makes an unusually wide bower with see-through straw walls and approaches the female from behind them. "He's using the wall as a barrier," says Borgia. In contrast, in two species that build relatively small platforms, "the display is much toned down."

All for Sperm's Sake

It's hard to miss a rooster crowing for his hens or a stag proudly displaying his antlers. But males also compete in more subtle ways to get their genes into the next generation, as their sperm vie to fertilize the female's eggs. Extensive studies of a common insect pest, the Indian meal moth, are now giving scientists a glimpse of the lengths males may go to give their sperm an edge. "The more I look, the more I find sophistication," says Matthew Gage of the University of Liverpool in the United Kingdom.

At the meeting, Gage described how moths can size up females and beef up their sperm counts accordingly. They can also change the size of adult body parts to optimize their sperm's chances of success. Scientists have studied sperm competition since 1970, but Gage's studies show how thoroughly sperm competition can shape the rest of the male's life, says Gerald Wilkinson, an evolutionary biologist at the University of Maryland, College Park. "There are life history consequences to male reproductive investment, just as there are in females," he says. "That hasn't been well appreciated."

Gage raised larvae in jars with one, five, 10, or 20 individuals per jar, adjusting the amounts of food accordingly. When the larvae emerged as adults, they were all about the same overall size but were proportioned quite differently, depending on the population of the jars, he reported. Those raised alone or with only four companions had small testes and produced small amounts of ejaculate, presumably because they somehow sensed that their sperm would face little competition from other males mating with the same female. But they had relatively large heads and thoraxes—which contain the muscles and sensory systems needed to find mates. The moths from uncrowded jars also developed faster and lived longer, Gage notes, presumably because their lower investment in sperm meant they could afford to stock up more fat reserves to sustain the nonfeeding adult stage.

In contrast, adult males from the more crowded jars—where they might have easier access to females but lots of sperm competition—had smaller heads and thorax muscles. Instead, they had larger abdomens, presumably to enhance their sperm-generating capacity, and they provided females with larger packets of sperm. But this investment apparently came at a cost: These insects tended to die sooner than their counterparts in uncrowded jars.

Gage found that both uncrowded and crowded males also have another stratagem to give their sperm a boost. "They are capable of manipulating the material they are putting into the female," Wilkinson notes. They make two kinds of sperm, one that can fertilize the egg and one that cannot because it lacks DNA. Gage suspects that the nonfertilizing sperm act as "cheap filler," giving the female the sense that she has plenty of sperm and doesn't need to mate again. He found that males add more filler, plumping up their sperm contribution, when the receiving female is young and likely to have more mating opportunities.

In addition, all males insert a larger packet of sperm when the female is bigger, possibly to get her to wait longer before she mates again, or because her size indicates she has more eggs to fertilize, Gage suggests. "Sperm competition is an incredibly potent and far-reaching force, so it's not surprising that males have evolved cryptic, but sophisticated, systems to be successful," he concludes.

–**Elizabeth Pennisi**

PLANETARY SCIENCE

Comet Origin of Oceans All Wet?

BLOIS, FRANCE—Comets are made largely of ice, and over geologic history, vast numbers of them have hit Earth. Even now, according to a controversial proposal by University of Iowa, Iowa City, physicist Lou Frank, miniature comets might be quietly showering our planet (*Science*, 30 May, p. 1333). Many planetary scientists have surmised that most of the water on Earth's surface could have originated in comets. But a close look at the water in two recent comets challenges that conclusion.

At a planetary science meeting held here last month, Tobias Owen of the University of Hawaii's Institute for Astronomy reported that he, Roland Meier, and their colleagues had measured the ratio of ordinary water molecules to molecules containing deuterium, a heavy isotope of hydrogen, in this spring's spectacular comet, Hale-Bopp. The group picked up radio emissions from the deuterated water with the James Clerk Maxwell Telescope on Mauna Kea. The intensity of the emissions, the Owen-Meier team found, indicated that Hale-Bopp contains about three deuterium atoms for every 10,000 atoms of ordinary hydrogen. That's about twice the ratio in seawater. But it agrees with measurements of last year's comet Hyakutake, made by Daniel Gautier of Meudon Observatory and his colleagues and also announced at the meeting, and with the decade-old observations from the flyby of comet Halley.

"These results show that you can't make the bulk of Earth's oceans with water from these sorts of comets," which come from the so-called Oort cloud in the farthest reaches of the solar system, says Owen. Other planetary scientists tend to agree. "The data are, at the least, discouraging," says Christopher Chyba of the University of Arizona's Lunar and Planetary Laboratory. "Of course, there are caveats: Other sorts of comets could have furnished our water, billions of years ago." David Stevenson of the California Institute of Technology agrees: "I think the hypothesis is in trouble, and comets are perhaps less important than we thought in making the oceans."

The processes responsible for the cloud of primordial material that coalesced into the solar system are thought to have enriched deuterium in some regions and depleted it in others. So planetary scientists are looking for the source of Earth's water in objects likely to have formed in other parts of the cloud. At the meeting, François Robert of the Natural History Museum in Paris announced support for one potential source. He and his colleagues have measured the deuterium-to-hydrogen ratio in carbonaceous chondrites, meteorites thought to date from the early days of the solar system. The ratio varies by an order of magnitude, but the average is close to that in the seas of Earth, suggesting that rocky, chondritelike material—which contains traces of water—could have been the wellspring of the oceans.

Frank, however, thinks the comet theory—his variant of it, at least—is unscathed by the new measurements. "Large comets [such as Hale-Bopp] have nothing to do with the water in our oceans," says Frank, who believes that the water arrived in swarms of tiny, fluffy objects, whose existence he has inferred from ultraviolet emission observed in Earth's upper atmosphere. These comets, he says, have markedly different compositions from comet Hale-Bopp and its ilk, and perhaps different deuterium-to-hydrogen ratios as well. Then again, no one has yet made a definitive sighting of a tiny comet, let alone measured its composition.

–**Donald Goldsmith**

Donald Goldsmith's book, The Hunt for Life on Mars, *was recently published by Dutton.*