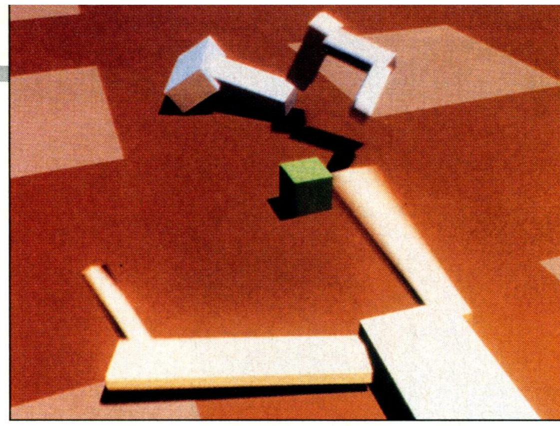
connected blocks. By chance, one proto-creature gets a mutation that makes it twitch a little bit toward the cube. That individual would then reproduce itself, and thus any mutation that gets a creature closer proliferates.

After 100 generations, some creatures developed long "bodies" that could fall on the cube, "arms" that could bat away competitors, and any number of types of "pincers" or "claws" that could grab hold. They also started creeping, crawling, and hopping around the screen.

Sims realized at the outset that he would have to give the creatures environmental constraints and programmed into the simulation some relevant laws of physics—gravity and friction, for instance. But he made a mistake with the law of the conservation of momentum and soon found some of his creatures were moving by kicking themselves. Sims, kicking himself, corrected the error, and evolution proceeded apace.

–Faye Flam



K. SIMS/THINKING MACHINES CORP.

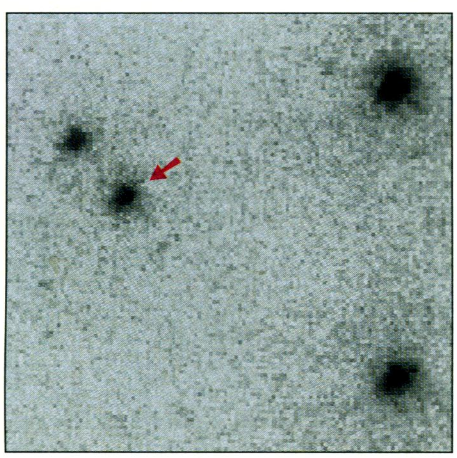
Give my creatures life! These animated entities evolved complex form and function on their own.

ASTRONOMY

Do Tides Power Black Widow's Mate?

The female black widow spider has achieved notoriety for devouring her mate, and such conjugal homicide inspired astronomers to name a star discovered in 1988 the Black Widow pulsar—because they believe the star is boiling away its nearby companion. In a paper to be published in November, two investigators from Columbia University now suggest that the Black Widow's unfortunate mate derives its energy from tides—the irregular flow of stellar gases caused by the neighboring pulsar's strong gravity.

That would be a first, since all other known stars are thought to be powered by nuclear fusion. As the companion has aged and lost mass, contends Columbia theoretical astrophysicist James Applegate, "it slowly switched from nuclear power to tidal power." If true—the jury is still out—this unusual energy source could then help explain some puzzling steps seen in the orbital dance between these two stars.



A. FRUCHTER/STSCI

Holding on to life. While the Black Widow pulsar *(not shown)* is destroying its companion star *(arrow)*, the pulsar's gravity may create the companion's energy.

Objects like the Black Widow pulsar are spinning neutron stars from which astronomers detect regular pulses of radio waves. When it was discovered in 1988, astronomers noticed that the signals from this pulsar, located some 5000 light-years away, disappeared for 50 minutes every 9 hours. They concluded that the pulsar's fierce radiation was gradually evaporating gaseous layers of the companion star, creating a stellar wind that trailed behind the companion and periodically blocked the Black Widow's radio pulses. Eventually, it is thought, this process will destroy the companion completely, a fate that not only gave the system its morbid name but also explained why some similar pulsars had no companions: They had already finished their meals.

In recent years, attention has partly shifted from the death of the companion to its orbit around the pulsar. To the puzzlement of everyone, says Princeton University radioastronomer Zaven Arzoumanian, the companion "went from spiraling in to spiraling out to spiraling back in now." He, Princeton colleague Joseph Taylor, and Andrew Fruchter of the Space Telescope Science Institute gave the latest report on these orbital changes in the 10 May *Astrophysical Journal Letters* and suggested that a theory used to explain similar variations in other star duos might also explain these unexpected motions.

The theory, first put forth by Applegate in the late 1980s, argues that magnetic fields within a star can distort its shape, producing changes in its gravitational fields and, in turn, affecting how it orbits around another star. But applying this notion to the pulsar's companion was problematic, because magnetic fields are generated by convection, an internal flow of energy within a star. Convection requires a strong energy source, and the standard energy source in a star—nuclear fusion—requires a lot of mass. The Black Widow's companion was much too small: It is only 25 times the mass of Jupiter and was thought to be white dwarf, a star that no longer generates new energy.

In the upcoming November issue of the *Astrophysical Journal*, Applegate and his colleague Jacob Shaham come to the theoretical rescue. They claim there is an alternative energy source available to the companion. The much more massive Black Widow has a huge gravitational pull, which should exert changing tidal forces on the companion as that star rotates. Those forces could slosh gaseous material around within the star, producing internal friction that becomes heat. This heat would then drive convection, producing the magnetic fields necessary for Applegate's theory of orbital variations.

Over time, the neutron star's immense gravity would normally "lock" the rate of the companion's rotation, so that the companion always offers the same face to the pulsar—as the moon offers but one side to Earth. The tidal forces on the companion would then be unchanging, material within the star would stop moving, and the energy source would stop. But Applegate and Shaham argue that the companion's stellar wind interacts with the star's magnetic field, producing a torque that jiggles the star's rotation and prevents it from ever locking in.

This is an awful lot of theorizing, and other astronomers, though intrigued, say facts may still get in the way. Some suggest it is still impossible for a star the size of the pulsar's companion to produce a large enough magnetic field for Applegate's complex orbital mechanism to work. "How you excite a very big field in a low-mass companion is not clear," says Princeton theorist Marco Tavani, who has an alternative theory in which the varying direction of the companion's eclipsing solar wind causes orbital swings.

Astronomers are trying to provide one check of the new theory. In addition to the bright glow caused by the pulsar heating part of its surface, the companion should have an intrinsic luminosity about one-thousandth that of the sun, if tides do provide it with energy. Recent pictures from the Hubble Space Telescope haven't resolved that issue, however. Fortunately, this celestial Black Widow should take eons to finish off her mate, allowing plenty of time for further study.

–John Travis