fects of the global haze released by the eruption of Mount Pinatubo, decades-long natural variations in the ocean-atmosphere system, or some combination of all three.

Whatever its cause, the 4-year warm spell has made forecasting this winter into something of a guessing game. The CAC's statistical model and human forecasters are relying on recent hints that the warm spell will continue: the failure of the tropical Pacific to cool all the way back to normal this summer and a slight increase in sea surface temperatures recorded across the tropical Pacific in September. Says Kousky, who helps keep an eye on El Niño for the CAC, "Odds are we will see a resurgence of the El Niño in the next 3 to 6 months."

The coupled ocean-atmosphere models, however, predict no El Niño, or even a cooling. No one is prepared to say exactly why these computer models disagree with the statistical forecasts, but some researchers think the models may be recognizing long-term trends in their input data that suggest the warm spell is ending. As one ingredient of its forecast, for example, the CAC model incorporates subsurface water temperatures. And Leetmaa thinks those measurements show that the stored heat that fed the unprecedented string of El Niños may finally be running out.

But Leetmaa, like other forecasters, knows that any prediction has its limits. As Cane puts it: "There's something out there to watch; we'll see what nature does."

**–Richard A. Kerr**

ASTRONOMY

# Lithium Hints at Possessed Stars

Astronomers have gotten used to a sky filled with monsters—black holes, black widow pulsars, even cannibalistic stars that devour their neighbors. Now they may have to get used to the idea that stellar versions of the "Invasion of the Body Snatchers," once thought to exist only in the minds of theorists, are for real. The bodies in question, "Thorne-Zytkow objects," are strange hybrids that form when a superdense neutron star sinks to the center of a vast, diffuse red giant star, transforming it from within. During a meeting this month at the University of Maryland* a theorist and an observer compared notes and realized that the observer may have picked up the first hints of this latest celestial monster.

Not that the observer, Philip Charles of Oxford University, has actually spotted Thorne-Zytkow objects in the flesh. Instead, he has found what may be their legacy: a suspiciously high abundance of lithium in the spectra of bright stars that seem to be trapped in orbit around massive, invisible objects such as neutron stars or black holes. Charles had already come up with a more conventional explanation for the lithium, but at the Maryland meeting, Philipp Podsiadlowski of Cambridge University approached him and suggested that the lithium dated from an earlier phase of the binary system's history, when the neutron star lay at the heart of a Thorne-Zytkow object. Charles says he is intrigued. "I thought [the idea] was outrageous and at the same time spectacular," he says.

Though Thorne-Zytkow objects are bizarre, they shouldn't be that rare. All it would take to form one, Kip Thorne of the California Institute of Technology and Anna Zytkow of Cambridge University theorized in 1975, is a neutron star in close orbit around a red giant. According to theory, the powerful gravity of the neutron star would siphon matter from the giant companion, explains Thorne. But because a neutron star can only incorporate new matter at a limited rate, gas might pile up around the neutron star, slowing it down. Eventually the neutron star would spiral into its companion and sink like a stone, destroying the giant star's core.

Once there, the neutron star would throw the star's metabolism completely out of kilter, says Garrett Beale, a former student of Thorne's. "Even though these look pretty much like ordinary stars, there is a lot of strange and wonderful stuff going on inside." The neutron core would continue to pull matter inward, compressing and heating it to generate 10 times more heat than the star's original core did. As a result, the star's outer layers would churn vigorously, favoring a set of nuclear reactions called the rapid proton process, which would forge heavy elements not seen in ordinary stars—among them molybdenum, yttrium, and rubidium.

This exotic brew could serve as a marker for Thorne-Zytkow objects, if only astronomers knew just what to look for. So last year, Beale calculated the precise mix of exotic elements a Thorne-Zytkow object would create. Concurrently, Podsiadlowski and his collaborators at Cambridge did the same calculation. Among the elements Podsiadlowski's and Beale's calculations predicted is lithium, in anomalously high amounts—just what Charles observed in the spectra of three stars recorded with a telescope in the Canary Islands.

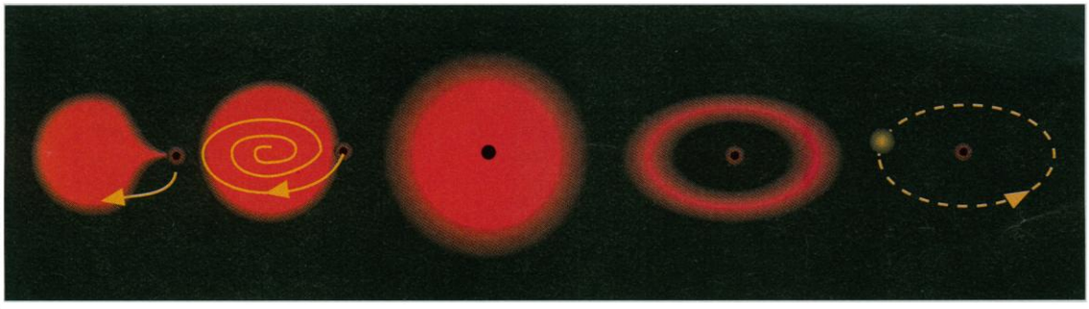
The stars look nothing like red giants, Charles notes. But Podsiadlowski thinks Charles is seeing the relics of Thorne-Zytkow objects. After forging the anomalous lithium and other elements, says Podsiadlowski, a Thorne-Zytkow object may exhaust its fuel, start a runaway contraction and then explode, throwing off the remains of the giant star into a disk. The material in the disk might later coalesce into a new companion star. The companion star would orbit the neutron star (which might have collapsed into a black hole in the meantime) and retain anomalous elements from the red giant. Such second-generation stars are exactly what Podsiadlowski thinks Charles has spotted.

Charles says he had already thought of a completely different explanation for the lithium: It might have been forged within the companion star by a barrage of high-speed protons and neutrons from the neutron star or black hole. But unlike his own idea, Charles notes, Podsiadlowski's has an obvious test: looking for other telltale Thorne-Zytkow elements in the three lithium-rich stars.

If Charles really has spotted the remnants of Thorne-Zytkow objects, the next step would be to track down an existing object. Podsiadlowski thinks the odds are good. "The 100 closest red supergiants should be Thorne-Zytkow objects," he says. Adds Thorne, "It's now time for serious searching."

**–Faye Flam**

*The Evolution of X-Ray Binaries, October 11-13.



SOURCE: PODSIADLOWSKI ILLUSTRATION: L. OWENS

**Helpless giant.** A neutron star invades its giant neighbor, forming a Thorne-Zytkow object *(center)*; later, the transformed giant may blow apart and coalesce into a new star.