tion," he says. But it's very hard to know whether such an introduction will upset the natural balance or prove benign, adds Carlton.

Carlton and Geller emphasize that a significant number of foreign invaders may have established themselves already in U.S. coastal waters. Some will go unnoticed until, like the zebra mussel, they present a major nuisance. Other invaders have been misidentified as native species. "We think the number of invasions is vastly underreported," says Carlton.

Recent events in the Black Sea illustrate the potential hazards of ballast-water dumping. In the early 1980s, the North American comb jellyfish rode a freighter into the Azov Sea, a semi-enclosed body of water in the northern Black Sea. The disruption that followed has virtually wiped out the Azov Sea's anchovy fisheries, causing a "major economic and social disaster," says Carlton.

Closer to home, San Francisco Bay has seen some notable invasions recently. For example, the Asian clam appeared there in 1986, almost certainly transported in the ballast tanks of a freighter, says Peter B. Moyle, a fish biologist at the University of California, Davis.

Today, the bay bottom is covered by 10,000 or more of these creatures per square meter. Moyle fears the clams will out-compete native species for food, retarding the recovery of the bay's declining estuary. And just last year, the European green crab found its way to the bay. Nobody is sure whether this voracious predator will help control the Asian clam invasion or damage the local shellfishing industry, according to Moyle.

"It's a lottery," he says. "Every time one of these ships comes over and dumps water into the system, you never know what's going to make it."

One very important question remains, says marine biologist John W. Chapman of Oregon State University's Hatfield Marine Science Center in Newport: How often do these inadvertently transplanted species actually gain a toehold in foreign harbors and estuaries? "We can speculate," says Chapman, "but there are no data."

– D. Pendick

A DNA structure that tags genetic junk?

Although DNA holds the instructions for making proteins, a sizable fraction of these sacred codes appears to contain nonsense. Indeed, after an RNA copy of DNA is made, an elaborate splicing system removes the genetic junk, sequences called introns. The substantive information in the remaining codes, called exons, can be patched together and translated into an enzyme or other useful protein. So why do introns exist at all?

A report in the June 22 BIOCHEMISTRY may provide a clue. Using a chemical probe, two chemists at the California Institute of Technology in Pasadena have discovered a structural landmark that appears to flag introns.

"Here we have what I think is a first indication that introns are structurally delineated at the DNA level," says Jacqueline K. Barton, one of the Caltech researchers.

A regularly occurring structure on DNA should play some important role, she says. Thus, the finding contradicts the view that introns are evolutionary relics that are removed because they serve no purpose.

The work supports the exon shuffling theory, which contends that introns act as spacers where breaks for genetic recombination occur. Under this scenario, exons – which usually contain instructions for building a protein subunit – remain intact when shuffled during recombination. In this way, proteins with new functional repertoires can evolve.

Barton and co-worker Inho Lee were searching viral DNA for unusual structures, which often prove to be biologically interesting. They used a chemical probe containing rhodium, which Barton describes as a "funny-looking metal complex which recognizes funny-looking structures."

The probe, it turns out, bound to specific structures on DNA introns. The researchers shone a light on the DNA to trigger a break at the sites of each of these structures and then determined their locations by studying the cleavage patterns. The structures appeared to occur near the ends of introns, says Barton. The same results emerged for each of the two different viral DNAs they studied.

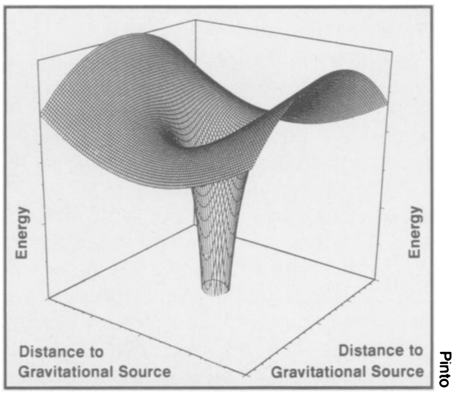
The new structures may be signposts marking where an intron ends and an exon begins, Barton says. The two chemists are planning additional studies that will compare the cleavage patterns of DNA introns and their RNA analogs. They hope eventually to look for hints of how these structures function. By fishing out which cellular or nuclear components bind to the structures, Barton says, they may be able to deduce the structures' physiological role.

– K.F. Schmidt

Exploring gravity, tides, and excited atoms

It's hard to imagine how the force of gravity – normally associated with baseballs, planets, and galaxies – could possibly have a perceptible effect on the motion of electrons in an atom, where quantum mechanics and electrical forces reign. But given a sufficiently strong gravitational field and an excited hydrogen atom in which the electron spends most of its time at great distances from the atomic nucleus, such an interaction becomes possible.

A physicist has now established that, in principle, the gravitational field of a compact, dense object such as a neutron star is strong enough to influence loosely bound electrons in hydrogen atoms close to it. Fabrizio Pinto of Boise (Idaho) State University reports his calculations in the June 21 PHYSICAL REVIEW LETTERS.



Pinto

This drawing shows how the strong gravitational field of a typical neutron star affects the potential energy of an electron bound to an atom situated at the star's surface. The star's gravitational force stretches the atom in much the same way the moon induces tides on Earth. This stretching adds a waviness to the corresponding potential energy diagram.

The idea of studying how a gravitational field may influence the motion of electrons in an atom and, hence, subtly change the characteristic wavelengths of light the atom may absorb or emit goes back more than a decade to the work of Leonard E. Parker of the University of Wisconsin-Milwaukee. He was interested in the possibility of using atomic spectra to measure strong gravitational fields.

Parker's calculations showed that for electrons tightly bound to atoms, only exotic black holes smaller than dust specks had sufficiently strong fields to influence electron energy. However, the situation looked a little more promising for excited atoms with loosely bound electrons.

Pinto carried this research further. His results reveal that electrons in freely falling, excited atoms close to the surface of a neutron star would experience gravitationally induced changes in energy large enough for a radiotelescope to detect.

Unfortunately, these excited atoms are also extremely fragile. Detection of a gravitational effect appears possible only at low temperatures and in the absence of significant magnetic fields. This rules out an environment such as the surface of a neutron star, which typically has a strong magnetic field and a high surface temperature. Pinto is now working to identify alternative situations where the gravitational effect may actually be observable.

– I. Peterson