Next on the exotics horizon? At the American Association for the Advancement of Science meeting in Chicago earlier this year, Carlton identified a crustacean 7 mm long and a snail 10 mm long as two of the most likely candidates to invade the Great Lakes – again through shipping. Initially hailing from the Caspian Sea and New Zealand, respectively, both creatures are now firmly established in western European ports frequented by Great Lakes haulers.

Biologists are laying out no welcome mats for either.

The tiny, shrimp-like crustacean, *Corophium curvispinum*, dwells in little tubes of mud it cements together with mucus. This amphipod has already gained notoriety throughout western Europe as a biofouling organism. Producing up to three generations a year, the animals quickly set up communities that coat underwater surfaces – from boat hulls and docks to zebra mussels – sometimes to densities reaching 100,000 animals per square meter.

Potamopyrgus antipodarum, the snail, also enjoys crowds, sometimes congregating in choking densities of up to 800,000 per square meter. And it's not very sensitive to temperature, surviving environments of 36° to 80°F.

Beginning this November, transoceanic shippers must exchange freshwater ballast for seawater before entering the Great Lakes – a move aimed at preventing the transport of freshwater exotics from one continent to another. This should slow the immigration of new species, Carlton notes: "If we had ballast exchange in place in 1980, my guess is that we would not have had the zebra-mussel invasion."

However, he warns, this new program is no panacea. Stowaways that can survive brief periods in salty or brackish water – as both *C. curvispinum* and *P. antipodarum* can – may still move in. Even more likely is their entry via a "back door," Carlton predicts.

The Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 mandates ballast exchange only for ships entering the Great Lakes. Such vessels remain free to discharge millions of gallons of water – and any exotics they hold – into other U.S. freshwater systems. And once an exotic species "gets a toehold in North America," Carlton says, "it will eventually colonize the Great Lakes too."

Many exotics have already used that back door route: The Eurasian goldfish (*Carrassius auratus*) may have entered from residential ponds through seasonal streams feeding Great Lakes tributaries. The oriental weatherfish (*Misgurnus anguillicaudatus*) made its escape from an aquarium supply house through a river draining into Lake Huron. Anglers probably released the ghost shiner (*Notropis buchanani*), first observed in the Great Lakes 13 years ago, as discarded bait while fishing lake tributaries. And the purple loosestrife (*Lythrum salicaria*) – which has edged out cattails and other prime waterfowl habitat along much of the Great Lakes shoreline – may have arrived in the early 1800s with sheep from Europe or as a cultivated plant.

"As a result of the invasions that we've been seeing here at the end of the 20th century," Carlton says, "we're beginning to see clear, direct movement about trying to reduce the amount of ballast water – which acts as a major mediator of invasions." His lab, for example, has just begun the National Biological Invasions Shipping Study – an analysis requested by Congress – to gauge the amount and source of ballast water entering freshwater systems throughout the United States. "We will also examine in detail proposed control options for ballast water," he reports.

The Canadians and Australians "also are very interested in doing something about ballast water," Carlton adds, and the U.S. Coast Guard has formally called for the voluntary national adoption of ballast-water exchange for ships entering all U.S. ports from foreign waters.

"I think we are where we were many years ago with [the problem of ships discharging] oil into the ocean," Carlton observes: "There is a growing realization that things have to change." □

Letters continued from p.51

reading words would be constant and the language would be the variable.

Jamie Hook
Dewitt, N.Y.

Why look back?

I think it is fair to assume that modern methods of astronomical observation and computation are significantly more precise in their measurement of stellar luminosity than those used 150 or even 50 years ago ("Astronomers Watch a Star Age," SN: 5/2/92, p.298). If that is so, a series of measurements taken even a few years apart could be used to extrapolate aging effects to longer periods.

Mart J. H. de Groot does not need to search through ancient records to recover data for testing models of stellar evolution; current data could serve as well.

Simcha Z. Pollack
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De Groot says P Cygni currently undergoes changes in brightness, even from night to night, that seem unrelated to aging. Thus, measurements of the star's luminosity must be averaged over a long period; even observations a few years apart may not be sufficient. In addition, he says, researchers must monitor the star over many years to see the true effects of aging. Using even highly accurate, modern measurements of the brightness of this star to infer its status 300 years ago could lead to erroneous results.
– R. Cowen

Stalking asthma relief

I read "Celery studies yield blood pressure boon" (SN: 5/9/92, p.319) just after suffering an asthma attack from walking through the smoking area at Houston Intercontinental Airport. Is there any evidence that the celery chemical 3-n-butyl phthalide would have the same relaxing effect on the smooth muscle in the *lungs?* This chemical, if it can relieve bronchial constriction, may offer a safer alternative to albuterol, in light of recent reports of higher death rates among asthmatics who use albuterol regularly.

I'm wondering if it's time to trade in my inhaler for a stalk of celery.

Gilbert C. Jennett
Houston, Texas

Despite their similar-sounding names, the asthma drug albuterol and 3-n-butyl phthalide are very different compounds, says clinical pharmacologist William J. Elliott of the University of Chicago, who led the celery study. Albuterol is a fat-soluble drug, which helps it penetrate deep into the lungs when inhaled, whereas 3-n-butyl phthalide is water soluble. Elliott says he doubts that inhaled 3-n-butyl phthalide would reach an asthmatic's constricted bronchi.

Might eating more celery work? "We haven't tested it yet," says Elliott, mainly because there are no asthmatic rats. – C. Ezzell

Tin data 'incomplete'

I find it disturbing that SCIENCE NEWS carried such an unbalanced report concerning the possible tin sources in Anatolia ("Turkish tin mine revises Bronze Age history," SN: 5/9/92, p.309). Serious archaeological and metallurgical concerns still need to be addressed.

Your article gives no details on the tin content of the slag. Bronze melting and purifying operations can produce slags that contain appreciable amounts of tin; the presence of tin in a slag does not mean a tin smelting operation was occurring.

To date, the published chemical analyses of the ores from the Kestel and the Bolkardag region indicate that these ores contain less than 0.25 percent tin. There are plenty of other metalliferous ore sources in southwest Asia, such as the Black Sea sands, that contain this much tin or more.

To further complicate extraction, the particles of cassiterite in these ores are smaller than 2 millimeters. The question should be: How did Bronze Age miners and smelters ever figure out there was tin in these ores to begin with?

Your article also ignores the issue of the Old Assyrian trade with Anatolia. Cuneiform texts indicate that in the early second millennium B.C., Old Assyrian traders brought tin and textiles to Anatolia in exchange for gold and silver. If there is a tin source in southeastern Anatolia, why was it being imported?

It is hard to say what is going on at Goltepe and Kestel. Not until publication of a definitive site report, including publication of the scientific analyses of the finds, can claims for a major tin source be made. To date, the incomplete data that have trickled out about Goltepe and Kestel allow other interpretations to be forwarded.

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