nearby source areas." This phenomenon is sometimes known as the rescue effect.

In temperate regions, where species' ranges are much larger, most dispersing individuals will fall within the preferred habitats, not in unsuitable habitats. As a result, the flow of colonists to marginal habitats is limited: the rescue effect is much less obvious in temperate latitudes.

In presenting data for geographic ranges of species in his paper, Stevens is quick to point out that he is building on an observation made almost a decade and a half ago by an Argentinian ecologist, Eduardo Rapoport. "I suggest that this correlation between geographic range and latitude be called 'Rapoport's rule'," says Stevens. Rapoport had made some limited observations about the geographic ranges of some subspecies of small mammals in his book, *Areografia*, published in 1975. Described by Brown as "one of the most original works in biogeography," Rapoport's book is, however, not widely known.

"I came across Rapoport's book while I was doing a literature search based on my initial findings, in May 1986," says Stevens. "I quickly found that the pattern he described for small mammals also applies to other vertebrates, to trees, mollusks, everything." It was this generality that convinced Stevens that the latitudinal pattern for geographic range might tie in with the species-richness pattern. "Stevens seems to have developed Rapoport's observations in an inventive way," comments Brown.

"Stevens has directly related something in the physical environment that leads to species diversity over the whole latitudinal range," says Ricklefs. "Many others have made connections between certain environmental conditions and *local* diversity, but none has been general throughout." Ricklefs is intrigued by the way the rescue effect is part of this overall pattern.

Faced with a problem that has frustrated biologists for generations, he would have to be incautious in the extreme who would claim to have solved it. "I certainly don't say 'this is the answer'," Stevens told *Science*. For one thing, he acknowledges, some of the relevant data on species distributions are often poor or even absent. "But there are enough there for me to be as confident as I can be that the pattern is real."

"A lot of the impact of science is not necessarily priority, who publishes an idea first," says Brown. "It often has to do with someone who pulls ideas from here and there, and takes them a step further." There are ideas here of both Janzen and Rapoport, notes Brown. But the key element is that "Stevens has taken it all a step further."

■ ROGER LEWIN

The Circle Can Be Squared!

Ask any mathematician if it's possible to square the circle, and the answer is bound to be No. Anyone claiming to have done so is rightfully disregarded as a crank, since mathematicians proved the impossibility of circle-squaring over a hundred years ago. Now along comes Miklós Laczkovich of the Eötvös Loránd University in Budapest with a claim that he can square the circle, and this time the response is enthusiastic applause. What's going on here?

The difference is, Laczkovich has solved a different, more difficult problem that goes by the same name.

The unsolvable circle-squaring problem requires a ruler-and-compass construction of a square having the same area as a given circle. The question—Is there such a construction?—predates even Euclid; the answer—No!—was finally proved in 1882. Even so, some amateur mathematicians refuse to give up. Mathematics journals still receive—and automatically reject—"solutions" to the problem.

Laczkovich's circle-squaring problem is entirely different. What Laczkovich has shown, in 39 pages of intricate analysis, is that a circle (the interior plus the boundary) can be cut up into a finite number of pieces, which can then be rearranged into the form of a square having the same area. In fact, Laczkovich has shown that almost anything can be cut up and rearranged into a square of the same area, with no gaps and no overlaps.

This version of the problem was first posed by Alfred Tarski in 1925. In 1924, Tarski and Stefan Banach proved a remarkable analog in three dimensions: Not only can a sphere be cut up and rearranged into a cube of the same volume, but it can be cut up and rearranged into a cube of *twice* the volume, or for that matter into virtually any shape of any size whatever. In fact, a solid ball can be rearranged into two solid balls of the same radius using as few as five pieces!

At first glance, the Banach-Tarski result sounds like a contradiction at the very heart of geometry. The explanation of the paradox lies in the nature of the pieces that get rearranged. The pieces are not solid chunks with nice boundaries. Instead they are so convoluted, diffuse, and intertwined that it is mathematically impossible to measure the volume of an individual piece. It's only when the pieces are put together that the resulting solid has a measurable volume—and strange as it seems, there's no contradiction in concluding that this can be done in two different ways resulting in two different volumes.

The Banach-Tarski paradox does not exist as such in two dimensions: Banach proved that any rearrangement of a figure in the plane must have the same area as the original. The reason lies in a difference between plane and solid geometry: two-dimensional objects can only rotate clockwise or counterclockwise, while three-dimensional objects have many possible axes of rotation. It remained to prove, or disprove, that plane figures of the same area could be rearranged one into the other.

Laczkovich's result goes far beyond what Tarski asked for. For one thing, Laczkovich shows that not only can the circle be squared, but so can any figure that has a suitably nice boundary. More surprisingly, he shows that it is not necessary to rotate any of the pieces—the rearrangement can be done using only rigid translations left or right and up or down. The result even applies to polygons: it is possible to take apart a triangle and fit the pieces back together as a square without rotating any of the pieces.

If you're reaching for your scissors, though, relax. As in the Banach-Tarski paradox, Laczkovich's pieces are not the sort of thing you can cut out of paper. Lester Dubins, Morris Hirsch, and Jack Karush proved in 1963 that you can't square the circle if the pieces have any kind of ordinary boundary. And even if the pieces could be cut with scissors, you probably wouldn't want to do it: Further analysis may bring the number down, but for now Laczkovich estimates that his method of squaring the circle requires something like 10^{50} pieces.

■ BARRY A. CIPRA

ADDITIONAL READING

M. Laczkovich, *Equidecomposability and Discrepancy; A Solution of Tarski's Circle-Squaring Problem* (in press).

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