

# Staying Alive



## Summertime, and the genes are jumping

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Gasoline prices, house prices and presidential political statements are not the only things rapidly shifting this summer — so are genetics. A recent Canadian study highlighted in the Economist argues that a sudden, interspecies genetic transfer has occurred in fish. This research finding in search of a mechanism may ultimately change our view of what a species is — including our human kind.

Antifreeze is a group of chemicals we believe belongs in cars or motorcycles, which is correct if you're not a fish. In northern climes, sea salt causes water temperatures to decline to below zero centigrade. Without a way to resist internal freezing, you die. If you're a whale, you possess acres of protective fat, whose attractive energy, food and light uses has nearly caused whales' extinction.

Fish don't have so much fat. Ice crystals quickly form in their blood. To survive cold waters, they've developed proteins that control the size of ice in their arteries. Special genes make these antifreeze proteins.

Kingston, Ontario, is a small northern city better known for its huge prison than excellent Queen's University, where researchers found out something special about these fish antifreeze genes. Studying herring, smelt and the extraordinary, leafy and horror movie ready sea raven, they discovered that antifreeze genes across the three species were virtually identical.

That congruence is not supposed to happen. Every species slowly builds up its own genetic inheritance, using sexual or asexual reproduction to transfer genes to the new generation. The hemoglobin molecule in orangutans and chimpanzees is similar to ours, but there have been many changes since our evolutionary paths separated millions of years ago.

The fish antifreeze genes were so similar they looked

like they might have been ordered from a catalogue. A spectacularly successful series of genes somehow spectacularly jumped from one species to another.

How? Part of being a species means you don't cross reproduce. Dogs don't mate with cats. The researchers postulate interspecies sperm going astray in the ocean, fertilizing already fertilized eggs, but that explanation may not hold water. Something strange is afoot.



### The human superorganism

We may discover alternate explanations by looking at the 100 trillion or so other organisms that live within or on your body. Genetic "promiscuity" is far better tolerated among bacteria and viruses, "simple" organisms, which often pass genetic material from species to species. We can recognize how common this event is with the recent, unhappy realization that anti-malarial drugs are causing resistance to drugs, which fight bacteria.

Chloroquine is an old anti-malarial, ineffective against new strains of the disease but helpful in preventing illness. Researchers received a shock when they discovered many children given chloroquine malaria prophylaxis suddenly developed antibiotic resistance to fluoroquinolones, the newest large antibiotic group. None of the children had ever seen a single dose of a fluoroquinolone antibiotic, yet the chemistry of chloroquine was apparently close enough to induce bacterial genetic resistance.

This is scary. For some illnesses, fluoroquinolones are all we have. With the increasing virulence of methicillin resistant staphylococci and clostridium difficile, tens of thousands of Americans die each year from bugs we can barely control.

Bacteria and viruses exchange genetic material with more than each other. Though surveys vary, a large minority of your genetic material appears to originate in viruses. Some estimates put genetic material from retroviruses, which shuffle RNA to DNA and include HIV, as making up 8 percent to 12 percent of the human genome. Viruses have been playing around in the human genome well before there were humans.

The new antifreeze gene finding argues species inviolability is not what we thought. You are a superorganism with 10 times as many cells (if you count viruses) from species other than your human ones. We are familiar with bacteria and viruses rapidly shift genes amongst themselves, but what if they're also moving material into us that comes from yet other species?

For a world savaged throughout history by arguments over racial and ethnic purity, this is not a simple question. Certainly the organisms that live in and on us have changed our genes, modified our immune systems and powerfully altered our metabolism. Yet it may be these organisms are more protean still, shifting genetic material around as if DNA were letters in some cosmic alphabet that can be mixed and matched at will. Sexual reproduction has certainly transferred human genes far and wide, making us, in species terms, remarkably alike. Yet it now appears that other species may have joined in the work.

Genetic engineering has not been occurring for decades, but for eons. We need to know what these mechanisms are and how they work. Once understood, we will know more both about disease and what we are. Nature is, as usual, ahead of us. It's just a matter of how far.

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# KeyTravel



## Wunderbar Wurzburg

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Surrounded by vineyards and filled with atmospheric wine-gardens, this small, tourist-friendly town (just 90 minutes by train from Frankfurt) is easy to navigate by foot or streetcar. Today, 25,000 of its 130,000 residents are students — making the town feel young and very alive.

Standing on Wurzburg's venerable bridge — the second oldest in Germany — I squint up at a statue of the town's favorite saint, an Irish monk named Killian. I wonder why he still has his head on. Killian was one of three Irish missionary monks who dropped by in A.D. 686 to Christianize the local barbarians. Overreacting, inhospitable locals beheaded them. Later their relics were planted in the town's church, putting Würzburg on the pilgrimage map.

About 500 years later, since the town was the seat of a bishop, Holy Roman Emperor Frederick Barbarossa came here to get the bishop's OK to divorce his wife. The bishop said, "No problem," and Barbarossa thanked him by granting him secular rule of the entire region of Franconia. From then on, Würzburg's bishop was also a prince. And the "Prince Bishop" of Würzburg answered only to the Holy Roman Emperor.

The Prince Bishop dominated the

town. The late-Gothic Marienkapelle, the merchants' answer to the Prince Bishop's cathedral, is pretty humble. Since Rome didn't bankroll the place, it's ringed with "swallow shops" (like swallows' nests cuddled up against a house) — enabling the church to run little businesses.

Würzburg's City Hall, also humble because of the power of the Prince Bishop, is interesting for a room holding the "Gedenkraum 16 März (March) 1945" memorial. This commemorates victims of the 20-minute Allied bombing that created a firestorm, destroying the town just six weeks before the end of World War II. Pondering models of the bomb damage and the seemingly endless list of names of those killed on that day is a sobering experience.

The Prince Bishop's Residenz palace, in the center of town, is one of the most impressive royal palaces in all of Germany. While devastated by World War II bombs, it has been painstakingly restored. This Franconian Versailles features grand rooms, 3-D art, and a massive fresco by Tiepolo.

In 1752, the Venetian master Tiepolo was instructed to make a grand fresco illustrating the greatness of Europe, Würzburg, and the Prince Bishop. And he did. The four continents are each symbolized by a woman on an animal and pointing to the Prince Bishop in the medallion above Europe. America — des-



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*Compact, historic Würzburg is easy-going and tourist-friendly.*

perately uncivilized — sits naked with feathers in her hair on an alligator among severed heads. She's being served hot chocolate, a favorite import and nearly a drug for Europeans back then. Africa sits on a camel in a land of trade and fantasy animals (based on secondhand reports). Asia rides her elephant in the birthplace of Christianity. And Europe is shown as the center of high culture — Lady

Culture points her brush not at Rome, but at Würzburg. The Prince Bishop had a healthy ego. The ceiling features Apollo and a host of Greek gods, all paying homage to Würzburg and its leader.

The sumptuous Hofkirche Chapel, adjacent to the palace, was for the exclusive use of the Prince Bishop and his court. The decor and design is textbook

**Travel, page 12**