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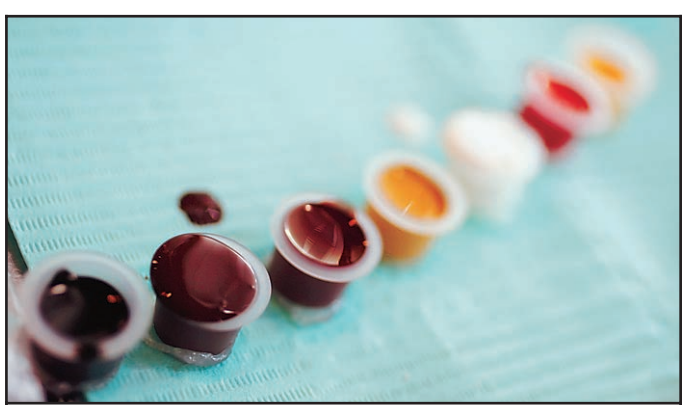
"Once your adrenaline kicks in, you don't feel it much."

**TARA BROGAN** | while sitting for her third tattoo

SHARI LEWIS | DISPATCH PHOTOS

**Artist Giovani photographs Tara Brogan's bacon tattoo. "I've done a lot of food tattoos," he said. "When they look delicious, then you know it looks good."**



**The pigment in inks like these lined up at High Street Tattoo can determine how vibrant a tattoo remains over time.**

### Hell City Tattoo Festival

Hyatt Regency Columbus, 350 N. High St.

(614-463-1234, www.columbusregency.hyatt.com; www.hellcity.com)

Time: noon to 11 p.m. on Friday and Saturday; noon to 8 p.m. Sunday.

Tickets: $20 per day, or $55 for a three-day pass. Children 10 and younger are admitted free to the Heck City Kids Zone.

**ON THE WEB**

**▶ To watch an audio slide show of a tattoo being inked, go to Dispatch.com/multimedia.**

## INK

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ess of tattooing has remained unchanged since at least the days of Otzi the Iceman, the tattooed mummy from circa 3300 B.C. found frozen in 1991 in the Alps between Austria and Italy. Otzi was found with dots and lines on his back, knees, ankles and one foot.

To embed an image in a person's skin, a needle of some sort is used to puncture shallow holes.

Joshua Adams, who teaches in the Department of Sociology at Ohio State University, has studied the history and culture of tattooing.

He said that in Otzi's times, "The standard method of tattooing was to hammer the needles into the skin by hand by tapping the needle. This would be roughly equivalent to the same motion we use to hammer a nail: One hand holds the nail, the other guides the hammer."

The tattooed among us today are joining a tribe of ancient painted people who walked the earth thousands of years ago.

"There is a fairly well-documented history of tattooing throughout Europe, Asia, the Middle East, the Americas and the Pacific Islands," Adams said.

"Many people are also somewhat familiar with the idea that the Bible mentions tattooing. The book of Leviticus specifically prohibits tattooing, which suggests that it was a reasonably common practice, at least among groups the ancient Hebrews were encountering on a regular basis."

The Maori people Capt. James Cook and his men encountered during their 1769 expedition to the South Pacific used chisels made of animal bones to tattoo themselves. The men punctured their skin and filled the holes with pigments made of fungi, soot and resins.

The tribesmen called it *tatau*. Cook and his sailors, some of whom returned to Europe with tribal markings, called it *tattaw*.

"Depending on the region and available resources, tattooing instruments were often made from bone, often from birds or fish, or shell," Adams said. "Eventually, many groups transitioned to metal needles."

Today, tattooists use an array of hand-held tattoo machines, many of which are hand-built to suit specific artists.

The tattoo machine, patented in 1891, is powered by electromagnetic coils and holds a set of tightly bound needles that swiftly move up and down. The size of the tattoo and whether an area needs detail or shading determines the number of needles an artist uses. Some large-scale back tattoos require a set of 45 bound needles to shade broad expanses of skin.

### Makin' bacon

Giovani, a 34-year-old Cleveland native who came to the world of tattooing nine years ago after a brief career as an ice sculptor, said most tattooists choose their inks the way they choose their tattoo machines: "by personal preference."

Giovani used a machine made by a friend in Fort Wayne, Ind., to tattoo the strip of bacon on Brogan's 29-year-old lower leg.

After he wiped her leg with a surgical antiseptic, he applied a stencil of the tattoo.

"Yeah?" he asked Brogan, who looked over her shoulder.

"Yeah," she said, smiling.

With a light-purple outline on Brogan's calf, Giovani then began to "line" the tattoo with a black carbon ink shot though a attachment made up of five needles soldered into one tip.

The light purple outline disappears thanks to light bleeding caused by the outlining process.

Lining the tattoo "just gives me an idea of where I'm going," Giovani said. "You have to move very deliberately."

He said that once he starts, the tattoo machine "will tell you if you're going too deep because it will bounce back a little."

As he continued, a light line of blood formed where the needles punctured Brogan's skin.

"Once your adrenaline kicks in, you don't feel it much," she said.

Giovani then began the shading process using a setup made of three tiny needles atop four similar needles. Shading needles are thicker than outlining needles.

Once his needles punctured Brogan's skin, this is what happened: The dye, in a reservoir just above the needles, pushed between the papillary and the reticular layers of the dermis, the system of connective tissue that cushions the muscles and bones. That's just less than a millimeter below the surface of the skin.

### Live and let dye

Good dyes make good tattoos, said Matthew J. Zirwas, a dermatology professor at Ohio State University.

"Lots of different dyes are used, but there is no FDA regulation at all about what the dyes have to have in them.

"Generally, tattoos are very, very safe, but if somebody goes to a shady tattoo parlor, you don't know what you can get. There has been some research showing high levels of toxic chemicals in some of the dyes."

Zirwas said the pigment, carbon-based as are most pigments used today, remains in the skin thanks to our immune system's reaction to foreign materials.

White blood cells "try to ingest any foreign body, in this case the ink that gets implanted in your skin," he said.

When they attack, they eat away the needle-damaged skin and in the process create a thin scab. When the scab flakes away within two weeks, the dye, which by then has other cellular fiber growing through it, is permanent. Components in the ink determine how vibrant the design will remain. However, location is the biggest factor in a tattoo's longevity.

The strip of bacon on Brogan's calf, for example, should be bright for decades.

"Tattoos probably last a little bit longer on the arms and legs, the further toward your hands and feet they are," Zirwas said. "The circulation of the immune system to and from those areas is less than it is on the central part of your body."

### Less than permanent

As Otzi proved, tattoos can remain visible for eons. But the modern tattooed can usually turn to a laser to remove artwork that has lost its appeal.

And these days, the process can be less trying than it once was.

"There are now tattoos you can get that are made to be easily removed," Zirwas said. "It's a special kind of ink that if you hit it with the right laser, it's designed to disappear."

Color figures heavily into how easily a design can be removed.

Blues, blacks and greens are the easiest to erase. Whites, yellows and oranges are the toughest.

"It has to do with how a laser works," Zirwas said. "The color of the light has to be matched to the color of the pigment so that the dye or the pigment absorbs the energy from the laser and essentially explodes. With white, yellow or orange, we don't really have good lasers that get absorbed real well by those colors."

Advances in tattoo removal do not concern Brogan, a photographer whose first of three tattoos was a skull with "Daddy's girl" and crossed crescent wrenches on her right upper arm.

"The more you get, the less you think about them," she said.

After 45 minutes, Giovani removed his surgical gloves, took a step back and smiled.

"I've done a lot of food tattoos," he said. "A Japanese eggplant, green beans, okra, elephant garlic, asparagus. When they look delicious, then you know it looks good. This bacon is starting to look delicious."

Brogan caught a glimpse of her new look in the mirror.

"That's awesome," she said. "Maybe I'll get eggs on the other calf someday. I think that's why it made sense to get bacon on the left leg. You know, bacon and eggs."

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**GEOLOGY**

# When continental plates stop moving, volcanoes die

The continents are on the move. Their motion is driven by heat that escapes from deep in the Earth, like a simmering pot of soup. The continents are carried by thin sheets or plates of crust, either less-dense continental crust or heavier ocean crust.

DALE GNIDOVEC

Interesting things happen where two plates converge. If both plates are of light continental crust, they pile up like the foam on a root beer float. That's what happened when India collided with Asia, forming the Himalaya Mountains.

If one of the plates is composed of heavier ocean crust and the other of continental crust, the ocean plate dives beneath the other in a process called subduction. Eventually, components of the descending plate begin to melt. The resulting molten rock, or magma, rises to the surface, forming volcanoes. Examples include the Cascades and the Andes.

Geologists have assumed that plate motion was constant. But research published this year in the journal *Science* shows that that assumption is not correct.

Today's Pacific Ocean is rimmed by volcanoes. If plate motion continues at present rates and directions, the Pacific Ocean will close as continents collide, creating a new supercontinent in 350 million years.

Plate motion will come to a halt, and most of the world's volcanoes will die.

That is probably what happened about 1.3 billion years ago, when the supercontinent Rodinia (the one before Pangaea) formed.

Further evidence for such temporary stops in plate tectonic activity comes from measurements of heat loss. The high rate of heat loss today cannot be extrapolated back in time much more than 1 billion years before most of the Earth would be molten, something termed the "thermal catastrophe."

The rock record shows that didn't happen at least back to 3.5 billion years ago.

Today Venus, Mars and the moon all have hot interiors but no plate movement. It appears that, at times in the past, Earth resembled them.

*Dale Gnidovec is curator of the Orton Geological Museum at Ohio State University.*

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**EMERGENCY MEDICINE**

# View from the ER takes fun out of backyard trampoline

One of the unintended side effects of my job is that I can be a real killjoy.

It's difficult to work where I work and not see the severe consequences of everything and anything considered fun. My poor neighbors who innocently bought a trampoline could read the look on my face when I saw the monstrosity being erected in their backyard.

DR. DIANE GORGAS

It brought to mind every trampoline injury that I'd seen during my 18 years as an emergency physician.

From minor injuries to the truly life- and limb-threatening, they all flash through my mind. I think of the 12-year-old girl who inadvertently jumped between a set of springs and dislocated her knee. It was a serious dislocation, not just of the patella, or kneecap, but of the entire lower leg from the upper leg.

More concerning yet, she had no pulse in her foot, meaning the potential for a limb-threatening arterial injury. Sadly, this was the case and meant multiple circulation-restoring surgeries, amputating four toes and performing skin grafts.

Then I remember the 24-year-old man who, after a night of celebration, was on a trampoline trying to see whether his buddies could catapult him over the safety netting.

Because youth and alcohol know no bounds, he succeeded. He arrived at the hospital in a coma with a life-threatening skull fracture and bleeding around his brain.

I also remember the 40-year-old man who did a back flip on a neighborhood trampoline and broke his neck. I was 12 at the time, but watching my acrobatic father spend the rest of the summer in a brace that immobilized his spine by screwing into his skull left an impression.

I'll spare you the dozens of other stories that might forever change your opinion of fun when it comes to trampolines (or skiing, or scuba diving, or motorcycle riding, or any other risky behavior).

Use logic. Realize you (and your family) are made of only flesh and bone, and are mortal. Have fun, be safe, and we're here if you need us.

And to my neighbors, you know my number.

*Dr. Diane Gorgas is an emergency physician at Ohio State University Medical Center.*

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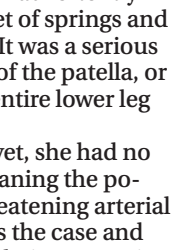
**BIOLOGY**

# Pollen allergies a side effect of greater floral purpose

Some flowers get a bum rap.

The immune systems of many people take offense at the presence of pollen grains in their sinuses and lungs. Those immune systems recognize the pollen-grain proteins as coming from an invading disease organism. Familiar symptoms of hay fever follow.



STEVE RISSING

At first blush, it makes some sense to blame showy flowers such as tulips, daffodils and dogwoods for this annual discomfort. But they usually are not to blame. They produce pollen in tiny amounts compared with the real culprits at this time of the year: trees.

Mosses and ferns, the first plants with adaptations to life on land, have sperm that swim or splash their way to eggs in wet environments or with the help of raindrops. Such methods work, but only in habitats with abundant water.

Pollen became the dominant way for most plants to spread sperm to other plants more than 300 million years ago. Plants from that era that have stuck around include pines, spruces and firs.

Each spring, in the right light, you can see clouds of yellow-green pollen billowing from some trees. You also often find pollen drifts of the same color on sidewalks and car hoods.

Flowers represent the most recent adaptation for plant reproduction on land. With tulips, lilacs and others blooming, it's easy to miss tiny ash, oak and maple flowers.

What the adaptation of showy flowers and nectar production accomplishes for some plant species is accomplished in these tree species in the same way as the pines and firs: massive amounts of pollen released blindly in the wind.

Such a "broadcast" dispersal system obviously works; we'll have ash seeds and acorns later in the year. But any one pollen grain in such a system has a minuscule chance of ever landing on a female flower and fertilizing it.

In fact, it probably has just as good a chance these days of ending up in someone's respiratory tract. At that point, it's dueling adaptations: compact plant sperm-dispersal system versus human immune system.

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