VESTIGIA

By Steph Yin and Sandeep Nayak

WE WERE BORN AND GREW UP in the briny blue, and even when we evolved to invade land, we never left the sea. We just brought it with us in our blood. Now the briny red bathes our innards. In evolution, function follows form. Each change occurs and can only occur on the substrate of those that came before it. Slowly the swim bladders of our marine past have been repurposed into lungs, while our gills and tails have receded, relegated only to the early stages of the embryo. As Mr. Darwin noted, "Organs or parts in this strange condition, bearing the stamp of inutility, are extremely common throughout nature."

This stamp of inutility is the stamp of history. We are our creation incarnate, and vestigia are evolution's clearest examples. These "useless" organs are not the failures of an idiotic design process, rather champions that have served their functions and now bask in retirement. Vestigia are clues to what we were, cues to be attentive to origins.

Let's explore.

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PINNAE REFLEX

Fig. 1: When a cat's eyes dart back and forth, they send signals to the brainstem instructing the ears to follow suit. When our eyes dart back and forth, deafening anticlimax ensues.

When a cat swivels its eyes to attend to something, its ears follow. The cat has a reflex circuit that ties eye movements to the auricular muscles of the ear, allowing audition to track vision. Humans have the same muscles, though they are now entirely useless, save for some freaks who can wiggle them a bit. While these muscles do absolutely nothing, the reflex circuit is preserved.

Try it yourself: place your index fingers behind your ears, approximately behind the bony outgrowths of your mastoid processes. Now move your eyes vigorously from left to right. Feel that? That's the slight twinge of incompetent muscles trying to budge.

GOOSEBUMPS

This is an easy one. Each of our hairs is attached to an *arrector pili* muscle, which can constrict to straighten the hair. Our mammal cousins use this to exaggerate their size in situations of fear or dominance display. The effect on a chimpanzee or cat is impressive. Alternatively, if it's very cold the *arrectores pilorum* can make hair stand up to create a layer of insulation. Yet even the hairiest of humans don't have enough hair for either of these functions. All we get instead is an impotent rippling of gooseflesh.

VITAMIN C PATHWAY

We're always hearing about the benefits of vitamin C. *Oh, you're sick? Better load up on some vitamin C*. Pull on sweatpants, pop some Airborne or Emergen-C in your water bottle and listen to "Graduation" to remind you that you and your besties will be friends forever. Chug. Repeat.

But wouldn't it be nice if we didn't have to constantly supplement our diets with pills and fizzy drinks?

Most animals synthesize their own vitamin C. Notable exceptions include capybaras—the world's largest rodents—and humans. If we don't eat enough fruits and vegetables, we grow morose, our teeth fall out, spots bloom across our skin and bleeding, pus-filled wounds erupt on our bodies.

This figures unexpectedly in colonial history. Colonizing scum can only travel so far before they die of scurvy. Introducing agriculture to South Africa gave Dutch sailors access to fresh fruits and veggies, a vitamin C pit stop on the way to maraud the East Indies. In fact, the chemical name for vitamin C, ascorbic acid, literally means "lack of scurvy" (in Latin, scurvy is *scorbutus*).

We actually have broken remnants of vitamin C synthesis machinery in our DNA. The gene is there; it just no longer works. Why have we abandoned this valuable pathway? Why put ourselves at the mercy of citrus and kale?

For one, Vitamin C synthesis produces hydrogen peroxide, a reactive oxygen species that harms cells. By getting vitamin C from external sources, humans can avoid cell damage that results from synthesis. Moreover, we use vitamin C as a nutritional thermostat: when we don't get enough of it, our bodies turn on the same system activated when we lack oxygen. Loss of vitamin C synthesis possibly helped our ancestors survive malaria, which has killed half of all humans. Since Vitamin C counters the obesogenic quality of sugar, losing it also might have helped our ancestors fatten up in scarce times.

PALMAR GRASP REFLEX

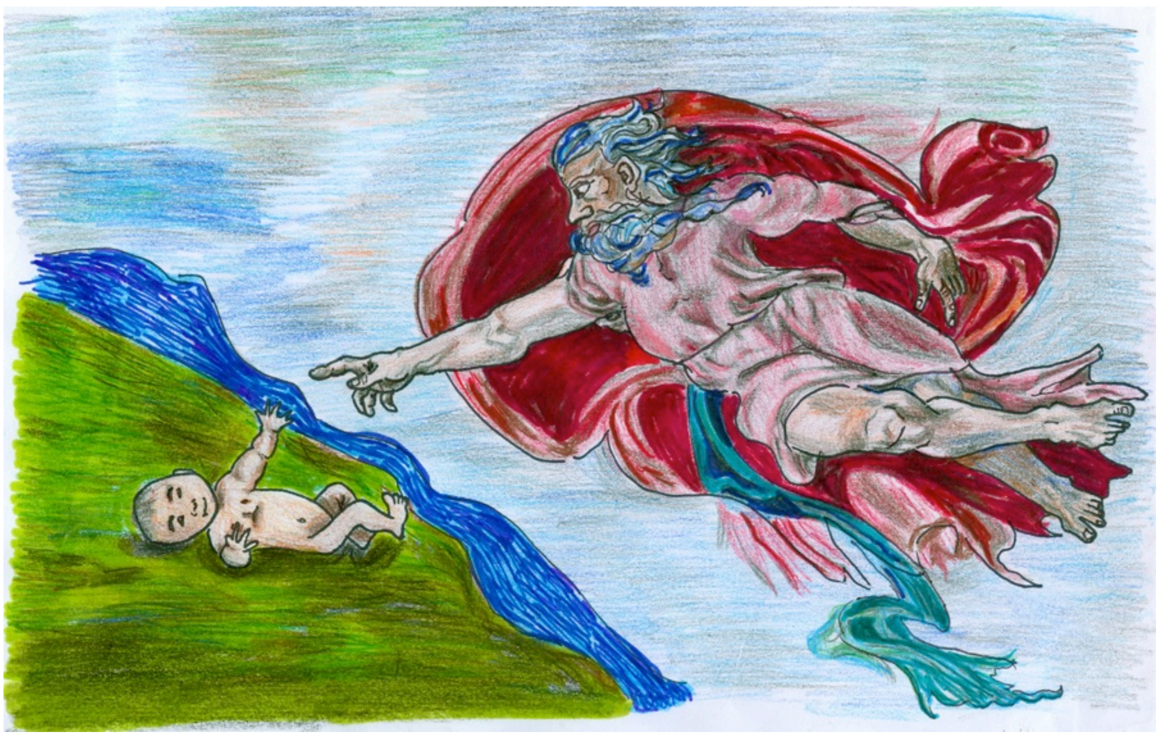


Fig. 2: Sentimental in appearance, this scene is nothing more than a baby reaching out for a reflexive squeeze.

Imagine a baby who, having braved congenital malformations or medical malpractice, emerges premature, battered yet alive, improbably miraculous. And the father who'd secretly harbored regrets all the while sees his newborn and places his finger into the baby's impossibly tiny hand, and the hand squeezes in reply! The father swoons as he realizes he is witnessing a nascent will, the first volitional act of his progeny.

The poor sap doesn't realize that this is nothing more than the palmar grasp reflex, to which premature infants are more susceptible. It is a holdover from the days of yore when our ancestors' mothers were covered in body hair. The grasp reflex was useful in that it allowed infants to clutch on as their mothers ambled about the treetops. Nowadays, a baby relying on the same safety net would just make a feeble grasp at his mother's waxed arms then plummet to the linoleum.

This reflex can recur in elderly individuals suffering from dementia and stroke patients, who will involuntarily grab at whatever graces the surface of their palm. It is a clinical sign that bodes poorly.

PLICA SEMILUMINARIS (THIRD EYELID)

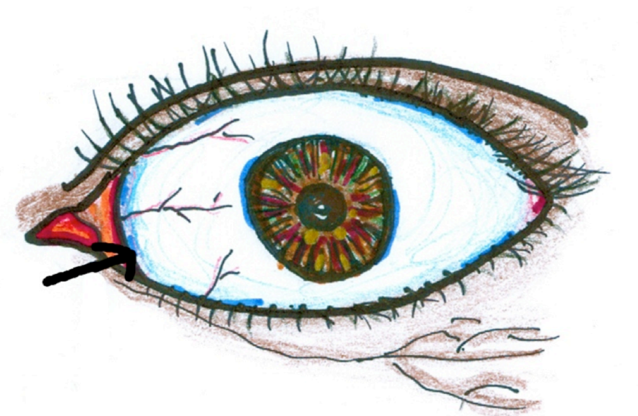


Fig. 3: The plica semiluminaris is a flap of remnant tissue from our ancestors' third eyelids.

Anyone who has a cat or dog has probably caught the occasional glimpse of a third eyelid—a translucent screen that sometimes creeps across the eye when the animal is falling asleep.

This third eyelid, also called a haw, nictitating membrane, or plica semiluminaris, lets animals protect, moisten, and clear debris from their eyes while still being able to see what's going on. Manatees use them to see underwater, peregrine falcons to protect their eyes on 200 mile-per-hour dives for prey, aardvarks to ward off bites from the termites they eat, polar bears to filter UV light from blindingly white snow, and woodpeckers to prevent injury when drilling wood.

In humans, the nictitating membrane has shrunken down to a fold of tissue near the fleshy pink bulb at the inner corner of our eyes where crusty flotsam accumulates in the mornings. It's unclear why we humans don't have fully functioning nictitating membranes. Granted, unlike some three-lidded creatures, we're not constantly diving underwater, dealing with thrashing prey, or getting sand in our eyes. But think about it—we could see underwater, look at solar eclipses, ski without goggles, open our eyes in a sandstorm, conduct carefree chemistry experiments, and bike in the rain! Just to name a few examples.

WISDOM TEETH (THIRD MOLARS)

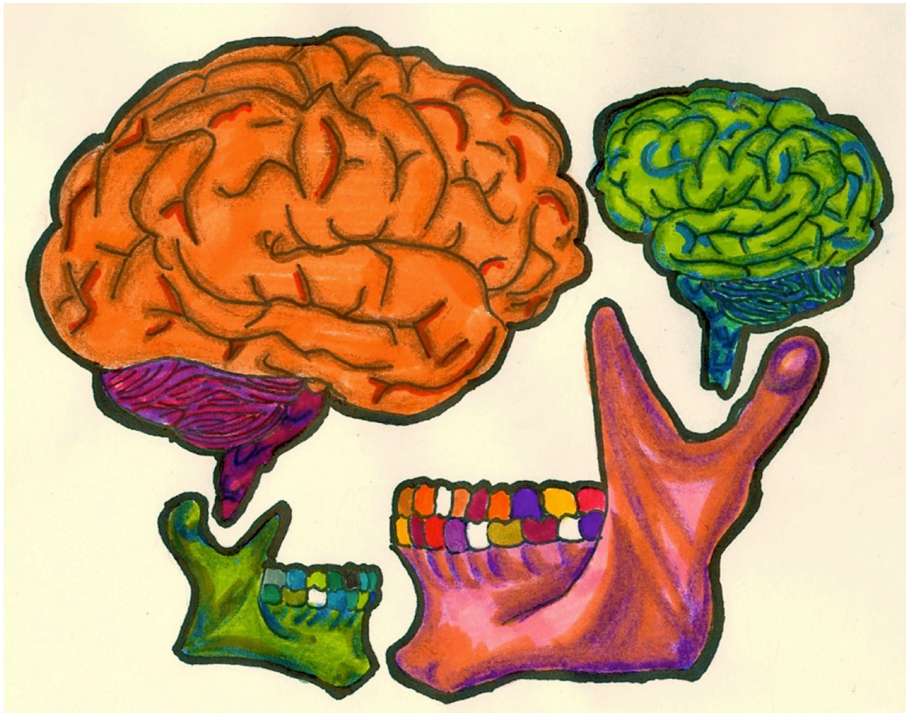


Fig. 4: Which came first, big brains or small jaws?

Wisdom teeth removal is a shitty ordeal. For this hapless reporter, my gums refused to clot, so post-surgery I spent the day gobbing blood into a sink. Even after my platelets got their act together, the tender sinkholes that remained turned out to be especially effective food traps. My tongue grew stiff from excavating.

"Wisdom" teeth are teeth that no longer fit in our shrunken heads. Sure, dentists love the extra business, but why would the Creator have crammed so many teeth into a mouth so small? One explanation is the brain/jaw trade-off. Huge jaws are good for grinding leaves but not for housing a large brain. Which accommodated the other? Did the jaw suddenly shrink and the brain expand in the vacuum? Or did the growing brain force the jaw to compact?

We might pin it on mushy foods. When humans invented cooking and no longer had to chow down on bloody sinew, raw roots, and tough seeds, the premium on brawny jaws disappeared. This theory is supported in part by regional variations in jaw size and wisdom teeth prevalence—in some places where diets still include a lot of raw, tough foods, jaws tend to be larger and wisdom teeth more often develop normally.

What about dental hygiene itself? Before Sensodyne© and twice-yearly visits to the dentist, our ancestors would lose many of their chompers by puberty. For them, an extra set of understudies that appeared at the beginning of adulthood probably came in handy.

Now that most of us can practice dental hygiene and keep our teeth in working order, these back-up molars just get in the way.

HICCUP

As far as anyone can tell, hiccups also serve no useful function in humans. What is a hiccup, physiologically? It is a spasm of the diaphragm with an accompanying reflex that slams shut the glottis, resulting in a sound that is difficult to reproduce in text. They are mostly harmless, but if chronic can take a turn for the pathological.

A 1993 publication in the European Respiratory Journal entitled "Hiccup in adults: an overview" defines chronic hiccup as *"a rare but disabling condition which can induce depression, weight loss, and sleep deprivation. A wide variety of pathological conditions can cause chronic hiccup: myocardial infarction, brain tumor, renal failure, prostate cancer, abdominal surgery, etc."* Even lupus can cause chronic hiccup! The pathophysiology of this debilitating disease is not well defined, but pharmacological therapy can include anticonvulsants, antipsychotics, intravenous lidocaine, or even the dissociative club drug/horse tranquilizer ketamine.

A less-involved treatment is stimulation of the vagus nerve, which innervates the diaphragm. This was known even by the godless Greeks. In Plato's *Symposium*, Aristophanes once began to speak but was seized by a bout of hiccups. Eryximachus advised: "If you hold your breath a long time perhaps the hiccups will be willing to stop. But if not, gargle with water, and if they're very severe, grab something you think will tickle your nose and make yourself sneeze!" These last two are ways of stimulating the vagal nerve. To the ancient's recommendation I would add the gag reflex.

Hiccupping is a bizarre activity. The muscles of inspiration contract, as if to suck in wind, but then reflexively close off the windpipe. This makes little sense, except perhaps for an amphibious creature, who would use an inspiratory action plus glottal closing to move water across its gills while preventing that water from entering the lungs. Perhaps like gill slits, the hiccup is a holdover from an amphibious existence.

Babies in utero are seen to hiccup before they ever breathe, and premature infants can spend up to 2.5 percent of their time hiccuping. Moreover, when a tadpole's lungs are full of air, it is less likely to gill ventilate. This seems suspiciously like taking a deep breath and holding it to stop hiccups. One theory suggests that normal breathing evolved using the amphibious hiccup-like respiratory pattern generator as a scaffold (note that hiccups usually have a regular rate), but that this defunct circuit can occasionally resurface, as when my mom gets drunk. Who knows if it's true? It's just a theory.

VOMERONASAL ORGAN

Fig. 5: * = Approximate location of the human vomeronasal organ.

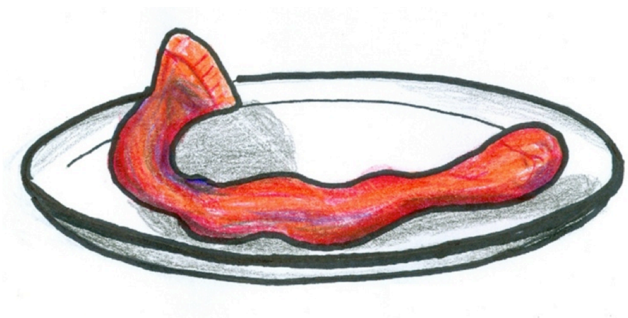
The vomeronasal organ (VNO) is the most elusive vestige on this list. For animals in which it is fully functioning, the VNO is a pair of tubes located at the base of the nose that primarily detects pheromones. We know for sure that it is present in human embryos. The question is whether, like our tails, they telescope as we mature.

Studies of the adult VNO have been erratic, with yeti-like variations in description of location, size, and even existence. These debates rage on with particular zest because the VNO's existence is linked to the unresolved question of whether humans are sending each other a whole suite of covert social and sexual cues. These pheromones operate beyond our immediate senses, potentially shaping our attractions, moods, and basic bodily functions. We don't know how large of a role these invisible chemicals play in our lives. While some may find it romantic to be governed by primal instincts, control freaks among us might revel in the thought that we exert more agency over our behaviors than most other mammals. Our strongest evidence for human pheromones is the syncing of menses.

In general, it doesn't appear that there are active nerves or genes related to VNO function in humans. In fact, most of the evidence for a functional VNO comes from research conducted in the 1990s by a group from Utah. Coincidentally, funding for their research came from a corporation that makes personal care products containing steroids that Monti-Bloch and his colleagues claimed the VNO could detect—pheromones that would turn your date on. Their results have never been replicated.

Fig. 6: The Flehmen response is when an animal curls its upper lip back and inhales to help waft pheromones into the vomeronasal organ located above the roof of the mouth. Duckface is when an eligible millenial pushes its lips together to give the impression of having larger lips and cheekbones.

APPENDIX: A COUPLE COMMONLY CITED VESTIGIA



The Vermiform Appendix:
The appendix might have uses, including gut bacteria storage, but as a shrunken relic of an ancestral intestine, it does not serve its evolved function.

The Coccyx:
We are wagging creatures for four glorious womb-weeks before our tails retract and we are left with an unemployable tailbone.