

# **Bovine Neuropathology with Dr. Nicole Ackermans**

## **Ologies Podcast**

### **January 13, 2022**

Oh hi, hey, it's still your brother-in-law who weighs his coffee beans, but in a cool way, Alie Ward. Not only is this a day late, baby, but also, this is the bonus episode that I promised you last week... So what? I turned around the Neuropathology episode on concussions last week so fast it just gave me additional whiplash, so I came to my senses and said, "Ward, go back to bed, sleep a little more. You bashed your skull and that's a great excuse. Use it."

So, here is the crisp, sunny, follow-up episode about concussions, about mTBI, TBI, CTE in the natural world, in animals. And if you're like, "I don't know what any of those acronyms are, they don't make sense," and you're also like, "Wait, dude, you recently sustained a severe, hospital-grade concussion?" then you're going to want to beep-beep mosey back to the Neuropathology episode from last week. It's a really, really great one; lots of asides about why I ended up in an ambulance a few weeks ago and, consequently, why this episode is two days late. TBIs man, no joke.

So, this ologist reached out after mine because she's a researcher in the field and in the lab and because severe neurological damage like CTE can only really be detected on autopsy, thus it's a very controversial diagnosis in living people. Lot of folks butting heads about it. So, she studies butting heads about it in bighorn sheep, and muskoxen, and all kinds of stuff.

So, she got her undergrad degree in the Biology of Organisms, Populations, and Ecosystems in France, she went to Antwerp and Vienna for her master's in Comparative Vertebrate Morphology, and then went and got a ding-dang doctorate in Evolutionary Biology in Zurich studying tooth wear on animals. And we recorded this a week or so ago and she was rounding out her postdoc in the lab of your favorite functional morphologist, Dr. Joy Reidenberg at Mount Sinai in New York City; great episode, I'll link it on my website. But her postdoc is wrapping up so use the links in the show notes to also reach out to her if you are hiring someone rad because she is.

You can also use the links in the show notes to join [Patreon.com/Ologies](https://www.patreon.com/Ologies) where, for a buck a month, you usually get to send questions for me to ask ahead of time except for this one because, like a goat brain on a lab slab, it was supposed to be all cut up and used for last week's episode but whatever, it was weird and fun and you deserve to hear the whole thing. So, for zero dollars also you can support the show and my very fragile sense of self by leaving a review, I read all of them and here's a still moist freshy one... that's gross, from someone from the name of Ranamatix who wrote the review:

*I gobble up almost every episode like a raccoon hits marshmallows.*

Also, thank you to the reviewer who said that their whole family watches *Brainchild* and listens to *Ologies* and to get well soon. They wrote:

*Please take care of yourself Alie.*

Which was so sweet, that made me cry. And it was signed, Hugefangs, and I don't know if they meant huge fans or not. But huge fangs, honestly, better. More fitting.

Let's talk about, while we're on it, animals showing off by acquiring brain damage. Let's get into it. We're going to talk about Bovine Neuropathology. So, get ready for the life of a retired ox, the sliced and stained brain, how to build a better helmet using sheep skulls, and how not to do that, Twitter flame wars, wild boar wars, how a bunch of tangled proteins can really mess up a melon, what a melon actually is, and sea creature gossip, and the coolest cooler you will ever crack open, with

vertebrate morphologist, evolutionary biologist, and bovine neuropathologist, Dr. Nicole Ackermans.

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**Alie:** Oh my gosh, Doctor. Dr. Headbutt, hello.

**Nicole:** [*laughs*] Hi, Alie. It's Dr. Nicole Ackermans. I go by she/her, but everyone calls me Nicky.

**Alie:** Dr. Headbutt it is. So, tell me a little bit about how you ended up in... I guess, would this be functional morphology, would this be traumatic osteology? What would you call this field?

**Nicole:** So, in my postdoc I'm combining functional morphology and neuroscience. So, the functional morphology part is the skull, horns, and head, and movement part, and the neuroscience part is the actual cellular brain damage part.

**Alie:** And how do you even do this work? [*Nicole laughs*] Do you have to go out into the field? Do you have to find concussed bighorn sheep? How do you start?

**Nicole:** Yeah, so I asked myself the same question because no one kind of looked at this before. A lot of people are like, "Bighorn sheep don't get concussions." Turns out, no one's checked. So, I figured out I should probably go check and, unfortunately, I started all this in 2020 so there was no field for me. But I started in January so I had a few months before the pandemic to call up everyone I could possibly get a number for at Fish and Wildlife, in any state where there was a bighorn sheep and say, "Hey, if you have a dead sheep can you send it to me [*"Totally normal."*] so I can look at their brain?" And I actually got like six sheep heads from them, and they're all natural deaths, or cougar kills, or one of them broke its leg so they had to euthanize it. So, no sheep were killed for the purpose of my study.

**Alie:** Nice.

**Nicole:** So, the neuroscience part, they have a big walk-in fridge full of random animal brains and they happened to have muskox brains in there, so I just added those to my study as well.

**Alie:** And what have you found looking at those brains? Do you have to put them in an MRI, in a CT scan?

**Nicole:** Yeah, so actually first we did MRI scan them because if you have a very, very bad brain trauma you might get regional shrinkage of different parts of your brain. I mean, at that point, in a human, you have behavioral problems. But I just wanted to first check, "Okay, is the brain intact on the MRI?" All of our MRIs were clean.

**Aside:** And if you listened to the Neuropathology episode last week you might remember that even though I did concuss myself falling down a flight of stairs, and then collapsed, and then convulsed, and then collapsed again, my CT scan was clean and an MRI would have been totally fine, looking A+ too. So, those hospital machine big boys are helpful for seeing life-threatening emergency brain bleeds, but they don't tell the full microscopic story. For that, you need rest and you also, to see it, you need either a psychic wizard or a scientist with a hacksaw.

**Nicole:** Then, once we had our pictures, I could go cut up the brain and take out a piece where I thought that there would be maybe some trauma if it was even there at all and look at that under the microscope.

**Alie:** Mhm. What did you find? [*"Okay, here we go."*]

**Nicole:** So, it was a very long process. I don't want to make it sound simple. It took me a year to first troubleshoot the technique to stain bighorn sheep brain because surprise, surprise, no one had stained a bighorn sheep brain before. It uses immunohistochemistry; we're looking for a certain type of protein that shows up when your brain gets damaged. And so, I had to troubleshoot this immunohistochemistry technique for about a year, but I figured it out, *[laughs]* eventually.

This paper is actually currently under review, so it's a little bit breaking news, but it's going to come out eventually. I found a few neurons, actually first in the muskoxen, which also butt their heads extremely hard, there were dead neurons and there were some sort of clumped up dendrites, which are like the neuron tails. First of all, I was excited to see just one of these. I mean, it's beautiful; it's like a big spiderweb under the microscope and it was perfectly stained, I was so happy. *[giggles]*

**Alie:** Wow.

**Aside:** It takes a special and divine person to get giddy for muskox head trauma and we found her. And when she described the spiderweb of dead neurons I was like, "Yes! Spiderweb patterns, I think I know what she's talking about. She's probably talking about these subarachnoid hemorrhages that I read about." So, I went to go see what they looked like, stained, under a microscope and it turns out, she was not talking about subarachnoid hemorrhages at all, those are totally different things, they both just happen to look spiderwebby.

The arachnoid layer is a layer under the skull between the brain and there, it's kind of webby and it houses fluid that floats your brain... she wasn't talking about that at all. A bleed there is what CT scans are looking for but what Dr. Ackermans is talking about is zooming in and in and in, way past the scope of a CT scan to see little knots of insoluble tau proteins.

**Nicole:** And then you know, after that one single one, I went further and did a really large amount of stains and counted them all by hand to see if there was grouping of these dead neurons or dying neurons in certain areas. Because if it was just, like, Alzheimer's, it could be more dying neurons on the surface going deeper and deeper as the disease gets worse. But if it's traumatic injury, the forces that are applied to the head when there's an injury kind of go into the folds of the brain and rip the cells at the bottom of these folds. And I actually found groups of... they're called neurofibrillary tangles, but pathological neurons at the bottoms of these folds. So, that showed for sure that it was brain trauma, actually.

**Aside:** So, after a life of headbutting or tackling or just thumping your skull on stuff, I guess like me, those tiny tube-filled taus ball up. Nicky says that she's finding them, kind of like you would necklaces at the bottom of your purse, just these delicate clots of problems. *[strained voice]* But whyyy? Why?

**Alie:** And how do you think evolution kind of selected for this behavior in, especially, breeding males, even though it might lead to brain trauma?

**Nicole:** Yeah, this is my question to myself as well. I have some theories. I guess, you know, the goal of life... This is going to seem really simple, but the goal of life is just sex, it is reproduction, right?

**Aside:** Okay, maybe not you personally, but Mother Nature is just a tunnel-visioned horny ghost inside each and every one of us.

**Nicole:** So, once you get to that point, if you're able to reproduce and pass on your genetic material, if you have dementia or if you're a bit damaged in the brain, it doesn't really matter anymore. So, one of my theories is just that, well, they don't live that long anyway, they might not develop dementia or Alzheimer's like we do in relation to these kinds of illnesses. And I'm sorry, I know you just got a concussion, so I don't want to freak you out [both laugh] although I'm sure the other experts you've talked to freaked you out enough already.

**Alie:** Little bit!

**Nicole:** But yeah, my theory is that first of all, maybe they don't live long enough to actually have really bad side effects and second of all, maybe it just doesn't matter because their life is not really, really complex. No disrespect to bighorn sheep, I love them, but they eat, they evade predators, and they reproduce. They don't need to do puzzles and memory games.

**Alie:** How do you think that... Those type of neurological impacts, how do you think it does affect them? Do you think that there's any loss of coordination or balance?

**Nicole:** I would love to know. We barely have a behavioral scale for mice, it's established in mice but almost no other species has a scientific behavioral scale. So, we don't have a baseline to say, "This is normal behavior," and based on that, "What is different behavior?" The only hint that I have that something might be different is that when I talk to the folks at the muskox farm in Alaska, they have a bull muskox who is, like, 27 years old, which is like twice his normal lifespan. And apparently, he just hangs out in his field and stares into the distance all day. [*Are you okay buddy?*] So, I'm guessing there might be a little bit of something going on there.

I would love to have someone go out into the field and observe and see if over the years, if they act differently. I'm assuming it would show like in humans, you'd have memory issues, you'd have loss of coordination. But one thing is for sure is that if they had a human head, they would not survive. It is actually their big skulls and horns that help, even though they do get brain trauma, it helps protect them for long enough.

**Aside:** So, horns and skulls, ultimate helmets for hoofed and cud chewing-pugilists who are motivated by sweet lovemaking.

**Alie:** Are there animals that aren't ruminants that do that?

**Nicole:** Oh my god, yes. It's so exciting, it's really exciting. This is going to blow your mind. So, I actually wrote a little bit of a review about this last year during quarantine. So, whales. Whales headbutt.

**Alie:** What?!

**Nicole:** We're pretty sure. Almost every group of whales has been either observed or just written about headbutting. The review that I published has a picture of two bottlenose dolphins jumping out of the water and headbutting each other midair.

**Aside:** Whaaaat the fuck? So, that blew my mind that had just suffered a blow. So, a little more on that. What other ocean animals bean each other with their literal melons? A melon, apparently, is the squishy part of a whale head.

And we're going to get to that in one second but first we need to take a really, really quick break for our sponsors who allow us to donate to a cause of Nicky's choosing. She selected the Society for Women's Health Research and she said, "As a biologist, I'm

constantly running into illnesses that are poorly researched in women, if even studied at all. Concussions fall into that category, so I hope it's fitting." So, the Society for Women's Health Research promotes research on biological sex differences in disease to improve women's health through science, policy, and education. So, thank you for helping us slam some cash into their hands. There's more at SWHR.org and I'll link that in the show notes. So, thanks sponsors.

[Ad Break]

Okay, back into it. Dolphins and whales who butt each other in the head like they're in a Vin Diesel movie. So, in her paper, Dr. Ackermans cites that the ramming behavior has been observed in sperm whales, narwhals, humpback whales, bottlenose whales, bottlenose dolphins, and orcas. And she writes, "In pilot whales, unusual skull structures may even act as a form of antlers inside the head." Whaaat?

So, we need so many cetology episodes given that these things evolved out of the water to dry land, hung around on dry land, hoofed around, romped around munching on grass and maybe, like deer, eating birds, [*"Michael, he ate a bird."*] and then they bounced back to the water and they modded their already modded fins from legs, back to flippers. And dolphins have bigger brains than us, four to five times larger than we'd expect them to be for their size. Which by the way, did you know that dolphins can be like 11 feet long? I feel like no one has ever told me that. Anyway, "Relative to that body size, they are the second most encephalized animals on the planet," which is a sentence I read recently that was written by the most encephalized species on the planet. But yes, why the headbutting? Why? Why? Why? Why?

**Nicole:** One of the ideas is that this is maybe a conserved practice between all of the artiodactyls because whales are part of the artiodactyl, hooved animal family. So, that's super exciting!

**Alie:** Why do you... Any idea why they might do that?

**Nicole:** Same as with the bighorn sheep and the other male animals, it's fighting for females and showing, like, which male has the superior genetics to be able to survive that, basically. [*"It's wild."*] There's a type of wild forest hog that headbutts and it makes a crazy loud noise. And there are hornbills, they fly into each other's heads in midair. So, I wanted to name those guys because it's pretty cool.

**Aside:** So, Nicky's 2021 paper is titled, "Unconventional animal models for traumatic brain injury and chronic traumatic encephalopathy" and in it she notes that this clash has been described by other researchers watching hogs, and it produces a loud cracking sound. She even included and cited a YouTube link; naturally, I clicked it as fast as my fingers allowed, and let me set the scene...

We open on a springtime hillside [*faint sounds of wind and birds*] serving as a verdant arena for two shaggy, tusked contenders. [*hogs begin to snort and snarl*] They look like a cross between a farm pig and a warthog but also wearing a Ghillie suit, and they scratch in the soil beneath them, and then run at each other's skulls [*snorts continue and quicken*] over and over. And the weirdest part is that their tails are wagging so much, and I don't know if that just means they're excited or amped up, or if they love it... whatever, they're relentless. And in her paper, Nicky writes:

*On rare occasions, these head clashes can result in skull fractures and even death, raising the question of the cost that these fights take on the hog's neuroanatomy.*

*Perhaps similarly to the thick fat pad found between a sheep's horns, the giant forest hogs' facial pads serve both as a means of protection and as a sexual signal.*

So, in the wild, with a fatty, sexy brain cushion and some boney helmets, individuals prove their merit before a hopefully receptive and, I guess, ovulating, audience. So, next time you're out there and you're witnessing a soggy, beer-soaked kerfuffle in a bar, just be glad no one in there is growing knives out of their temples... Can get real gnarly.

**Alie:** I mean, is it so impossible for you to watch, like, a boxing match or a UFC match with friends and not be like...?

**Nicole:** Dude, yes. [*Alie laughs*] I cringe every time something happens. Because every time you get a concussion or a brain injury, it's an exponential curve toward potential future problems like dementia, Alzheimer's, PTSD, seizures.

**Alie:** It's like, why doesn't anyone fight by just bumping butts together? Why can't they do it where we've got so much flesh and no brain?

**Nicole:** There might be some species of sea slug that does that, I don't know. [*laughs*]

**Aside:** Do any animals pierce each other's heads with their phalluses, in dick-to-dick combat, you ask? Of course they do, this is Earth. But just be glad that it was *Twilight* and not the 2015 paper, "Cephalo-traumatic secretion transfer in a hermaphroditic sea slug," that inspired *50 Shades of Grey*, because slugs are out there and they are stabbing each other in the head with their dicks, and putting secretions in there... Babies!

**Alie:** Is there anything that you have to kind of cross-reference at all with human impacts? Or is it just impossible to even extrapolate this information into humans?

**Nicole:** Oh yeah, a lot of the cellular stuff is really similar to humans, and honestly, that's all I have to work off of because, like I said, not a lot of other people are looking at this. There's a lot of artificial induced traumatic brain injury in sheep to study the development but it's really hard to study in humans too because a lot of the data comes from post-mortem brains. You can't really take a brain biopsy while someone's alive. So, we're developing new techniques as technology gets better but the actual overall data out there is not a lot. I do use a lot of the human stuff to try and compare and prove that that is indeed what's going on.

**Alie:** Do you have to put a call out on the Worldwide Sheep Brain Web where you've asked more people... Do you think that the more your information becomes public, or when this paper gets published, you'll be able to get more samples?

**Nicole:** First of all, I think we need to trademark that because I need a Worldwide Sheep Web, because I wish it was that easy-to-get samples. I don't know; I don't think there really is a system to get samples like that. I just called Fish and Wildlife because I happened to be in the US.

But I don't know, it's really interesting for this topic because it's something that everyone internally thinks, "Oh yeah, bighorn sheep, headbutting, concussions. That totally makes sense." But it's not something that a lot of people are willing to investigate because there's not a huge financial gain behind it. Part of it for me is understanding headbutting in all animals helps the human science and maybe we can learn from bighorn sheep to help humans, but it's not like I'm going to sell a helmet to the NFL right off the bat. I mean, NFL, please call me, but I don't know if it's going to happen. I'd love to get more

samples if there are people out there with bighorn sheep samples, send them to me, but that's the hardest part.

**Alie:** Yeah, I bet. Do you find that there's a lot of controversy when it comes to concussions, or TBI, or mTBI, or CTE? I was not plugged into that subculture at all before I ate shit down the stairs, but are there a lot of differing opinions based on what is making money?

**Nicole:** I have opinions. *[laughs]*

**Alie:** Yeah, I bet.

**Nicole:** I know there's a lot of pseudoscience people that freak out about it. Actually, on our Twitter thread I think that happened, it was weird.

**Aside:** It was weird. We had one tweeter keep popping up in the replies like a fucking marmot with comments about how football should not take the blame for any CTE and that all the impact athlete with postmortem evidence of CTE likely just happened to get it elsewhere, like coincidentally. This person also had the emoji of a football in their bio.

Anyway, Dr. Ackermans, Nicole, a wonderful person to follow on Twitter, so you can tweet and ask her about how woodpeckers have more accumulations of tau proteins compared to non-pecking bird species. And Dr. Ackermans will even do things like treat her followers to a 25-part thread on how to de-flesh a skull, should you need to.

**Nicole:** But I try to avoid that, I stick to my sheep, so I don't have to deal with the human part. I understand why people freak out, it's scary. There are some people... for me, it's really frustrating, the biomechanics area where they use this sort of bio-inspired materials. They think, like I said, bighorn sheep don't get concussions because sheep are amazing and they're perfect. And then they don't actually look at the biological background, but they create devices based on this without looking at the basic science.

One example is the Q-Collar. I don't know if you've looked into this yet. So, do take a look at the controversy behind the Q-Collar. It's this collar that goes around your neck and sort of tightens around your veins and arteries and it's supposed to... Okay, the basic idea is that it's supposed to increase the pressure in your head similar to the arteriole pressure of a bighorn sheep because they live in altitude, and they have higher pressure, and this causes less concussions.

**Alie:** Oh no.

**Nicole:** In theory, if you didn't know any biology, this would be a great idea. Unfortunately, no one's arteriole pressure increases that high, even if you're on the top of Machu Picchu. I guess they didn't google that.

**Alie:** Oh no.

**Nicole:** I mean, yeah. So, the problem is, this made it to the popular science and the actual paper got a lot of traction. And without people thinking this could actually be dangerous to football players and youth athletes because it's based on a faulty premise. Although, I have another thing to say about this, is that it may work for other reasons including maybe a sort of placebo effect that you feel protected because you have this on. But we don't know. They're testing it.

This really frustrated me because it could be dangerous, and people didn't bother to look at the real science behind it. This is my own personal vendetta. *[laughs]* Every time I see

a paper where they say, “Bighorn sheep don’t get brain trauma,” I’m like, “Nooo!” Shake my computer. But to their credit, I haven’t published yet so...

**Alie:** And when people say that bighorn sheep don’t get brain trauma, obviously you know from looking at it first-hand that that’s false. But also, from what I understand, concussions have to be clinically diagnosed, so unless you’re a bighorn sheep’s doctor asking about symptoms, you can’t diagnose a bighorn sheep with a concussion because you can’t have them fill out a form. Right?

**Nicole:** Alie, that is exactly correct. Sometimes in humans they get up and walk away and you think they’re perfectly fine. So, how would you even tell in a sheep where, yeah, they look fine, but I don’t know, what does a fine sheep look like? *[laughs]*

**Alie:** Yeah, yeah! You can’t ask them if they’re experiencing any dizziness or tingling in the limbs, necessarily.

What do you think is the hardest part or most frustrating part about the work? We’ve just talked about flimflam and making helmets and safety gear that are not sound. But anything else that just gets your goat?

**Nicole:** I get really impatient when it comes to writing grants, because you don’t always have a success rate. It takes a lot of time and people kind of think that your ideas are dumb because, like for my stuff, it’s not immediately saving the world so obviously no money is coming my way. *[laughs]* And the job market kind of sucks when you’re an academic. I know you’ve covered this with a lot of other guests before.

**Aside:** Ah yes, the broken system of academia. Do you suffer and help change it? Or do you take care of your mental and physical well-being? Let’s look at the bright side.

**Alie:** What about the stuff that gets you really excited about your work?

**Nicole:** I’m obsessed with evolution. I think it’s so crazy that it works. Like, basically that the world is just random chaos and eventually if you throw enough pasta to the wall it sticks *[Alie laughs]* and that makes an animal, that’s so cool! And every day, even actually from your podcast, every time I listen to a different expert, I found out some weird thing that I think I wasn’t going to care about, about spider claws or something and it’s a whole new world of awesome things that are going on. So, I’m just excited about it every day and animals are awesome.

**Alie:** It’s just so cool to think that we’re just a collection of successful mutations, you know?

**Nicole:** Yes! Yeah.

**Alie:** It’s just like, something mutated, it happened to work for the time and the place we’re at, and... Go! You know. I always think about that when I think about luck or success, it’s just a lot of mutations, on mutations, on mutations.

**Nicole:** And then when you look at something like comparative evolution where you have a Tasmanian tiger compared to a dingo and they look exactly the same, they have almost the same tooth pattern, the same size, the same limbs, and they’re not related *at all*. One’s a placental mammal and one’s a marsupial and meanwhile, they look almost exactly the same. Proof that evolution is pretty cool, I don’t know. It’s formed by the different habitats, but I don’t know... it’s just fascinating.

**Alie:** Oh, and one more question. When someone sends you a sheep head, what kind of box does that come in?



**Nicole:** [giggles] I'm so glad you asked. Usually, it's in a cooler filled with ice and really tightly duct taped. It actually worked really well. I got it FedExed overnight last time and it was still fresh when I got it. Because brains have an expiration date; you want them fresh, if you freeze them the crystals can damage your sample depending on the technique you're doing. So, under 36 hours is best.

**Alie:** What?!

**Nicole:** So, I got it shipped overnight and it worked, so that's what I do now. It was a whole head by the way. [laughs]

**Alie:** Did the Fish and Wildlife Department just say, "We happen to have a freshly dead one, right here"?

**Nicole:** Yeah, I just gave them all my number and I said, "When a sheep dies, call me." And then they did, and I was at the MET at the time I think, and I was like, "Okay, send me the sheep!" It was exciting!

**Alie:** Oh my gosh, I love the idea that the FedEx person has it on a dolly just getting it up to your floor. [laughs]

**Nicole:** Yeah, I mean we have a pretty wild zoo of brains that come in and out. We work a lot with whales as well. As you know, Joy is a whale specialist, and the problem with that is the 36-hour time frame because once they die and they beach, it's usually quite soupy in there. We're looking at explosions for brain trauma in whales too but it's really hard to get good brain samples for those guys.

**Alie:** Oh my god, never use "whale" and "explosion" in the same sentence again. [both laugh]

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So, ask bighorn experts, big horny questions about why they destroy their brains for sex... the bighorns do that, not the experts. But honestly, the experts love talking about it. So, learn more about Dr. Ackermans at [NicoleAckermans.com](http://NicoleAckermans.com) which is linked in the show notes. Learn more about Systems Biology guest Dr. Emily Ackerman, not related, whose episode [is also linked](#) in the show notes. Nicole's Twitter handle is [@AckermansNicole](https://twitter.com/AckermansNicole) where she goes by Dr. Sheep, which should definitely be Dr. Headbutt... whatever. She also has a monthly podcast interviewing older folks about their unexpected life stories and it's called [Stories Your Granny Never Told](#). You can find out more about the Society for Women's Health Research at [SWHR.org](http://SWHR.org).

We are on [Twitter](#) and [Instagram](#) @Ologies, I am [@AlieWard](#) on [both](#). Thank you, Erin Talbert, who admins the *Ologies* Podcast [Facebook group](#) with help from Boni Dutch and Shannon Feltus of the *You Are That* podcast. Thanks Noel Dilworth and Susan Hale for all the behind-the-scenes help, from social media wrangling, to scheduling, and merch. Thank you to Emily White of The Wordary for making our professional transcripts, Caleb Patton for bleeping them. Thanks to Kelly R. Dwyer for making my website, she can make yours too.

And to Steven Ray Morris and of course Zeke Rodrigues Thomas for helping edit *Smologies* episodes which are short, classroom-safe versions of the classics. We just posted number nine which was Ludology with Dr. Jane McGonigal, so that is up in your feed in case you have kiddos, or you don't like asides, there's fewer asides in it. Of course, thank you to lead editor and fresh mullet-haver, Jarrett Sleeper of Mindjam Media for stitching it all together every week, sometimes many times a week, often on a tight deadline. Happy birthdays to Dr. Sarah MacAttack MacAnulty, you can listen to her episodes on squids, you can tell her you love her on the 16th. Happy birthday MaKearns and Soph-a-loaf [phonetic] as well. Nick Thorburn wrote and performed the theme music.

And if you stick around until the end of the episode, I tell you a secret. And this week it's that when it comes to doing skincare routines, I'm horrible at it, I hate it, I resent it, I don't like it. Oftentimes, I don't remember what order to put things in: you've got to use a toner, and a serum, and a moisturizer, I don't know what goes on when, what about retinol? I guess you don't use the sunscreen at night... Anyway, I don't know. And I was just thinking it would be dope to have a sticker, kind of like the ones that go on bananas with a sun and moon on it and you could write a number so at a glance you could just remember what things go in what orders, at what time of day.

Anyway, it's only a secret at the end because I will either never do this and I just wanted to tell someone about it, or I will do this immediately and maybe I'll put it in the merch store if other people are like, "I could use those!" I don't know. Also, thanks for bearing with the lateness in the last few weeks as I readjust to life when things are expected of my bruised brain. Totally feeling better, I'm just kind of slow-moving. So, maybe algae will begin to coat my hair like a fine, mossy halo. We can only hope. Okay, berbye.

*Transcribed by Aveline Malek at TheWordary.com*

### **More Links:**

[Get all the background on head trauma, including my recent brainwhack concussion](#)

Check Dr. Nicole Ackerman's [website](#) & [Twitter](#)

Her paper: "[Unconventional animal models for traumatic brain injury and chronic traumatic encephalopathy](#)"

Her podcast: [Stories Your Granny Never Told](#)

Her [Twitter thread](#) on cleaning bones

A donation was made to [Society for Women's Health Research](#)

["Cephalo-traumatic secretion transfer in a hermaphrodite sea slug"](#)

[Dr. Emily Ackerman's episode](#)

[Giant forest hogs butting heads](#)