

## WESTERN SCIENCE SPEAKS PODCAST SEASON 5, EPISODE 1

### EPISODE TITLE

Lessons from the World's Smallest Monarchy

### PODCAST SUMMARY

Dr. Graham Thompson from the Department of Biology joins Western Science Speaks to compare and contrast the social hierarchies of humans and bees. Dr. Thompson also describes the evolution necessary for these honey producers to thrive within the world's smallest monarchy.

### INTERVIEW

You're listening to the Western science speaks podcast. Presented by Henry Standage.

#### **Henry Standage 0:02**

Hey, welcome to the Western science speaks podcast. Today on the show, our guest is Dr. Graham Thompson from the Department of Biology, Graham studies the complexity of insect societies, most prominently that of the honeybee, and his work is filled with interesting ideas of social evolution theory, how hierarchies are naturally formed, and what it really means to be a team player within a community. He came onto the show to talk about his work, while also offering a level-headed available evaluation of the sudden murder hornet crisis. And finally, a few thoughts on how he is interpreting the collective behaviour of humanity during the pandemic. Here we go.

What are the distinguishing motivating factors between insect societies and human societies?

#### **Graham Thompson 1:19**

Well, those are both cool topics and they're related in a way, I guess. The human centred study of societies, or that is the domain of Social Sciences, really is animal behaviour. It's just focused on one particular animal - humans. And then I think when people get that little break, that connection between humans and human society and other animals and other animal societies, then their world, their thought process gets bigger, and you get into the whole theory of sociobiology, which is very evolutionary, and you can start to make comparisons and point out differences to between, let's say, animal societies like vertebrates that you might think of, or even insects, insects have great organised societies, some of them do. And then you can start to compare. And one of the comparisons for example, many people will be familiar with the general workings of say a honeybee colony or an ant colony or something like that. And it's no coincidence that the characters in let's say a honeybee colony are named after human roles in human societies. So, you have queens, right? This is not an etymological term, or it wasn't and you have workers and you have undertakers and you have soldiers, and you have nurses, these are terms that are brought over from a human working.

#### **Henry Standage 2:40**

They're like an 18<sup>th</sup>-century monarchy.

#### **Graham Thompson 2:42**

Yeah, it's a bit, you know, stuffy the terms that they got, but they have a role like, they serve to convey how it's organised, their societies in a way that a first day student could even immediately start to grasp in terms of oh, I get it. There's a power structure going on here. Oh, and it's organised in a certain way with dominance and subordinates or with older and younger, or with parents and siblings. And there's a division of labour. That's a key one that, oh, some of these individuals are focused on reproductive tasks, and others are specialised for other non-

reproductive roles. And even some of them are quite selfless if you're labouring away your whole life, defending others, but not yourself, for example, as a worker bee might, or foraging.

**Henry Standage 3:36**

One difference is that insects obviously lack one important tool that we have, which is communication verbally. So how do they compensate for that?

**Graham Thompson 3:46**

Well, the way you post the question made it sound like humans have this super quality that insects are lacking. But if you could imagine yourself as an insect, you might pose the question in a different way. You might say, gosh, how do these humans even function, their ability to perceive chemicals and pheromones is so crude. I mean, these guys can barely smell bacon in the morning. How do they distinguish between individuals that are less and more related or that have a mild versus a strong infection, or that are reproductively receptive or not? And all this is done not verbally, but just the chemicals and the cuticular hydrocarbons on their exoskeletons and the pheromones that they walked. And so, they've just evolved a different set of signals that humans have. And so it's kind of like, a little bit human centric to think that wow, if something hasn't evolved the very same qualities that we have, they must be in some way deficient and gosh, I wonder how they survive at all. But that's not the best question. Well, it is a great question, but it's not the best way to think about it. Actually, these insects have evolved fascinatingly complex ways of communicating that aren't vocal, and they've been around a lot longer than our vocalisations. So, they're perfectly well suited to communicating.

**Henry Standage 5:16**

The use of pheromones is super interesting to me because their perception of someone is so concrete, these chemicals tell me these dimensions about you. Whereas humans, there's so much you have to sort through because of the visual component.

**Graham Thompson 5:31**

I don't know, like humans are very good at social perception - that's true, but we just use different ways of communicating. Visual is one for sure. The whole facial expressions and all these body movements and things and vocalisations as you say, as subtle as they might be, not just literal language but the way and tone and volume and direction that we use our vocals and stuff is very good at reading people. And a lot of our big brains are geared at interacting socially. And insects do it too. They just do it with less cognition, I suppose. They do it in a way that involves less brainpower. So, they're just using rules of thumb, that they've evolved in response to cues that they acquire and that they've evolved.

**Henry Standage 6:18**

How capable is the honeybee of a trait such as altruism?

**Graham Thompson 6:23**

Yeah, honeybees are a good example for studying a type of altruism called reproductive altruism. But this is a nice reference to earlier remarks in social science versus biological science, and that this term altruism gets used in different ways. And so, there's a street version of altruism, the word altruism, that might mean to be you know, consciously charitable or nice, right? If you make a donation to a charity, or if you help someone or you volunteer, or donate your money or your time, you're said to be altruistic, right? And there's a certain agency that's associated with that - you're intending to be nice. And so, if you transfer over that same sort of definition of understanding to the biological sciences, then it starts to break down a bit because you can't imagine that an individual honeybee worker is consciously trying to be nice, right? And it's true. You can't really make that argument. But honeybees are definitely altruistic just in a slightly different way. They're altruistic in, in a more sort of evolutionary way, in that they don't consciously try to be nice or charitable, but they are giving something up for the benefit of others. They're giving up elements of their own survival and reproduction to the benefit of others. And they're not doing so willy nilly because they're nice, but they're doing so because they've been under selection to do so. That is to say that the genes for reproductive altruism that give rise to their helpfulness within the hive, their sterility, and their selflessness in terms of defending, and stinging others to their own detriment, those very

qualities, the qualities that make up a reproductively altruistic worker, are selected for, that is to say they evolve as a consequence of their effect on others. And the others are, their relatives who live in the hive with them. So, honeybee workers to keep this one example going, they will sting you and die as a consequence. And they will respond to the Queen's pheromones and render themselves sterile, not because they're nice or charitable, but because they've evolved to do so meaning that those that did left more genes than those that didn't, and the way that they leave genes, even though they have no offspring, is to help others who are related to them and therefore carry those same genes, and have more offspring than they otherwise would have had. So, if a honeybee worker divests from her own eggling and reinvests that energy into her Queen mother's reproductive output, then the extra offspring that her Queen has, as a consequence, can be attributed to that worker in an evolutionary sense. And that is called your indirect fitness.

**Henry Standage 9:18**

How much freedom is there with the honeybees and accepting their role? Does the Queen release these pheromones and the honeybee give the proverbial green light? Or does it lack any type of agency with respect to the Queen's command?

**Graham Thompson 9:33**

You know, that's an interesting narrative that comes up a lot and it goes back to the original distinction I was making between social and biological sciences that, the workers, for your perception of them to be altruistic, you kind of can't help but think that oh, they must willfully be wanting to be doing this. Otherwise, how can they be altruistic, but that's something that you're imposing on them. You could think of the bees as having no thoughts at all and it wouldn't matter. They don't have to want to do this, they don't have to be willing to do this, by whatever means, if they in fact, are giving up their reproductive output in order to help another, then that is altruism. Because it's not measured by the intent, or the desire in its evolutionary context.

**Henry Standage 10:24**

Yeah, and I think we're onto something interesting here with the idea of the hive mind and how much intent goes into how that labour is divided up. How does the division of roles evolve within a bee colony? Are they born to go into a certain role? How much agency is there?

**Graham Thompson 10:42**

So yeah, that's a cool one in terms of actual individual being born in a hive and you want to know about like, what their fate is, then, that's more of a proximate as opposed to an ultimate question. It's about the mechanism by which that happens. And a lot of thought has gone into that. The crude simple answer is that most of the cues that direct an individual's development into one caste, or another are mostly environmental, meaning that the colony is immediately responsive to its needs in the environment that it's in. So, if there's a shortage of say foragers, then foragers will differentiate.

**Henry Standage 11:22**

The concept of the hive mind, in essence, you know, being a team player is especially relevant in this pandemic, we have to trust one another in our local communities, but also our nation at large to behave and follow orders so that things are back to normal sooner rather than later. In bee colony what happens if the Queen's orders aren't followed?

**Graham Thompson 11:46**

You might think of a honeybee colony as being like so harmonious and like evolutionarily honed into this perfect machine where every individualist has its own exact perfect role. But if you look closely, that's not really the case. There's a lot of conflict within colonies and in terms of disease and things like that you can see it there too. If individuals returned to the hive that are affected with something which happens a lot, then they might not be welcome actually, they might be deterred at the entrance from entering. Or if they do get in, they might be ostracised, and quarantined for real or harassed and rejected. And so there is more of an evolved sense of long term interest in health within the colonies as opposed to like, a cultural and government mediated one in human societies.

**Henry Standage 12:36**

You've researched the effects of probiotics on bees, what prompted this and what were your findings?

**Graham Thompson 12:43**

Yeah, the probiotics one is an interesting thing. It's a little bit different than the evolutionary sociobiology we've just been talking about. And that was to feed these honeybees, feed the workers, these protein patties that are infused with a certain mix of beneficial bacteria. We juice them up, and then they get exposed to all the natural pathogens that they do. And you'll know even without being a specialist that honeybees are under a lot of stress and their pathogens and parasites pose a lot of pressure on them. And so, giving these honey bees, these bacteria that live in their guts and digestive tracts, help them to overcome a lot of environmental stress. So that's kind of cool, because the honeybees themselves already have, as do most living things, a lot of micro organisms that live in their guts, and so do humans, but the composition of those bacteria in your guts is variable, both in terms of how they vary over your age or in a certain diet or in a certain state of health. And you can manipulate them a little bit too by feeding probiotics into humans or bees.

**Henry Standage 13:53**

Is the idea that they'll perform their tasks better if they're on probiotics?

**Graham Thompson 13:59**

Yeah, that's a broad way to say it. If you choose the mix of probiotics just right, then it might actually just help those individual bees that eat them be a little bit healthier, right? Their immune systems a little bit more stimulated, and so on and so forth. And so far, that's all we've measured, like in a crude sense their immune genes are like shining bright right now. And their overall survival and productivity is a bit higher. And so those are the crude benchmarks that we've been using so far. But it would be good as you're alluding to, to say like, okay, more subtly - are the workers more efficient at foraging? Or at nursing? Or, you know, does it fine tune or supercharge their division of labour that already serves them well? Can you hone it up? Like, if you think of workers as being literal human workers in a factory, you know, except its a factory in this case that's making honeybee babies as opposed to televisions or something. Can you motivate them and make sure everybody showed up to work on time, stays their full shift and not call in sick? Maybe probiotics do that.

**Henry Standage 15:08**

What do you think we can learn from the species in terms of determining our own social structures in the future? Is there anything you look at and go, hmm, we might actually be able to translate that to us?

**Graham Thompson 15:20**

Something we touched on just a few minutes ago, about this distinguishing your selfish from the collective interests, and one of them, let's say, altruism and cooperation versus selfishness. I see this playing out in the political landscape a lot. It's not put in biological terms, but it's there. And so, for example, take like, left versus right politics or something like this. So often, the underlying arguments can be just pigeonholed into this sort of what's good for the selfish individual in the short term. I would say that's more like right wing politics and what's good for the long-term collective interest of the group, and I would say that's left wing politics. And so that sort of distinction between the long term collective interests of the group, or cooperation, versus short term selfish interests of individuals or in a word freedom, you can see that both sides of that spectrum have their merits, and both sides have their costs. And I think that if you can just be clear on why you're arguing on one side or the other and what the consequences are that that would help a lot of people navigate the political landscape and be more fluid in their thinking and choices and not be so, sort of blindly wed to one side or the other. So, I think biology and sociobiology can inform the way we think and govern our own societies a lot.

**Henry Standage 16:50**

I had a couple housemates over the years who thought they might be interested in pursuing a career within political science and over the course of second year, third year of undergrad, when you really start to figure this

stuff out, they would come home on Fridays looking just so beaten down. And they would just say, man, I think I might hate it.

**Graham Thompson 17:11**

No, yeah, I noticed this a lot, like any political discourse, you can basically simplify it to like, oh, this person's arguing this case, and the other person's arguing the other case and even though the details from one topic to another vary, there is an underlying factor that's pulling people to one side or the other. And I think it's just your natural disposition to sympathise with the long term collective interests of the group versus others that don't value that as much and really value the short term self interest of the individual and that's the most important thing for those individuals: to have total freedom and immediate choice in anything that you want to do, regardless of the consequence.

**Henry Standage 17:57**

I'll change the topic before I get you in trouble. How does us not being out this summer affect the bees?

**Graham Thompson 18:03**

I think that us in some commercial apiaries that have had to not hire people, for example, or might not be able to attend them as well. So that could affect things. A lot of those bees, the reason they exist in such large numbers in apiaries, is because they get used to pollinate commercial crops. And so maybe, if those crops are not being planted or attended to or grown as vigorously as they might have been without the pandemic, then there won't be as much of a demand. Otherwise, the honeybees should be fairly fine, I think, and more generally outside of honeybees, but a lot of the native honey bees and all the native plants that they feed on, from my understanding, are suddenly doing a little bit better because there's a lot less air pollution, a lot less traffic, a lot less human activity around natural areas where they can now thrive a little bit. So, I think, from what I'm reading the environment is kind of like breathing a sigh of relief from all the lack of human activity. Heavy industries not as busy, transports way down. Flying and shipping is way down. So, I think bees and all living things are enjoying this.

**Henry Standage 19:15**

Yeah, the more nature-oriented people in my life are really driving home this 'we are the virus' narrative.

**Graham Thompson 19:21**

Well, whatever. But I think that one thing though is, why don't we have the same social global buzz and every day, country by country by country reporting, as if it was a World Cup of COVID you know, which countries doing the best and which countries doing the worst? Oh, Russia's coming up from behind, you know, why don't we do that with co2, report everyone's daily and weekly co2 emissions and how they're going down, and people and countries could be proud of their accomplishments in that way.

**Henry Standage 19:57**

I'm really jealous that you thought of this idea.

**Graham Thompson 20:00**

Yeah, it would be great. If when we do restart that we restart on a clean foot. Why not? It just went to show against all the naysayers who said it couldn't be done. How could you possibly shut everything down like well, we just did. And so now when you start it up again, why don't we start it up clean? Invest in future industries and not reinvest into old ones.

**Henry Standage 20:24**

I am curious to see to what extent the competition becomes addictive in some form for these world leaders who undeniably insert their ego into these global issues.

**Graham Thompson 20:36**

But isn't it funny how you said like, it's true that most world leaders would like to claim some political clout at being the best at mediating the crisis, right? Anyway, it's interesting, I think the crisis has brought into focus the

value of socialised health care, for example, which requires taxes and things. And so, governments that hate taxes and that hates centralised healthcare systems are having a hard time right now. So even though those leaders would like to claim that they're doing the best, they're in such a bad position for doing so.

**Henry Standage 21:08**

I really think it goes one of two ways, either being better prepared in the future is going to become a real priority in our societies. Or you'll see the attitude that well, this was the one crazy thing of our lifetime. We can go back to the old ways, because now we've paid our dues.

**Graham Thompson 21:26**

Yeah, who knows right? I think people will be thinking about that question a lot. But another thing that came out of it that I think is that is maybe going to be a good thing is that it revalues the science and research. I mean, it's no surprise to think that there's a bit of an anti-intellectual movement going on in the last 5-10 years, you know, where people don't believe in science. They don't believe in vaccines. They don't believe in public education. They're prone to conspiracy theories.

**Henry Standage 21:59**

Everything inconvenient is a hoax.

**Graham Thompson 22:02**

And there's been this backlash against intellectualism, where if you're actually competent in a field of study, it's considered to be negative, right? You're elite or something like this. But actually, we need this expertise. And we need these people and we need to invest in our scientists and scientific infrastructure, because now we're all relying on them. We're waiting for the science to figure this out, right?

**Henry Standage 22:29**

Before you go, I got to ask about the murder Hornets.

**Graham Thompson 22:32**

Yeah, go ahead.

**Henry Standage 22:34**

What's going on here, Graham? Should I be terrified? Are they going to destroy our bee populations? Just take me through it.

**Graham Thompson 22:42**

Before we talk about the biology of the Hornets. Let's talk about the psychology of humans, when they saw that story, it somehow just tapped into this sense of dread for 2020 right. For some reason, this story about the Hornets which might otherwise just have been like, you know, a total back page observation, oh, you know, a giant rat discovered in New York City or something, you know, just a little funny thing on the back page. But no, it went front page and was burning through front pages on social media for a long time, like for a week and a half, for almost two weeks. It was quite cool. So I'm not sure, it's interesting, I guess it was the name, Hornets might attract some attention. But murder Hornets really, really made it go crazy. But in terms of the actual biology of the Hornets, I don't think that there's really a threat yet. It was mostly like the potential of a threat because they'd been observed on the west coast of Washington state and in British Columbia. But it's really only a handful of observations made over the last couple of years. And it's pretty stochastic, like okay, maybe that's what it was, and maybe we'll see another one in a couple years and it'll just not be an issue. Or maybe, you know these things have gained a foothold and like other invasive species we can expect to see a lot more out. So if it's the latter not saying it's going to be, but if it was the latter, then yeah, they do prey upon honeybees and so if kept that ecological niche in their new environment then honey beekeepers would need to be on the lookout for them and they would have to try and get rid of them.

**Henry Standage 24:24**

Cool, I really appreciate you coming on today.

**Graham Thompson 24:27**

It was fun. Thanks a lot. Appreciate it.

**Henry Standage 24:33**

That wraps up another episode of Western science speaks. Thanks to Graham Thompson for coming on. If you enjoyed the episode, subscribe to us on Apple podcasts, Spotify and PodBean to stay up to date on the newest episodes and topics. For now. I'm Henry Standage, signing out. Thanks for listening.