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00:06 Sarah Crespi: Welcome to the Science Podcast for June 26, 2020. I'm Sarah Crespi. First up this week, researcher Kimberly Prather is here to talk about science, communication, and coronavirus. Yes, you should wear a mask, and here's how to tell other people why they should wear masks. Next, we have researcher Mikkel Sinding. He talks about many specialized genes found in a Siberian dog thought to have been used to pull sleds almost 10,000 years ago. Finally, in our book segment, Kiki Sandford talks with author Rutger Bregman about his book Humankind: A Hopeful History.

00:44 SC: Now we have Kimberly Prather, she wrote this week in Science about aerosol transmission of coronavirus. Kimberly, your background is in aerosols in environmental chemistry, more than necessarily in public health. How did you get involved in this? What made you decide to start speaking out?

01:02 Kimberly Prather: So I direct a large National Science Foundation center that looks at how the ocean actually regulates climate, clouds and climate. And one of the things we've been studying over the last few years is that when waves crash, bacteria and viruses get into the air from the ocean. I've become very interested in biological, we call them biological particles, but bacteria and viruses, and how they become airborne. And now we're just starting to branch into whether or not those bacteria and viruses actually affect human health. So I was heading down this path. We had a major study that was going on looking at this ocean release method, and then now Covid came up and again, it's viruses in the air, and we know very, very little about airborne viruses.

01:51 SC: So I think in a lot of ways, our listeners on the Science podcast, they're the choir, we're preaching to the choir, "Wear masks. Do social distancing. Spend time outdoors if you're gonna be around other people." Those kinds of things. But we're also talking to a bunch of potential science communicators who may get questions about, "How safe is it to do X or Y in this era of Coronavirus?" What are some messages that you think really simplify how to communicate this to the public?

02:20 KP: The big one obviously is we're constantly talking about masks are really critical for this particular virus, but then the public has never been told that before, so what's different about this one? And the difference that most of the public doesn't realize is that you're wearing the mask to protect others. It just blocks the release of these viruses, or potentially infectious viruses, from people who are infected but don't know it. When I talk to people in the public and mention that the mask is more about protecting others and more about basically reducing the emission from people who are sick and don't know it, that resonates with the public quite well.

03:00 SC: So when we say aerosol in this, we mean these tiny little particles that don't necessarily come from coughing or sneezing, but from the regular breathing and talking that we do.

03:12 KP: Exactly. Mostly they come from speech. Not that much comes out, we don't think, in just breath alone, but if somebody is talking and they're infected. And more importantly for this virus, that person could be infected and not know it.

03:26 SC: Right.

03:26 KP: So the traditional coughing, sneezing, sick person that we can identify, for this one, there's more what we refer to as the silent aerosol spread that seems to be playing a rule.

03:39 SC: Adding this together, the fact that talking and breathing in the same room with someone who's sick but maybe doesn't know it yet or may never even get symptoms, what does that mean for stopping the spread of coronavirus?

03:51 KP: Well, in simple terms, it means that the messaging we get about two meters or six feet that we've been hearing over and over, social distancing will not work indoors. Especially if you have low ventilation, especially if you have a person that's sick. These aerosols don't fall to the ground in six feet. They can instead float in the air for hours and build up. And how safe you are depends on how ventilated that room is. So it's just a different set of controls that are needed to actually reduce the spread via the aerosols.

04:26 SC: Well, one of the controls that people have been trying is masks. Do those work for aerosols?

04:32 KP: Absolutely. Some people say that we don't know, that's not true. We definitely need to do more studies to figure out if they're cutting out 90% versus 70%. There's a lot of variables. A lot of people will say, "Oh, the aerosols are too small." Viruses are really tiny, they're like 150 nanometers for this virus, but that's not what's floating around in the air. When you speak, you put out aerosols that are more right about one micron, and so actually masks do a really good job filtering in both directions, I should add, the aerosols. If someone is speaking, the masks will block the release of aerosols into a room.

05:13 SC: I think the diagram that came with this article is really... It's just the simplest way to explain. It shows one person wearing a mask and one person not wearing a mask and what happens with the aerosols. I recommend that everybody go check that out, and I'll tweet it with this podcast as well.

05:30 KP: Yeah, that's great.

05:31 SC: Masks aren't the only thing that we should be doing. There are other things that are needed to keep people safe, right?

05:36 KP: That's correct. Well, it's been called the third layer of protection. We have good hygiene: Washing your hands and being careful with surfaces. We also have social distancing. The further you're apart, that's still true, because the concentration will diminish as a function of how far you are away from the source. And then masks are your third layer of protection. There's a couple of

other factors. Once you acknowledge that it's in the air, then ventilation becomes really important. It's a very fixable problem indoors in that you can add filters. Aerosols, especially of this size, are pretty easily removed by filters. And so it's a very... Better ventilation, more air exchanges, open the window. There's just simple ways to dilute their concentrations. So ventilation is important as well as just not going to crowded places indoors where things potentially aren't being ventilated enough and spending a significant amount of time.

06:34 SC: You mentioned ventilation as being fixable when it comes to dealing with airflow in buildings. Is that a fix that is happening in certain places? Buildings, airplanes, factories, schools, dormitories, are any of them looking to change the way their ventilation works or add these filters?

06:53 KP: I'm contacted almost every day by people who are designing new buildings and trying to think about how to reopen schools and how to reopen restaurants. This virus is actually pretty sensitive to UV light, you can kill it with UV light. And so people are putting UV in their air handling systems to basically kill it that way. It is a very, very active area of, "How do we make safe air in the air that we breathe indoors?"

07:20 SC: I think the metaphor that you used in your piece about cigarette smoke, especially outside, really resonated with me. So if you're walking behind someone who's smoking and you can smell their smoke, that means that you're being exposed to particles, to aerosol's coming out of their mouth.

07:35 KP: That's right. Smoke is about the same size, and so that is true. Albeit, when you smell it and it's pretty weak, again, you'd be maybe breathing in a few of these viruses at most. So if you're walking behind someone and they're exhaling, they're running or doing something, exerting themselves and exhaling aerosols like about a micron, they will follow the same flow lines of smoke. And so if you breathe in and you smell smoke, there's a chance that in that same breath, you're also breathing in their aerosols, and some of those aerosols could contain these infectious viruses.

08:13 SC: It seems like it's much more diffuse outside than it would be inside, but it is still something that people should take into consideration if they're exercising or maybe in a crowded place outside.

08:24 KP: Outside is much safer. The things we know and looking at where most of the exposure, the big events, they refer to as superspreader events, most of these have happened indoors.

08:34 SC: Masks are not foolproof, they obviously can let some of these particles through. But even if someone is near you that does serve you up some aerosols with viral particles in them, does it help to have a mask?

08:46 KP: Even if a few get through, the point is is that you're lowering the dose. And by lowering the dose that you inhale, you will lower the severity of disease if you catch COVID.

08:57 SC: I've seen imaging of people with masks on showing that the aerosols are not getting past

the mask. A very clear with mask, without mask. What other evidence do we have that masks can cut down on coronavirus infection?

09:12 KP: Well, if you look around at how other places that have had less problems than we are having here in the United States, such as Taiwan, which we discuss in the paper, they never shut down. They never did a lockdown. And at the end, they've had seven deaths. And they're larger than New York in terms of people. You can look at a lot of the countries that wore masks and you can just see that they never had the severe spread. I should be clear, they implemented other strategies as well. They had more testing, many of them had tracing, they had other measures, but the masks seemed to be the common link in reducing the spread in other places.

09:54 KP: Adding to that, the new piece of evidence here in the United States is what we're seeing with big cities trying to re-open. They're basically starting to see more cases, most of the cities, almost all of the cities. There's only one city where that is not the case, and that is New York, which was ironically the place that had the most cases and the most infection. What I've been told about New York is no one would set foot outside without wearing a mask. And if someone does, then people tell them, "Put on your mask." They are taking social distancing, mask wearing, following the rules to protect them, they're taking them incredibly seriously, and they're opening. And they're a big city, and the numbers continue to go down.

10:38 SC: Going back to messaging and science communication for a second. What other messages have you felt have been effective when talking with the public about preventing transmission?

10:46 KP: I think some of the resistance to aerosol. Accepting it's airborne. People will say, "Well, that creates fear." In my mind, it does not create fear. It's not a fear factor, it's a fix factor. If you acknowledge that it could be spread by aerosols, then you can put in measures that protect people. It's a very fixable problem. It should not create fear, it should be allowing us to go back to functioning as a society, which we all say we wanna do. The alternative if we continue to not wear masks, choose not to wear masks, is the only other thing we can do is the extreme measures of being locked down and nobody wants that. And so, again, look around, there's plenty of success stories of places that are opening, have never shut down, and have not seen the degree of spread. And they just follow these, I think, very simple practices. And so I think people appreciate knowing or hearing that there are solutions. You acknowledge this pathway, there's this relatively straightforward solution.

11:44 SC: Hopefully, we're all wearing masks and staying home as much as we can even if things are slightly opening up. But we are waiting for something, right? We're waiting for tests and treatment at this point.

11:54 KP: If we had more testing, then we could identify the asymptomatic people and isolate them. But since we can't do that, we've got this silent spreading going on, then masks are the backup plan. This is sort of buying us time while people work on vaccines and treatments.

12:13 SC: Thank you so much, Kimberly.

12:14 KP: Thank you for having me and thank you for helping get the word out.

12:17 SC: Kimberly Prather is the distinguished professor and distinguished Chair in Atmospheric Chemistry at UC San Diego. She's also the Director of The Center for Aerosol Impacts on Chemistry of the Environment. Stay tuned for an interview with Mikkel Sinding about ancient sled dogs.

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12:38 SC: Next, we have an interview with Mikkel Sinding. He and his colleagues wrote this week about many specialized genes that they found in an ancient Siberian dog thought to have been used to pull sleds 10,000 years ago. His group compared the genomes of modern domesticated dogs, modern Greenland sled dogs, and an ancient Siberian wolf to find special adaptations that may have helped ancient dogs survive in the Arctic and pull sleds.

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13:12 SC: My attention was captured by this paper because it was about dogs, it's about the history of dogs, the genetics of dogs, some little bits about dog domestication. Then I was reading about where the different genomes came from, and this was really awesome, I thought. So there's this island in what, Siberia, in the Arctic Circle where this jaw bone was found. Do you know how it was collected?

13:36 Mikkel Sinding: God knows how on earth they ever found this site. It's a very small island in the East Siberian Sea, which is basically the end of the world, right?

13:44 SC: Mm-hmm.

13:46 MS: Somebody at some point found archeological remains and they've been excavating there for a decade, I think, the Russian Academy of Science. And it's an amazing site because it's the first site in the world where you see people have what looks like actual dog breeding. Dogs are older than this for sure, but this is the first time you see a lot of them.

14:04 SC: The remains have been dated to what, 9500 years ago?

14:09 MS: So it's nine and a half thousand directly dated, and that is the oldest full nuclear genome of a dog to date. Initially, we had something like 10 dogs from the site. It's all about preservation and this dog was the best preserved one, and it also happened to be the oldest.

14:23 SC: There's also evidence from the site that these may have been sled dogs. What kind of evidence did they find for that?

14:31 MS: For a lot of time, people have speculated that this is probably where people were doing the first real dog sledding. They have stone tools. They come from cliffs that are more than 1000 kilometers away and they transport polar bears and reindeer and things like that, probably from very

far distances to this site, and you need something to do that. People can't carry a polar bear for 1000 kilometers or whatever. This is the first site also where you have... You can tell that this was a sledge. It's relatively big sledges. This is probably pulled by something.

15:02 SC: Going back to this jaw bone, this well-preserved jaw bone from a dog from this Siberian island, what were you expecting to find when you sequenced DNA from it?

15:13 MS: We didn't know anything about what to expect genotype-wise. So, of course, we wanted to first of all find out, "What kind of dog is this?" And we honestly speculated that it would be the grand ancestor of all modern dogs because we are moving into that time frame where we're gonna have to start looking for a common ancestor of all modern dogs.

15:33 SC: Why did you include so many modern Greenland dogs in your comparison? What made you hone in on this particular breed?

15:41 MS: A lot of our funding is obtained for a project called the Qimmiq project, and Qimmiq means "dog" in Inuit. And throughout thousands of years, people in the Arctic, they have been using dogs as tools and for transportation. We know that for sure at least for 2000, 3000 years in Siberia and North America and in Greenland. We were also interested in investigating these sledge dogs that are in the world today. We really quickly found out that the genome regenerated was closest related to the modern sledge dogs. And then we went back, we went to Greenland, which is the place in the world today where you have the most still alive sledge dog culture, and we got samples from 10 dogs from across the country and included them to have some robust data of actual modern Arctic sledge dogs.

16:29 SC: When you compared these genomes, you found these relationships between the Greenland sled dogs, the Siberian dog, but you also found specific genes that were of interest that kind of suggested some Arctic adaptations. What did you see?

16:45 MS: Once we sort of figured out the bigger patterns of ancestry, and actually the sledge dogs were super unique through all dogs and wolves in the world. They had a good proportion of genes that was quite unique to them, and some of them were shared with this 10,000-year-old dog and some of them were not. But the most interesting one... So one of them, or two of them, involved in temperature sensation, so the ability to sense when temperature changed. This is actually the same group of genes that's described to be under selection in the wooly mammoth, which is an Ice Age icon that everybody knows.

17:20 SC: Why would sensing temperature or being very sensitive to temperature change be important?

17:24 MS: I guess you don't wanna freeze to death and you don't wanna overheat. Given that we have these two groups now, very different animals having the same adaptations, this must be advantageous in the Arctic. It goes a little bit further with the temperature because one of the genes is also involved in oxygen uptake, really. And we don't know for sure if that is what the sledge dogs are doing with it, so we haven't had the ability to test for sure exactly how it works in the dogs. But

we know from all the literature that these genes have other roles, so it might also be involved in their ability to take in oxygen. Which would make sense, because sledge dogs are pulling a sled so they're running with heavy load.

18:05 SC: In addition to this group of genes that you just talked about that relate to temperature sensitivity and maybe oxygen use, you found another oxygen-related gene that's under selection pressure in sled dogs that's also been found under selection pressure in certain people?

18:21 MS: So there's another gene that you actually see in a group of humans, which we also think could be related to oxygen. And that's seen in the Bajau sea nomads in Indonesia. These people, they dive and are the best divers in the whole world, and they have evolved to be able to hold their breath. And one of the genes that's been under selection in these people to do that, is also under selection in the sledge dogs. So it rhymes with oxygen again. We don't know for sure if that is what the sledge dogs use it for, but given that we see it in these people, it's likely. And then, of course, it's a very cool observation, that it's something completely different as people diving in Asia, having the same adaptation. We used to joke in the beginning about maybe the dogs were diving. That group of genes is already selected for in that nine-and-a-half-thousand-year-old dog, so it's something that the common ancestor that had, so it goes a long way back in the Arctic. And that's very interesting, and it's also what makes us speculate that the culture of sledding and the tradition of the dog use we see in the modern Arctic dogs were already going on at this point in time.

19:30 SC: Another unusual finding in the genes of these sled dogs relates to what they eat. What do we know about genes and diet in dogs?

19:38 MS: We know that modern domestic dogs have followed humans all around the world, and they sort of do what we do and eat what we do. It's well described that dogs became adapted to eating starch when humans did. Dogs in Asia and in Europe, where we eat a lot of starch products, they have many copies of this gene, and it's probably to digest more starch. It's a specific gene called MLA 2B. That doesn't occur in the same proportions in the Arctic dogs. And that was seen before, but given that we generated a bunch of new Arctic dog, and had right now the oldest Arctic dog ever, it sort of became more significant. There's another gene as well that is related to starch and sugar metabolism. On this gene as well, the sledge dog's looks completely like the wolves. So while the rest of the dogs in the world have changed and shifted to eating what humans did thousands of years ago, in the Arctic, they're very much the wild type. So on those particular genes, they're wolf-like, but not because they got it from wolves, just because they never changed from the original state.

20:43 SC: We talked about wooly mammoths, and the Bajau diving people. What about polar bears? There's also some genes that you were able to identify that these dogs had in common with polar bears.

20:55 MS: Traditionally, we know that dogs in the Arctic have been fed marine mammals and fish. Very, very rich in fatty acids. And we also know that Arctic people have been, for generations, eating a lot of fat acids, and that they carry some adaptations to that. And there's actually two genes that pop up which are completely related to clearing cholesterol from the blood and digest a lot of fat acids. And one of those genes is very closely related to another gene that is described to be under

selection in the polar bear to do the exact same thing. It's also cool because we know that Arctic people are exceptional compared to the rest of the human population in coping with a lot of fat intake. It ties also the sledge dogs to the Arctic people, that they have co-evolved to be able to eat all this fat.

21:45 SC: We talked a little bit about this group of domestic dogs, a more general sample that you compared these different genomes with, including they had Siberian Huskies and the Malamute in there. Did those dogs have any of these specializations or are we mostly just talking about the Greenland sled dogs and the one that was found on the 10,000-year-old sample?

22:05 MS: They all have it. The Alaskan Malamute, and the Siberian Husky, and the Alaskan Husky and the Greenland sled dog, are all quite closely related to each other. But the Greenland dogs seem to be quite pure and quite original, while the rest of them had mixed with foreign dogs. And in those parts which are original, they have these same genes, so they all had them from the common ancestor.

22:30 SC: This puts the date of sledding back further because you see these adaptations for a sled dog that's 9,500 years old, or a supposed sled dog. What does this say about domestication of dogs and the spread of dogs around the planet more broadly?

22:47 MS: All dogs, as far as we can see, are related to each other. So they must have had a common ancestor not too far ago. We were a little bit, as I said in the beginning, hoping to find a common ancestor. But given that we find actually a specific group of dogs, that means that the diversification from the common ancestor of all dogs must be older than these 9,500 years. So, we don't have a good offer. There are a lot of other papers trying to estimate that, but it is quite exceptional that we, at this point in time, have a whole group of dogs that specifically diverged. It leaves a lot of room to investigate the rest of the dog diversity in the world, of course. But it is really a milestone in how far back in time do we have to go to find the common ancestor? And we can say for sure, you need to be far beyond 9,500 years.

23:37 SC: Are Greenland dogs protected? I did read something about Greenland not allowing foreign dogs into certain parts of the country?

23:45 MS: That's also an important part of this paper. So since 1906, it's been illegal to bring in foreign dogs to the parts of Greenland where the sledge dogs are. In the northern part and the eastern part, there is a lot of stories about it and mixture happened in the past. Greenland have had contact with Europe since the 1600s. It was clearly, already back then, people had the foresight to see, "We want to preserve these dogs. Please don't bring anything else in here." And from the research that we do in this study, we can tell that the Greenland dogs are all equally distantly related to, for example, European dogs. That means two things: Firstly, there's very, very little, if any, European dog in them, but also there's sort of the same amount in them and it shows this pattern. So we're quite comfortable that they are not significantly had mixed with foreign diversity, and that's a big thing that we can prove that now in Greenland.

24:41 SC: So are they at risk now? Are they still a healthy population?

24:45 MS: They are somewhat at risk. So, the population in Greenland has decreased by half over a 30-year period, but something like the last four years, it's been relatively stable and there's a whole new movement in Greenland now that the project that we've been working with has also sort of promoted to use these dogs. 'Cause if you're not using them for hunting anymore, you have to find a different use. And people are starting to use the more and more for dog racing. And of course, they're super popular for tourists. So, the dog use in Greenland is sort of changing from being the hunter going out hunting, to people making money or going for dog sledding in the weekend. I wouldn't say it's a stable situation for sure, there needs to be conservation measurements doing something to try to preserve these dogs.

25:32 SC: Thank you, Mikkel.

25:33 MS: Thank you very much.

25:35 SC: Mikkel Sinding is a post-doctoral fellow at Trinity College in Dublin. You can find a link to his research at sciencemag.org/podcast. Stick around for our book segment. This week, Kiki Sanford talks with Rutger Bregman about his book, Humankind: A Hopeful History.

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25:58 Kiki Sandford: Welcome to the book segment of the Science Podcast. I'm Dr. Kiki Stanford. Media in recent weeks has been filled with images of protesters taking to the streets against systemic police brutality, sometimes clashing violently with law enforcement. Some see the protesters as righteous while others view them as lawless rioters. And how we perceive those involved can affect how we treat them. In his latest book Humankind: A Hopeful History, Dutch historian Rutger Bregman argues that people are generally good and changing our view on human nature will change society for the better. Thank you so much for joining me today on the Science Podcast.

26:38 Rutger Bregman: Yeah, thanks for having me.

26:39 KS: What brought you to this idea of humanity as generally good?

26:43 RB: Well, look, I am not an academic. I work for The Correspondent, which is a journalism platform that tries to completely ignore the news, and I see The Correspondent as being a little bit in between academia and traditional journalism. So I have a job where for a couple of months, I can go deep in sociology, and then a couple of months deep in anthropology, and then just jump around a little bit. And I've been working on this book for the last five, six years because I started to notice that there seemed to be kind of shift happening in the social sciences. I saw that so many scientists from so many different disciplines, anthropologists, psychologists, sociologists, all seemed to be moving from a quite cynical view of human nature to a more hopeful, optimistic view of who we are as a species. And this book is my attempt to make a synthesis of all these different disciplines, moving towards what I think is a new and hopeful view of human nature.

27:38 KS: Is this a shift in viewing human nature itself or is it a shift in how we are actually acting as people?

27:45 RB: Well, we have indeed seen an extraordinary amount of progress in the past couple of decades; we are richer, we are healthier, we are wealthier than ever. And relatively speaking, we're living in the most peaceful of all eras. So I used to have this view that history was a bit like a march of progress. For example, I've got a chapter in my book about the archaeology and the history of war. I talk about this view that Thomas Hobbes, the British philosopher, had that in the state of nature when we were still nomadic hunter-gatherers, which we've been for what is it, 95% of our history, we lived these lives that were nasty, brutish and short, and there was some kind of war of all against all going on. While Rousseau, the French philosopher, believed the opposite. He said that, "No, actually life and the state of nature was pretty good, but civilization, that was the big disaster." And I used to believe that Hobbes was right. He's often described as the father of realism. But if you look at the latest evidence we have from archeology and anthropology, you arrive at a quite different picture.

28:40 KS: What kind of a picture?

28:41 RB: There's still a big debate happening obviously, but it seems to point in the direction of Rousseau. The evidence for war in our very deep history's quite thin. We have some excavations that support the idea that there were wars going on, but there's not much. And if you look at cave paintings, for example, well, you would suspect that some kind of Picasso from the Stone Age would have made some kind of Guernica of people engaging in this war of all against all, but we haven't found it. But then when we settled down, when we became sedentary, we started living in cities and became farmers, and suddenly you do find a lot of those cave paintings. So there's obviously still a big debate about it going on, and I try to write as nuanced about it as possible, but I do sense this shift as well, that we're starting to arrive at a different, more hopeful view of where we've come from and who we are.

29:30 KS: In the book, you write about the idea of the media presenting a particular view of humanity, the more negative side that stands to reinforce our own perspective of this negative nature of humanity. How does that feed back?

29:44 RB: Well, this happens a lot in science communication as well. Often when there's a new study that portrays human nature in a really dark way, it goes viral very quickly and it may even reach the front page of Science. But then when we have a study that seems to suggest the opposite, what I see and what I noticed during my research, is that it often doesn't get the attention it deserves. So, for example, I've got this whole part in my book where I talk about all the social psychology experiments from the 1960s. We all know them. The Stanford Prison Experiment. The Milgram experiment, in which subjects were willing to give dangerous electric shocks to just innocent people who were sitting in another room. These seem to suggest or paint a very dark picture of who we are as a species, that civilization is only a thin veneer and that just below the surface that we're all savages and capable of really horrible things. And the Stanford Prison Experiment is, I think, maybe the best example. It became very, very famous, ended up in all the psychology textbooks around the globe. Millions of students, generations of students, were taught the story of the Stanford Prison Experiment.

30:46 RB: And only very recently, we've discovered that actually, to my mind, it can be described as a hoax. We now know that this researcher, Philip Zimbardo, specifically instructed his students in his experiment, the ones who were made in to the guards, that he instructed his students to be as sadistic as possible. And many of those students said that they didn't want to do it. Then he said, "No, you need to do this because I need these results. This is important so that we can go to the press and say, 'Look, prisons are horrible environments. We need to reform the whole prison system in the United States.'" That's what happened, and that's how this study became hugely famous. And it took 50 years, 50 years, for a French sociologist, Thibault Le Texier, to go into the archives and to actually find out that something very different happened in reality. I try to show many examples of that throughout the book, where a new generation of scientists actually is saying goodbye to this more cynical view of human nature, and doing, I think, much more rigorous research and arriving at a very different conclusion.

31:44 KS: What's another example?

31:46 RB: So another example is the bystander effect. For decades, psychologists believed that when something happens or there's a local emergency, someone's drowning or is attacked in the street, if a lot of people saw this happening, that the chance that someone would help you was rather low and actually it would go down if more people saw it happening. Because people were supposed to be like, "It's not my responsibility. I'm just gonna grab a coffee," or something like that. And I spoke to Marie Lindegaard, who's a Danish social psychologist. They built this huge database of real life incidents with real people who were being attacked in the streets. Turns out that in 90% of all cases, people help each other, and if more people see something happening, then the chance that you'll be helped only goes up because people find support in each other.

32:31 KS: In chapters related to the bystander effect that you mentioned, you write about empathy and how that connects people. But this connectedness also leads us to the idea of in-groups and out-groups, those we are connected to and not connected to, the idea of otherness. Can you talk a bit about how you covered this idea of how humans can see the other?

32:55 RB: In the book, I arrive at a quite paradoxical view of human nature. So on the one hand, we're one of the friendliest species in the whole animal kingdom. There's a wonderful evolutionary anthropologist called Brian Hare who literally talks about survival of the friendliest. So what he means is that for millennia it was actually the friendliest among us who had the most kids and so had the biggest chance of passing on their genes to the next generation. The scientific term for this is self-domestication theory. We domesticated ourselves. We became a bit puppy-ish over the course of our evolutionary history. I call this homo-puppy. But then there's a real dark side to this as well, and the dark side is our tribal behavior, our group-ish behaviour, is that there seems to be limits to this friendliness.

33:36 RB: So often the biggest atrocities are committed not in the name of sadism, people enjoy violence or anything like that, actually very often we don't, but in the name of comradeship, and in the name of loyalty, and in the name of friendship. And that is, I think, a really dark truth about who we are as a species. We've evolved to work together, to cooperate, and to be friendly. And sometimes this friendliness is exactly the problem because so often progress actually comes from

unfriendly people who are willing to go against the status quo, who are willing to be a little bit nasty and difficult and say what they really think or talk about the elephant in the room. So yeah, it's sort of a paradoxical view.

34:19 KS: As we potentially try to progress further as humanity, how do we work with these individuals who maybe take advantage of the trustworthiness and cooperation that we have to be able to gain power, and then use that power to feed back and continue their rise to more power? How do we trust them but also limit that ability to gain power?

34:45 RB: Let's put it like this. When elites look in the mirror and when they think about human nature, they often assume that other people are like themselves, that they're also corrupted by power, and that, for example, when there's a crisis that they will behave very selfishly. But that's not the case. Most people are pretty decent, but power corrupts. And I think that on those two fundamental insights that we have so much evidence for, that's what you should keep in mind when you design your institutions. Our human nature, or our view of human nature, tends to be a self-fulfilling prophecy. So if we assume that most people are selfish, then we'll design our schools around that idea, our workplaces, our democracies, even our prisons. And we tend to create the kind of people that our theory of human nature supposes. And the second half of my book is all about people who are trying to turn that around. So, who are trying to build different kind of schools, different kind of workplaces, even different kinds of prisons that assume the best in each and every one of us, and then so try to create a different kind of people.

35:46 RB: One of the most radical examples here is prisons, because it's relatively easy to assume the best in your friends and your co-workers, but if you can really assume the best even in people who did really nasty things, then that could be very powerful, and they're doing that in Norway. So what Norway has is this prison system where... Well, these prisons look like holiday resorts, where the guards have the freedom to socialize with the inmates and vice versa, and they make music together, they've got their own music studio, their own music label, which is called "Criminal Records". And you look at it and you think, "Oh, the Norwegians have gone nuts, they're crazy." But then you look at the scientific evidence, and it's really interesting. You first notice that they have the lowest recidivism rate in the world, the lowest chance that someone will commit another crime once he or she gets out of prison.

36:33 RB: And then you notice that the system actually turns criminals into citizens. The chance that they'll find a job goes up by 40% according to a really great recent paper by two American and two Norwegian economists. And it actually saves money as well, the whole system because obviously you have to spend quite a bit of money on these prisons, but then if you then have to spend less on healthcare, and the whole criminal justice system and the police and you name it, you save money. So in the US, you have prisons that turn citizens who've done a small drug offense, they turn them into criminals, like universities for crime. In Norway, you have the opposite. So that's what I mean about applying this view of human nature and putting it into practice. We shouldn't be dogmatic about it, so there are no blueprints, and should really experiment and see where it goes in different places. But I am very excited and hopeful about this new generation of entrepreneurs and reformers who are putting it into practice.

37:30 KS: At the end of the book, the last chapter, you say, "You know, I'm not into self-help

books, but here's some advice." What brought you to the point of realizing that maybe it was a good idea to give some advice?

37:42 RB: I didn't want to write a self-help book because I think that real change starts with different institutions, and it doesn't start with me, but with us building different kinds of schools and workplaces and you name it. But then I noticed that writing this book, that it sort of changed my own life a little bit. That, yeah, you just can't help but take a couple of lessons from all this research. And we already talked about one of them, I think, which is when in doubt, assume the best. Which is, I think, just a rational approach. Because most people are pretty decent and most people really mean well. But then, why should we assume the best even when in doubt? Well, in the first place, because most of the time we'll be right, and the second place, because our response could have what psychologists call a non-complementary effect. People often mirror each other, so if you wanna break a cycle, then someone that's nasty, you act with niceness, that may actually be contagious. And then in the third place, yeah, just accept the collateral damage. If you've never been conned in your whole life, then you should really ask yourself the question, "What's wrong with me? Should I see a therapist? Is my basic attitude to life trusting enough?"

38:43 KS: Yeah, I think that goes against so many people's natural grain. It makes you really reconsider your own preconceptions and biases and where you come from as a person. As a final question, I'd love to know if there's any message that you wanna share.

39:01 RB: Well, maybe the one final, and perhaps quite obvious thing, but important thing to keep in mind right now, is that not only this virus that we're dealing with is contagious, but our behavior as well. There's just so many evidence that kindness is catching. I love this term from Jonathan Haidt, one of my favorite psychologists. He calls it, "We're wired to inspire." That may sound a little bit cheesy, but isn't that an amazing fact about our psychology and our nature? That we can just see someone else from a distance, or even in a film when we're in an airplane or something like that and watching it, that we can be inspired by that and think, "Oh, God, I wanna help as well. I wanna do something. I wanna contribute." And I think that's the feeling that many, many people had at the beginning of this crisis, at the beginning of this pandemic. So much of the evidence we have from sociology about how people respond to natural disasters, we now have more than 700 case studies that show that you get an explosion of altruism. People from the left to the right, rich, poor, young, old, all working together. I think that's really important to keep in mind, to remember that you're not an island, that small acts can have big ripple effects throughout society.

40:10 KS: Thank you so much for joining me today.

40:12 RB: Thanks. Thanks for having me.

40:13 KS: And thank you for joining me for this interview with Rutger Bregman about his book Humankind: A Hopeful History. I'm Dr. Kiki Sanford, and I hope that you'll join us again for a peek between the pages of another science book.

40:26 SC: And that concludes this edition of The Science Podcast. If you have any comments or suggestions for the show, write to us at sciencepodcast@AAAS.org. You can listen to the show on

the Science website, sciencemag.org/podcast. You'll find links on the site to the research and news discussed in the episode. And of course, you can subscribe to the podcast anywhere you get your podcasts. This show was edited and produced by Sarah Crespi with production help from Podigy, Megan Cantwell, and Joel Goldberg. Jeffrey Cook composed the music. On behalf of Science Magazine and its publisher AAAS, thanks for joining us.