Mind & Life Podcast Transcript
Neil Theise – Everything is Connected

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Opening Quote – Neil Theise (00:00:03): *Where is the boundary of your body? At the everyday scale, it's your skin. So if we're sitting in a room, we're separate, aren't we? But at the cellular scale, we're shedding microbiome and exchanging microbiome with other people all the time. So the boundaries of your body are actually all the bodies you've come in contact with that day. At the molecular level, we're breathing out carbon dioxide, the plants take it in and breathe out oxygen. At the molecular level, your boundaries are the entire biomass of the planet. At the atomic level, you can think about us as the atomic mass of the planet, that over three and a half billion years organized itself into beings that misunderstand that they are separate.*

Intro – Wendy Hasenkamp (00:00:45): Welcome to Mind & Life. I'm Wendy Hasenkamp. My guest this time is medical pathologist, Buddhist meditator, and complexity theorist, Neil Theise. Neil's pioneering work in human anatomy is shedding new light on interconnectedness, both in the body and beyond. In today's conversation, we start out with his work on the interstitium, which is a physiological, body-wide communication network that we're only just beginning to understand. You may have heard about this in the news in the last few years being described as a "new organ," although the reality is much more nuanced than that, which Neil explains in the episode. And as you'll hear, the implications of his findings around the interstitium, take us well beyond conventional Western views of the human body, providing bridges to other healing traditions and systems such as fascia, meridians and acupuncture, and even possibly chakras, subtle energy, and more.

(00:01:47) Neil has also delved deeply into the world of complexity theory, which we get into here as well. And he draws beautiful parallels between those ideas and the Buddhist concepts of emptiness, impermanence, and interdependence. I feel like even the way Neil talks about his work reflects his deep understanding of interconnectedness—showing how life and work and history and emotions, and the many realities of being human on this planet are all interwoven.

(00:02:16) Make sure you give this one a thorough listen, because we go in a lot of different and fascinating directions. And if you're interested in Neil's work, definitely check the show notes for more resources, including his latest book, *Notes on Complexity.* I really hope you enjoy this, and come away with some new insights about the many ways we're all interconnected. I'm really happy to share with you, Neil Theise.

Wendy Hasenkamp (00:02:42): It's an absolute pleasure to be joined today by Neil Theise. Neil, welcome and thanks so much for being here.

Neil Theise (00:02:48): Oh, thank you for inviting me, Wendy.

Wendy Hasenkamp (00:02:51): I always like to get started with a little bit of context and background from the guests to understand how it is they came to be doing the work that they do. And often that's a very wandering and complicated path. But for you, how would you contextualize how you came to be interested in and studying medicine, and also Zen Buddhism, and the many things that you think about?

Neil Theise (00:03:15): Well, those are really kind of sad and pathetic questions, or rather the answers are. All right, so I was in freshman year of college, it was a Tuesday, and I was starting to realize and name the fact that I was gay. And my imagination of that on this Tuesday morning was that that meant I would never get married, and never have any children, and would live alone and be lonely. And if I continued on my then particular path, I would become a rabbinic scholar. And if I lived long enough, I would become a dusty old rabbinic scholar. And when I died, the only other people that would be at my funeral would be other dusty old rabbinic scholars, unless I outlived them, in which case no one would come to my funeral. *[laughter]*

(00:04:16) And that morning, my mother called me and said Dr. Robinson—who was the OBGYN for whom she worked and who delivered my brother and I—that he had died on the golf course of a heart attack that morning. So the next day, Wednesday afternoon, she called me up after the funeral and I said, "How was Dr. Robinson's funeral?" And she said, "It was amazing. All of Hartford came out for his funeral." And I thought, if you go to medical school, people come to your funeral! So that's why I went into medicine. *[laughter]*

(00:04:53) So Lulu Miller, Radiolab, when they interviewed me and they asked me about this, and she said, "So most people go to medical school because they want to help people. But you went to medical school because you wanted people to help you," which embarrassed me because it was absolutely true. But then I revised it and said to her, "What I wanted was to have meaningful connection in my life, and helping other people would allow me to have meaningful connection." I recognize that. So yes, it was not particularly altruistic, but the altruistic imperative was part of the equation. So that's why I went to medical school.

(00:05:33) And then first year of medical school, it was the Reagan era, student loans were 23% interest for medical school, and they started compounding as soon as you signed the loan. And it was in the loan contract that they could go to your parents if you defaulted. So three months in, I realized, "That was a really bad reason to go to medical school." But it was too late, I couldn't afford to leave. And so I stuck with it.

(00:06:00) It was very hard. In college, I avoided being depressed over being gay because I just kept incredibly socially active. So I distracted myself. And in medical school, it wasn't possible to do that anymore. And I hit a really bad point—first year, was up on the George Washington Bridge, ready to jump. Couldn't do it because I thought, "It'll kill my parents!" So then I climbed down and thought, "I'm going to be alone the rest of my life!" So I climbed back up, "Oh, I'm going to kill my parents!" I went up and down a few times, and then ran off the bridge and the next day started in therapy. And then finally went into psychoanalysis four times a week on the couch during medical school because I thought that was the best way to become straight. I had a good analyst who didn't make me run away by suggesting I

get used to it and allowed me to come to that on my own. And within three and a half years, I'd come out to my parents, and I met Mark, who's now my husband, the day I came out to my parents and-

Wendy Hasenkamp (00:07:08): Oh wow.

Neil Theise (00:07:09): Yeah, yeah. So it all worked out in the end. But I was stuck in medical school. I failed a year, largely because of all this, and had to repeat it, second year. (It was a high drama decade, my 20s.) So I had a summer off when all my classmates were going on into the hospital wearing their white coats, becoming baby doctors. And so I realized that if I came back after a summer away and saw them with all their confidence, it would really be a problem for me. So I wanted to stick around and watch. And I got a job in the pathology department.

(00:07:47) I never would've thought of doing pathology, because in medical school back then, you didn't get a sense of what the practice of pathology actually was. It was just this course you took, which was okay—the pathologists were really dynamic, best teachers in the medical school. But I realized I loved looking at slides. But I had gone to medical school so people would come to my funeral, so this was at cross purposes. I was also thinking about psychiatry, I was very good at it (it turned out, being on the other side of the couch), and I thought about pediatrics. But then realized by the end of third year: do what you love. And I'd left the other reasoning behind, so I became a pathologist.

Wendy Hasenkamp (00:08:32): That's awesome. And do you want to say anything now about Zen Buddhism or does that feel like a different path?

Neil Theise (00:08:36): Oh yeah, well, that's easier... but also kind of pathetic. *[laughter]* I grew up a child of Holocaust survivors. My father was born in Germany and was sent to England when he was 12 on the Kindertransport five days before World War II started and never saw his parents again, and they were killed in the war. His brother survived. The Kindertransport was the British in 1938 and '39, paying the German government for 10,000 German Jewish kids, and they were rescued and brought to England just on the eve of war. My father was one of them.

(00:09:14) I grew up in a community of Holocaust survivors. My synagogue was founded by German survivors. I was very spiritually motivated when I was a kid, and I grew up in a family with a very rich Jewish practice, and I was very attracted to it. I was thinking about becoming a rabbi for a long time. And when I was 14, the current girlfriend of one of my father's cousins, they were visiting and she saw that I was an obsessive, nerdy reader. And she gave me a copy of a novel by James Michener called The Source about a place in Israel where there's an archeological dig. And as they go down through the dig, they find objects, and that opens up a chapter on that era. So it goes back like 3,000 years.

(00:10:05) And there's a chapter on the 15th century in a place called Tzfat in the Galilee, which was the major home of what has become modern Jewish mysticism. So through this, I learned about Jewish mysticism. It was not accessible to secular, middle class, nerdy, gay kids. But the way it was described, and then I started doing some more reading, this idea that people could have a mystical experience that would lead to some kind of unity with God, whatever that means, through which they could have God's perspective, is the way I imagined it. And it occurred to me that if you could accomplish that, then maybe from the God's eye view, suffering—the Holocaust—could make sense.

(00:11:04) So I started having this ambition to be a mystic, to relieve my suffering because of the Holocaust. But at the time, I mean now Jewish mystical practice is available, but it still wasn't even when I was in college, not significantly. And a friend gave me this book, *The Three Pillars of Zen*, which

described enlightenment experiences like people's firsthand reports. And I thought, "Oh, this is similar to stuff I've read in the Jewish mystical literature."

(00:11:36) And I thought Zen seemed kind of agnostic, just the pure practice. So that's why I turned to Zen. I was looking for a contemplative practice. Jewish mysticism wasn't available at the time. I discovered Buddhist practice through a book on Zen, and Zen seemed doable. And so I started meditating on my own. But I didn't really seriously enter a stream of practice until '88, which was the year after I met my husband. And he said, "You know, you have a meditation cushion, but you don't sit on it very often, and you're always talking about becoming a serious Zen student. Well, the New York Times has this getaway weekend article, and one of the things they talk about for an easy getaway in New York state is Zen Mountain Monastery, a Zen beginners weekend." And I was like, "Okay, I'll go." And I did. And it was... you know, nothing with me is ever easy. So it was a little bit of a fraught beginning, but that's how I began my Zen practice. And now it's 36 years later and I'm a senior student at the Village Zendo in New York City.

Wendy Hasenkamp (00:12:54): Awesome. Well, yeah, it'll be great to hear how all these things kind of weave together as we get into your work. Maybe we can start—I had a hard time figuring out where to start because you have such diverse interests, and I want to talk about all of it—but maybe we can start with your work on the interstitium. And maybe it would be good to just contextualize a little bit what the interstitium is... I know you've talked about different scales of it and what was known before and what are the parts that you've contributed.

Neil Theise (00:13:22): Yeah. So 'interstitium' means the stuff in between basically, the interstices. The stuff like the cement between bricks, you could call an interstitium, the grout between mosaic tiles. In biology, we talk about an interstitium as being tiny little spaces that exist between some cell types that don't fit tightly together. Most cells, when they have contact with a neighbor, it's a very tight junction and there's nothing comes between them. But there are some cells "by design" that have spaces with a little bit of fluid between them; it's part of how they function. And so that's an interstitium.

(00:14:06): And then the major interstitium that people have been studying for many years—though it's not a huge field, there aren't a lot of people who have studied this, it's hard to study, I think that's part of the issue—are the spaces around capillaries. So capillaries are the tiniest blood vessels that bring blood and nutrients into a tissue, and the nutrients like oxygen or amino acids, things you've eaten and digested, proteins, sugars, lipids, et cetera, they move out of the capillary and they have to get to the cells of the tissue. And so there's this space (although it's not really empty), there's an interstitium between the capillary and the cells of the tissue. And so nutrients come in and then waste products from the cells have to leave the tissue, and they go out, like carbon dioxide. They move across the interstitium into the capillary and get carried out either to the kidney, the liver, or the lungs for release into the environment as waste products.

(00:15:06) So those are the interstitia that people have talked about. And one of the other primary features other than this molecular transport of nutrients and waste products is that the fluid that flows through it, enters into lymphatic vessels of the lymph system that goes to lymph nodes. And when we talk about lymph, which fills the lymphatics, the source of lymph is the interstitial fluid. The fluid flows in. So this is a definition of interstitium, is that it's the pre-lymphatic space.

(00:15:42) And whether these things are in connection to each other or just little pockets in their individual little spaces doesn't seem to have been a particular question that people studied. The question people studied primarily was, how does stuff move across that space? What controls nutrients

coming in, waste products going out, and to a limited extent when there's disease, how does that change?

(00:16:07) And an example of how that can change is when you think of women who have had breast cancer and have had lymph nodes removed from under their arm and their arm swells up—what we call lymphedema, which can become quite a problem—it's filling up with fluid because the lymph nodes are no longer there to drain fluid from the interstitium. And so presumably this fluid is collecting in the interstitium. But even that's never been well understood, and it hasn't been something people have explored very much. You know, how do you develop a model of it or how do you study it in living tissue?

(00:16:45) Now, scientifically, I had no intention... The only science that didn't interest me when I was a kid.... I mean that's what I really wanted to do was quantum physics or cosmology. That's really where I wanted to be headed in high school. So I've been reading physics, and that comes back importantly into a lot of what we'll wind up talking about. I've been doing physics since seventh grade, really—quantum physics and relativity. But biology didn't interest me at all. I went to medical school, not because I liked biology, it's because I wanted to rescue myself. And so I didn't think about becoming an academic doctor. I wanted to have a clinical practice.

(00:17:24) But going into pathology, you're sitting at a microscope. Every act of assessing a biopsy, you know, is this breast biopsy cancer or not? Is this polyp removed during colonoscopy a premalignant polyp or a benign thing you don't have to worry about? These sorts of questions are research questions. And the research material is human tissue. Most researchers, if they want to see what's going on in tissues, they have to study mice or rats or whatever. But I'm just gifted every day by mountains of glass that I have to go through. And the scientific urge that had been there when I was a kid woke up. Because you can't look at these tissues, normal and diseased, and not start to ask, why does it look like that? Or, why does it look like that at this point and then when you come back later, it looks like this?

(00:18:25) And then by chance, in my residency, I was still at Columbia, my main mentor who was a liver pathologist, I didn't know this, but he was planning on taking a sabbatical year to write an opera. *[laughter]* See in pathology, it's not surprising to get people who do many things, which is another reason why I think I...

Wendy Hasenkamp (00:18:48): It's a good fit.

Neil Theise (00:18:49): Yeah, it was a good fit. So they asked me in my second year of residency, if during my third year, I wanted to go to London to become a liver pathologist, to study where he studied. This is actually a story that's all tied up with the AIDS epidemic, which was another thing going on at the time. The vice chair of the department was dying of AIDS, and one of his primary passions was running the residency program and training resident pathologists to become pathologists. And I was one of his admissions to the program. And the chairman, his name was John Faniglia, when it was clear he wasn't going to be surviving much longer, every one of his last entering residents got a gift. My gift was to be sent to London for six months to learn liver pathology. And fortunately, he survived until I came back and he could see the result, but he died a short time after.

(00:19:48) And when I got home, it turned out, that's when they told me, "Oh, the reason we wanted you to do liver is Jay Lefkowitch," who was the mentor who was going to write the opera, "he's going away this year, your senior year of your residency, and no one wants to look at the liver biopsies. So you have to look at the liver biopsies." And suddenly, as a senior resident, I'm the liver pathologist for Columbia Medical Center. *[laughter]*

Wendy Hasenkamp (00:20:11): Right.

Neil Theise (00:20:12): So looking at liver slides, having a subspecialty and becoming sort of hypersensitive to the tissue. One of my models, Barbara McClintock—Nobel Prize winning geneticist, remarkable woman—there's a fabulous book that introduced me to her, sort of an intellectual biography of her called *A Feeling for the Organism*. And she described how she worked with corn plants and when in the genetics field, everyone moved to Drosophila flies, she was like, "No, I still want to work with my corn plants," because she had developed a feeling for the organism, she said, and didn't want to surrender that.

(00:20:51) So I developed a feeling for the liver. And it's not surprising, she was probably a Buddhist meditator, so contemplative practice was part of her thing too. And during this time, I'm now starting to become a meditator myself. And when you're sitting at a microscope, what is that but contemplative practice? And the practice of liver pathology in particular, the liver has such a limited array of changes that it can go through that it's easy if you're told the history is one thing and you believe it, you might miss some subtlety that tells you, "No, no, no, that clinical assessment was wrong. It's actually this." So it's the only organ that I'm aware of where we're trained to not look at the clinical history first.

Wendy Hasenkamp (00:21:37): Because it could mislead you?

Neil Theise (00:21:39): Because it could mislead you. So it was already training in beginner's mind.

Wendy Hasenkamp (00:21:43): Yeah, very cool.

Neil Theise (00:21:45): And so that's been my professional practice of a lifetime. And so when I look at slides, I've been trained to just be open to what's there. The interstitium stuff happened because I was a liver pathologist in the Department of Gastroenterology at Beth Israel Hospital in New York because they wanted their own liver pathologist in their offices so that their clinical fellows, trainees, could be taught by me in the room next door to where they sit. I was an investment in their education. And so I looked at all the liver biopsies for the medical center, and their trainees got to see whatever they wanted. Pathology residents would come to me too, but the fellows were right next door.

(00:22:30) And the head of Endoscopy and his main disciple at the time had this new endoscope. And they knocked on my door one day and said, "We have seen something in the wall of the ducts of the liver and the pancreas that doesn't make sense, and we were wondering if you could tell us what it is." They showed me the pictures they had taken. And this worked by injecting a fluorescent dye into a vein, and within seconds, all the fluid spaces of the body fill up. And looking in the wall of the ducts, there were all these fluid-filled spaces.

(00:23:03) Well, if you look at a slide of that tissue, there are no spaces there. If you look at anatomy drawings and textbooks going back a hundred years—because sometimes in the old literature, they saw things and then it gets lost—no one had seen it. It was like the wall was spongy and filled with fluid. Why? Ooh, science question. But who cares about the bile duct? *[laughter]* I mean, I care about the bile duct, but really it's not a big thing.

(00:23:32) What we figured out is that in the living tissue, the wall of the bile duct... on the slide, let me start there. On the typical slide of the bile duct, the wall of the bile duct is this dense layer of collagen. You know, it's the connective tissue, the glue that holds everything in the body together. So the wall of

the bile duct, which keeps the bile duct structure so it can do its jobs, looks like dense connective tissue. But because it's so stiff, collagen, when you slice it very thin to make a microscope slide, you get cracks in it. And you just learn that those are artifacts and you look past them. You don't really see them.

(00:24:09) In the living tissue though, which they were looking at with a microscope at the tip of their endoscope, what they were seeing was that the wall of the bile duct was this open meshwork of collagen fibers supporting these fluid-filled spaces through which the fluorescent dye was going. So the question was, why would the bile duct need to be spongy and fluid-filled like this? And again, it wasn't an exciting question to me. I mean, I was doing stem cell research. I was already doing my complexity theory. Really? But okay, I try to support my colleagues.

(00:24:44) But then, I was more of a general pathologist back then, and I saw, I was looking at colon specimens and stomach specimens that had been taken out for cancer. And the same layer that we were looking at in the bile duct is much more expansive and complex in the larger organs, but there were the same cracks in the tissue. So I thought, "Wait a second. Maybe this isn't a bile duct thing. Maybe it's a digestive tract thing. The entire digestive tract has a surprisingly spongy wall." But their scope couldn't look into that part of the... The reason they saw this in the bile duct is because the bile duct is so thin, their scope could see into this layer. It was the only part of the body where you could do that.

(00:25:24) So it was getting more interesting. And then a few days later, I got a mastectomy specimen from a woman with breast cancer, and there's nearly always a bit of skin that they take with that. And when I was looking at the slides from the skin, there were the same cracks. So wait a second, it's not just the digestive tract, it's the skin too? So I went back to them and I said, "What happens if you put the scope on the skin? Do you see the same pattern that you see in the bile duct?" And they said, "We don't put it on the skin. It's an endoscope. It's built to go inside." And I was like, "Well, can you put it on my skin?"

(00:26:04) And so, we took me to the scope room and injected me with a fluorescein dye. And inside my eye, at the top of my nose, my skin was thin enough that they could see into the dermis past the epidermis, and there was the same pattern as they saw in the bile duct. And so, now we knew if you see cracks in collagen-

Wendy Hasenkamp (00:26:25): On a slide...

Neil Theise (00:26:26): Right, that you can assume the living tissue actually has these spaces. And those cracks aren't artifact, they're remnants of the spaces when the tissue collapses, because when you take tissue out, it dehydrates and the spaces collapse. So what are these fluid-filled spaces?

(00:26:44) So to cut a long story short, what we figured out was that everywhere you see collagen in the body, you have these cracks, meaning all the collagen layers of the body are fluid-filled, and we know that that collagen network through the body spans the entire body. So what is this? Is this a weird kind of blood vessel we've never seen before? Some kind of liquid vessel? Is it a lymphatic? Is it a blood vessel? Is it something else? We didn't know. But then what became clear is that it was the pre-lymphatic space, in part because you could see tumor cells marching through it into the lymphatic vessels.

Wendy Hasenkamp (00:27:23): Oh, and so this is the way that tumor cells can spread through the body?

Neil Theise (00:27:27): Right. So number one, wait a second, there's a way that tumor spreads that we didn't know about? Not a small question. Number two, this proves that it's a pre-lymphatic space, which means it's an interstitium. And then my collaborator on most of my interstitium work, we brought her in for her bioengineering and biomechanical skills, Becky Wells, who's at University of Pennsylvania. She's a hepatologist by training, a liver doc, but she's a basic scientist of extraordinary skills—she's a cell biologist, a molecular biologist, a specialist in biomechanics. I mean, there's really nothing she can't do. And what she figured out is the spaces, they look empty on the slide, but they're actually filled with a molecule that most of your women listeners will recognize: hyaluronic acid.

Wendy Hasenkamp (00:28:22): Oh, yes.

Neil Theise (00:28:23): Right, because you're supposed to "put it on your skin to prevent wrinkling." Well, hyaluronic acid is a molecule that can make these huge complexes and hold water, and it's kind of like JELL-O. And so it turns out these spaces are filled with hyaluronic acid, which filters rapidly flowing water and small molecules that can get through if they have the right charge. So there's molecular signaling going through here. So that fluorescent dye they could inject into the skin, it spread through this space because that's how fast things move through the fluid of the body. But it's like JELL-O.

(00:29:03) So it turns out that the way one solid can filter another solid, think of how a sieve can filter flour or sand, a viscous fluid can filter a less viscous fluid. In this case, hyaluronic acid kind of JELL-O can filter water and molecules that are going through it. So this implies other functions. But you can stain for hyaluronic acid in tissue slides, and so by doing so, we can map where these spaces are and how they connect to each other.

(00:29:37) And the next paper we published—and this is the big step forward—is that in fact, this scale of interstitium within the connective tissue spans the entire body. It's a communication network through which cells can travel, molecules can travel, electrical signaling can happen through it, both along the collagen bundles and through the hyaluronic acid. And it's a communication network in the body that's four times the size of the cardiovascular system.

Wendy Hasenkamp (00:30:12): In terms of volume?

Neil Theise (00:30:13): In terms of volume, fluid volume. It's four times the size of the cardiovascular system.

Wendy Hasenkamp (00:30:16): Wow.

Neil Theise (00:30:16): And we think of the cardiovascular system as being pretty big. This is four times as big, and yet we've never looked at it. And so this is what we now know the interstitium to be. There are three scales of interstitium. They are all interconnected as a body-wide network. And we're just starting to figure out how infection spreads this way, how cancer spreads this way, but also what's the normal physiology of every single organ?

(00:30:44) People are like, if we're talking about the liver, "Well, what's different if we acknowledge that the liver has an interstitium?" Well, everything. It's 25% of the fluid volume of the liver and we've never thought about it, we've never studied it, we've never looked at it. Obviously, that's one thing I'm doing, and we're finding fascinating, unexpected things.

(00:31:10) So that's the interstitium. We published this in 2018, the first paper, and not in the paper, but in an interview with the PR people from NYU (I had moved to NYU by this time) I said, "Well, it's so large, and it sort of fulfills some of the definitions of what makes an organ. So is this potentially a new organ system?"

Wendy Hasenkamp (00:31:33): Like the way the skin is an organ?

Neil Theise (00:31:35): Right, and the liver is an organ, and the cardiovascular system is an organ. You can have organs that are localized like a heart and a kidney, or you can have organs which are distributed like the nervous system and the skin. So it would be that kind of organ.

(00:31:51) There was no other science news that week. *[laughter]* Really, really. Stephen Hawking had died two weeks before. Had he died this week, no one would've heard about this paper, and I probably wouldn't have followed it up much. But there was no other news. So suddenly our paper came out, the press release came out, and a week later, NYU said to me that they estimated that 3.8 billion people had seen the news of the new organ. Taxi drivers in New York City, three times, looked in the mirror and said, "You're that new organ guy!"

Wendy Hasenkamp (00:32:24): Oh my goodness. So yeah, I heard the Radiolab that you were referring to on this, and I actually recognized your name from long, long ago at the Mind & Life Summer Research Institute, which we'll come back to because I totally want to get to that. But yeah, so I was like, "Oh my gosh, I know that guy." So there was a lot made of, as the media does, this being like a "new organ."

Neil Theise (00:32:48): Right.

Wendy Hasenkamp (00:32:49): And I know I've also heard you say this kind of pushed you into conversations with folks who had been studying this kind of a system, maybe without the molecular or the kind of histology way that you're doing it. So can you share a little bit about the conversations that you had with different traditions that have been looking at this?

Neil Theise (00:33:08): Yeah. So the first thing that happened was... Another way to talk about all this connective tissue is to refer to it as fascia. Now in Western medicine, allopathic Western medicine, we use the term fascia pretty much to refer to the tissues covering the skeletal muscles of your body, the muscles of your body. It's the filmy tissue between your muscles. That's the musculoskeletal fascia.

(00:33:35) But there are people, there's a whole world of fascia out there, including osteopaths, which is a Western tradition of medicine from the last century, but is very different in how it views the human body in terms of fluid and dynamics and mechanics. And they talk about fluid channels throughout the body, though they aren't well described by them histologically, anatomically under the microscope. And then there are people who do craniosacral work and Rolfing.... and I've been Rolfed. My yoga teacher was also a Rolfer, and I got the whole series. And when we would talk about her Rolfing my fascia, she said, "Well, I can feel the fluid in it." And I'd say, "There's no fluid in it. I can show you in the microscope. There's no fluid there." And she said, "I can feel it." And I was like, "We're just going to have to agree to disagree." And then when I saw this stuff, I of course called her up, and I put musculoskeletal fascia in the paper for her. So that's in our first paper.

(00:34:36) So fascia world lit up saying, "Well, we've known about this for 70 years. This is nothing new." So they invited me onto an interview on the radio with basically the king and queen of fascia. And I was brought on, everyone expected... apparently there was a really big audience, as much as the fascia

world gets an audience, because people thought this would be a big take-down. But it wasn't because I'm like, "Wow, you knew about this too? Why don't I know that you knew about this?"

(00:35:08) The reason I didn't know about it is because while I looked in the traditional literature using our traditional search engines to find other examples—and there are scattered references to it, but nothing coherent—these communities have been talking about it for 70 years, but they haven't published in scientific peer-reviewed journals, probably because they weren't allowed to publish. So they publish in books, and they talk, and then post the modern age, they make videos. So they've been talking about this stuff over there where I couldn't hear it. And that was my fault I couldn't hear it.

(00:35:48) So I was very apologetic and they were like, "Oh, this guy seems nice. Is he really nice or is he just putting it on?" So they invited me to that year's biannual International Fascia Congress in Berlin, and the queen of fascia, Carla Stecco, who's become a very dear friend and collaborator, gave the plenary talk before me. And that world is not like other scientific communities. She gave her talk and it was like a rock star. They were on their feet cheering, and I thought, "Oh my God, I'm coming next and they're going to hate me." But I started off by apologizing and saying, "I feel like I've been wandering around in a forest, and suddenly I've stumbled into this meadow to find all of you who have been having a picnic that I wasn't aware of. Thank you for inviting me." And then I showed them what we'd done, and I apologized and I thanked them. And I got a rock star welcome. So ever since then, I've been working with these people.

(00:36:51) Now at the same time, I was doing liver research in China, because liver's big in China. So a whole other side of what I do is how scarring happens in the liver, cirrhosis develops. And it turns out we thought that that only ever progressed, but now we know it can regress, and that's another one of my areas where I'm very active. So I was there when this happened and they said, "Would you mind giving us a talk on the interstitium since it's in the news?"

(00:37:20) And someone I knew who was a liver doctor, but I didn't know he was the director of the Traditional Chinese Medicine version of NIH for China. And so he was given the first questions because of who he was, and his first question was, "So what's the reaction been to this kind of thing?" And I said, "Well, there was a lot of hostility and anger at first because they've known about this for 70 years and been talking about it for 70 years." And he laughed and said, "Yes, and we've been talking about it for 5,000." In China, they saw this work and immediately recognized, this is what we've been talking about.

Wendy Hasenkamp (00:38:02): With like with meridians?

Neil Theise (00:38:04): Meridians and acupuncture and energy healing practices, and, and, and. This is the stuff we've been... like my Rolfer could feel the... Just because they didn't know what it looked like under the microscope, they had a very, the way really sophisticated healing body workers, whether they're craniosacral, Rolfing, myofascial release, it doesn't matter, healers who have this extraordinary sense of touch and perception about human bodies, and subtle electrical currents. Practitioners in other cultures of health and healing have that kind of sensitivity and have seen all this with their fingertips, with their energy fields, and were able to recognize it immediately.

(00:38:53) And that's one of the exciting things to me about all this. I had started to work towards a program that got interrupted by COVID. My dream is to get 12 to 15 very high level practitioners of different 'cultures of health and healing' as I like to refer to it—Japan, China, Australia, someone from every continent. And I've done a lot of interdisciplinary work, and to get really robust creative exchanges, less than 12 people, it's just conversation. There's not a lot of creativity, and this is a

complexity theory sort of thing. Too few people, you don't have enough diversity of interaction or of information. More than 15, it starts to become people lecturing to an audience. But around 12 to 15, something else happens and there's creativity.

(00:39:51) So my idea was to have 12 to 15 people from all these different traditions, high up enough so that if they come back from this meeting with new information or new ideas, they will be heard with respect and interest. And start the meeting off, the first day there's no communication. We just have treatment rooms and set up a schedule so that everyone gets to experience three or four other people's practice of bodily interaction. Then the second day, Becky and I present what we now know about the interstitium. And then what follows is everyone saying how they think this anatomy and physiology reflects what they've been talking about in their culture. And just see what happens.

(00:40:40) – *musical interlude* –

Wendy Hasenkamp (00:40:41): I have a question that's emerging as you're talking. So you're saying these skilled practitioners of other traditions can feel the fluid and the interstitium that you've been talking about. Do you think they're feeling it with their interstitium? Is it a communication?

Neil Theise (00:41:29): Well, how could they not be, because their interstitium is a part of their body. How is their body sensing our body? And this gets us into the nature of the body, which becomes a complexity theory question. But just a short little dip in... Where is the boundary of your body? At the everyday scale, it's your skin. And so if we're sitting in a room, we're separate, aren't we? But every level of scale... At the cellular scale, we're shedding microbiome and exchanging microbiome with other people all the time. At the cellular level, the boundaries of your body are actually all the bodies you've come in contact with that day. At the molecular level, we're breathing out carbon dioxide, the plants take it in and breathe out oxygen. At the molecular level, your boundaries are the entire biomass of the planet.

Wendy Hasenkamp (00:42:19): Because we're exchanging all of these atoms, basically?

Neil Theise (00:42:22): Right. If you say, this is my CO2 molecule and you track it, when does it cease being yours?

Wendy Hasenkamp (00:42:31): Right.

Neil Theise (00:42:32): So at the atomic level, you can think of us as lonely, anxious people walking around on this rock we call planet Earth, or you can think about us as the atomic mass of the planet that over three and a half billion years organized itself into beings that misunderstand that they are separate. At the quantum level, where are your boundaries? It's the universe because there's non-locality and entanglement.

(00:42:58) Let's just make it simpler, the electromagnetic level, which is a quantum phenomenon. So your body has an electromagnetic field, my body has an electromagnetic field. My Rolfer comes into the treatment room to meet me, and our electromagnetic fields merge into a single field. I think there are people who have a sense of that, and you know when you're working with someone who, they're a healer. They've trained the same way as other people, but there's something different. What is it that makes them different? I don't know, but here's one possibility. Maybe they feel their electromagnetic field and can use it to probe yours and see where something is misaligned or off-kilter or weak or too strong or unbalanced.

(00:43:48) I had a physical therapist... Well, I have a congenital hereditary condition called Ehlers-Danlos syndrome; my collagen is screwed. So that's why I needed a Rolfer. And so I have a lot of physical therapy and my body does very strange things, and my back, just knots appear and disappear. And we would often start a physical therapy session, I saw him for years, I'd be facedown. And he'd start by reaching forward to put his hand on my back as he'd ask, "Where are the problems now?" And his hand would reach the spot where the problem was before I could answer the question.

Wendy Hasenkamp (00:44:29): Yeah, I've had that experience too.

Neil Theise (00:44:31): So yeah, for years, I pondered the weird question of, how could someone map the meridians and the acupoints? Did they put pins over every millimeter of the body looking for effects? You can't. How could they possibly...? And now I understand, no, if you just close your eyes, you have a sense of energy flow in your body. And if you're really good at it and you're really subtle, you can feel it. I now have learned how to slightly be aware of my chakras.

Wendy Hasenkamp (00:45:01): Yeah. I've heard you talk about how the structure of collagen and the way that it is arranged can cause bioelectric signals to happen. And so can you share a little bit about how that might relate to energy, chi, that kind of stuff?

Neil Theise (00:45:17): So there's something called piezo crystals, which are materials that if you move them, like bend them or shake them, they generate electrical current. Or if you put electrical current through it, it starts to move. Collagen, when you stack it up enough, becomes a piezo crystal. How much? The thickness of the collagen bundles of the interstitium. So that means whenever you move and your collagen moves, then it's generating electrical current. There's an electrical current through your body that's generated independent of the nervous system. That's going to create an electromagnetic field.

(00:45:57) What is the three-dimensional, or in time, four-dimensional structure of that electromagnetic field? Is that what chakras are, for example? Does this relate to meridians and acupoints? I'm not sure it does with meridians and acupoints. I think that's a different interstitium thing, but we're just starting to look at that. But there has to be a large-scale structure to this electromagnetic field, which we know exists. So why do we pretend otherwise?

(00:46:28) And the strange thing about the interstitium, it becomes a linguistic and cultural interstitium. So suddenly people can hear each other across because now they have a way of conceptualizing in their own terms what the other people are talking about.

Wendy Hasenkamp (00:46:46): Between these traditions that have been looking at the body.

Neil Theise (00:46:46): Yeah.

Wendy Hasenkamp (00:46:48): Yeah, that's fascinating. I'm remembering, so you gave a talk recently at Grand Rounds at the Osher Center up at Harvard, which is how I came again around to your name, and I was like, "Oh, there's Neil again! I need to have him on the podcast." *[laughter]* But in that talk, you laid out a way of attempting to visualize the interstitium by kind of overlaying all of these systems.

Neil Theise (00:47:12): Sure. Do you want me to take you through it?

Wendy Hasenkamp (00:47:13): Yeah, just because, I don't know, for me, that hits home of like, how can we even conceive of this in our bodies?

Neil Theise (00:47:20): Well, and that's always my question. People worry when I come to talk to them, "Am I going to understand what you're saying?" The only way I really, really grok something deeply is to have turned it into something I can understand. That's what the work is. It took me years to understand how complexity theory works, so now I can teach it to fifth graders because I had to do that for myself. So with the interstitium, how do you imagine this? I can imagine the cardiovascular tree. There's the heart and all the arteries going out and the capillaries and the veins coming back.

(00:47:54) So let's do this. Listeners, please close your eyes. *[laughter]* And in your mind's eye—no, no in your body—imagine where your heart is and the way the arteries come off your heart, travel out to the body, distribute to the capillaries and every tissue, and then collect back together again to the veins, which become big vessels, which come back to the heart. That entire structure is ensheathed in collagen, which contains interstitial spaces. So that's a part of the interstitium you can imagine.

(00:48:32) Now imagine the central nervous system and the peripheral nervous system stretching out from the brain, the skull, through the spine, out to the body, and then the sensory nerves coming back in and going up the spine and into the brain. That's all ensheathed in connective tissue and collagen. So that has an interstitium. Now interweave the cardiovascular interstitium and the nervous system interstitium. It's tricky, but you sort of can do it.

(00:49:02) Now, take all the visceral organs, which are covered by collagen and have collagen layers distributed through them, through which penetrate all these nerves and all these blood vessels. That all has an interstitium, and it's all interconnected. So merge all that. Now take all the musculoskeletal fascia, the tissues around every muscle and every bone of your body and add that to the whole system. And then take your skin, the dermis of which is a continuous interstitium, which interweaves with your nerves and your arteries and your veins and connects to everything else, and add that. And now you start to get a sense of how this thing we'd never seen could be four times the size of the cardiovascular system.

(00:49:59) In the living tissue, it is fluid-filled, dynamically and robustly, but when we take tissue out of the body to study it, that fluid drains away, we fix the tissue with formaldehyde chemicals to make it stiff enough to make a slide out of, and we lose all that stuff.

Wendy Hasenkamp (00:50:21): Yeah. It's making me think. I've heard people comment on, in speaking of Chinese medicine systems and meridians and things like that, the reason that in Western medicine we don't have those concepts is because we've studied dead bodies instead of living bodies, which is just what you're talking about.

Neil Theise (00:50:37): Right, bingo! Or dead pieces of tissue. And because of this happenstance of me being in a GI division—when is a liver pathologist in a division of gastroenterology?—with these people who happened to have an experimental endoscope, and we happened to be in a suite together, and all this unlocked. I remember the moment they came into my office. The senior one looked in the door, "Neil, can we ask you a question? I'm here with Petros." I remember that moment. And then I got up from my desk and went, and they showed me on their cell phone, the picture. And I was like, "I don't know what that is. That makes no sense." And my life changed.

Wendy Hasenkamp (00:51:19): Yeah, that's such a moment.

Neil Theise (00:51:21): And lots of people's lives are changing because of that question.

Wendy Hasenkamp (00:51:26): That's very cool. It's also making me think how much the view that has given us Western medicine, in its reductionistic sense of like, "Well, the cells are the things that we care about, and the spaces between are meaningless. That's just the 'glue,' or the space." No one has been really paying attention to that and it really lifts up the importance of the in-between spaces, like writ large, instead of chunking out things.

Neil Theise (00:51:56): Well, that's one of the nifty things. So this has led to... what you were just saying about, there's a social interstitium. Right? That's kind of what you were saying. And there's a woman named Jen Brandel who saw the article about the new organ. She's a remarkable woman who... it's really hard to say what she does. She works in social systems, she works in journalism, she works in democracy practices, she works in economics. And she heard what I was saying about the interstitium, and she said, "That's what I am. I'm an interstitial being. I go into organizations or cities...." Like, Chicago had a very successful COVID response, because I don't know the circumstances, but somehow she came in as a consultant to the city, and she explained to them how to weave services across the private and public sectors to create a unified response. She's come up with an economic system with some friends of hers who are similarly interstitial that has now been adopted by Japan as their economic modeling system. So she's the person who interviewed me for Radiolab, and she wrote an article tied to the Radiolab thing about this notion. And she's actually planning autumn next year to have a gathering of people to discuss social the interstitium and what it means to be 'interstitiary.' Which is kind of what you do, right?

Wendy Hasenkamp (00:53:32): Yes, actually, now that you're talking about it, it is often how I've conceptualized... I've always loved to be in between disciplines, in between traditions. To me, that's where the juice is.

Neil Theise (00:53:45): Right. Literally.

Wendy Hasenkamp (00:53:46): Yeah, literally. *[laughter]*

Neil Theise (00:53:48): Yeah, both energetically and fluidly. But we typically in our culture, throw that away. In fascia world, there's this brilliant anatomist named John Sharkey who leads these really, really extraordinary human anatomy labs around the world. He just travels around the world and 15 or 20 people get to come in contact with a human cadaver and dissect it.

(00:54:14) But he makes the point, and it's true, when I was in medical school, what did we do? We stripped off the skin and then we stripped off the connective tissue to get at the structures we were trying to memorize and name. We threw that stuff in a bucket. No! Why would you throw anything away? It's part of the problem—and here we go into the complexity stuff—that our predominant model for bodies and biology, since Newton to some extent, but certainly since the Industrial Revolution, is that these are all machines. And it's just the wrong metaphor.

(00:54:55) I sort of had an intuitive sense of this, going back 25 years ago now, when I started doing stem cell research. So looking at my liver biopsy slides from the transplant patients and seeing what was going on in those livers as they repaired themselves or adapted, I realized I could figure out how to prove that the liver had stem cells. Because back in those days, now it's commonplace, every organ has

stem cells. 25 years ago, only the bone marrow, the skin, and the GI tract had stem cells. But it was my team that showed that the human liver had stem cells.

(00:55:33) And that led me into an art-science collaboration because a friend of mine was a curator academically in England, and he had this friend named Jane Prophet who he just wanted me to meet; he felt we'd get along great. But whenever I was in London, she was out of town. Whenever she was in New York, I was out of town. So we got a grant from the Wellcome Trust to have Jane and I meet three times and record our conversations of how an artist and a scientist would talk to each other.

(00:55:58) And I was talking to her about how cells move around the body, how stem cells move around the body, because I was part of that crowd that was showing adult stem cells, from the bone marrow for example, could leave the bone marrow, travel to other organs, and become skin cells or heart cells or whatever. And this was my first viral scientific discovery back in 1999, 2000.

(00:56:22) So I'm explaining this to Jane, and she tells me... In my book, *Notes on Complexity,* this is actually the author's note at the beginning for how I got into this as a liver pathologist. It's because of Jane Prophet and this online art project she had called TechnoSphere, which I don't have time to go into. But resulting of that, she was familiar with concepts of artificial life in computer programming, and complexity theory. And she said, "The way you talk about cells moving around the body sounds to me like the way some people, people who do complexity theory, talk about slime molds or how ants build colonies." And I said, "What's complexity theory?"

(00:57:05) And complexity theory is sort of the 20th century (now 21st), I think it's the third most... What are the other two biggest scientific theories of the 20th century? Quantum physics and relativity. This is the third one, because quantum physics describes the most infinitesimal, relativity describes the largest scales. But where we live as living beings, where our planet lives as an ecosystem, is somewhere between those. Complexity describes what's between those. So it's the science that describes how life comes to be, how life evolves and adapts and changes, what life is.

(00:57:48) And through meeting Jane, I started to study complexity theory and this idea that cells are like ants building a colony. Ants interact with each other through pheromone signaling and through touch, to figure out... Not to figure out—because no one's figuring out anything. It's all a bottom-up sort of thing. There's no top-down organization that determines that, "We need a food line to go from this sugar cube to the colony. I want you guys over there looking for the next sugar cube." That doesn't happen. It's just ants moving around signaling to each other.

Wendy Hasenkamp (00:58:19): And it emerges.

Neil Theise (00:58:20): It emerges, and it's called an emergent property or an emergent structure, or just plain emergence. It's sort of like magic. How do people... I'm looking out my window from my 14th floor New York City apartment, and I can see the sidewalk and the patterns. You know, there are people on their phones, there are people thinking deep thoughts, there are people who are anxious and worried and not paying attention, and yet no one bumps into each other. How does that happen?

(00:58:48) When you're in an elevator and someone moves into the elevator and you shift your position, why and how? Until you get too many people in, you always move—you'll never stop noticing this now—you'll always move to minimize the amount of distance you have to move in order to maximize your distance from the other people in the elevator. Until you have too many, and then there's just no way, and then you just have a crowd.

Wendy Hasenkamp (00:59:19): Then you're smushed. *[laughter]*

Neil Theise (00:59:20): Right. So that's a complex system. So cells interacting with each other have molecular signaling, contact signaling. We know all this stuff. This is what I look at and study. And interacting with each other, they make a liver, they make a heart, they make a body. They make an embryo that turns into a fetus, that turns into a neonate, that turns into an adolescent (God help us), and then becomes old. Complexity describes all that.

(00:59:50) – *musical interlude* –

Wendy Hasenkamp (00:59:50): The first time I ever encountered you was at the very first Mind & Life Summer Research Institute that I attended, which was in 2008.

Neil Theise (01:00:19): Which was my first as well.

Wendy Hasenkamp (01:00:21): Yeah. And you gave kind of an impromptu, unplanned talk in the evening, and it was about complexity theory, and you were describing some of these ideas. And you're also bringing in what you mentioned earlier about that there aren't any boundaries. And thinking about the boundaries of the skin, and... That was the first time that I had ever been exposed to any of those ideas. I was very new to all of this. So it completely blew my mind. So first of all, I really want to deeply thank you for sharing that because it was a huge trajectory shift for me. But I think it was the first time that I ever started to question the solidity of me, as a self. And I think that's part of what you bring into all of your discussions around complexity is, at least through one lens, there aren't any boundaries. So can you just kind of dig into that a little bit more and the way that you think about it?

Neil Theise (01:01:14): Yeah, sure. So talking to Jane and pondering this stuff, out of that experience and the pondering, I started to think, okay, you're walking along the desert floor and you see this dark shape in the distance, and maybe it's moving and shifting, but it looks like a thing, and you don't know what it is. So you walk up to it and look, and at some point you get close enough and realize, oh, it's an ant colony. It's not a thing at all. It's just a phenomena arising from ants interacting with each other.

(01:01:46) Well, thanks to Jane, I'm now seeing bodies made of cells as the same thing. So these things that I call ants, if I go in more closely, the ant disappears. The ant body disappears. If I go into my body closely, my body disappears. And it becomes a community or a flock or a colony of cells that are interacting with each other. So is my body a thing or is it cells? Is my body a thing or is it a phenomenon?

(01:02:13) And this just became this Zen koan (I'll let people look that up if they don't know what it is), that I could not let go of. And I'm walking around all day long thinking, "Is my body a thing? There must be a way to decide this. Is my body a thing or a phenomenon?" And I got to the corner of, I think it was 20th Street and Park Avenue, and there was a stoplight. So I stood there, "Body or cells? Body or cells? Body or cells?" And then the light changed and people stepped off the curb. And I couldn't move, because I had become a flock of cells. My leg had become a flock of cells. And then I could move.

(01:02:53) And a few weeks later, I was alone in the Zendo. I was the opener on Thursday mornings, and back then, there wasn't necessarily someone else in the morning. And so I was sitting there, and again, I wasn't doing my Zen practice, "Body or cells? Body or cells? Body or cells?" And at one point, caught up in this, I looked... (I'll get choked up with this one too.) I opened my eyes for some reason and looked at the altar and saw the incense stick turning to smoke, and had this direct experience of, "Neither bodies

nor cells, both bodies and cells. Stick or smoke, body or cells, everything is empty." This is what emptiness is. Are you a thing or a phenomenon? You're not a thing, you're just a phenomenon. But you are a thing, but you're just a phenomenon.

(01:03:50) So I took this to my Zen teacher and I said, "Is this emptiness?" And she goes, "Yeah." And I said, "Really?" She goes, "Well, yeah, it's simple. It's just not easy." *[laughter]* But then I was left with the dilemma, so this was my Buddhist practice driving my scientific inquiry. Number one, this was the moment that my spiritual practices and my scientific practices, which I never had any interest in talking to each other, suddenly collapsed into one thing. High drama moment. Part of why I get choked up when I talk about it.

(01:04:21) But if this is truly about Buddhist emptiness, then it isn't just about cells. So are cells things? You said it, our culture, Western medicine and biology are based on cell doctrine, all living things are made of cells and all cells come from prior cells. One implication of that is we dismissed all the non-cell stuff, the interstitium. The other thing is that our whole medical system and biological understanding is based on cells as these bricks. But are they things? Well, no, at the fluid level, they're just molecules bumping into each other, like ants in a colony floating in water. So cells have no inherent existence. Well, what about the molecules? They're just atoms. What about the atoms? Subatomic particles. What about those?

(01:05:13) Well, it's not an infinite regress, and this is where I went at that Mind & Life retreat. Whatever the smallest things are, whether they're strings or loops or particles or fields, that's not settled. What is settled is that at the level of space-time, space-time is not smooth. Space-time is rough. And there is a smallest unit of time and a smallest unit of distance—the Planck length and the Planck time. And space-time is not a vacuum, it's not empty, which is how we've always pictured it, as 'empty space.'

Wendy Hasenkamp (01:05:52): Yes, right, nothingness.

Neil Theise (01:05:54): It's an energy-rich field, and that's a quantum mechanics thing. It is necessarily full of energy. And relativity, E equals MC squared, that energy gives rise to mass. And usually it does so in matter-antimatter pairings. And so they come into existence and they immediately annihilate. Those are called virtual particles. But sometimes they don't. And if they don't, then they persist. And whatever those smallest things are coming out of—and this is called the quantum foam—whatever those smallest things are that are popping in and out of existence in the quantum foam, if they persist, they can interact with each other, giving rise to subatomic particles, giving rise to atoms, giving rise to molecules, giving rise to the entire universe as one single vast, complex self-organizing system. There is no thingness anywhere. So that's emptiness of inherent existence.

(01:06:50) And interdependence, well, at the quantum scale, nothing is separate from anything else. As I was saying before, boundaries—at the quantum scale, what's the boundary of our bodies? The edge of the universe. We are all one seamless self-organizing complex system. Now you also said something really key: but we look like things at this level of scale. You can always choose a perspective in which thingness will be seen, will emerge.

Wendy Hasenkamp (01:07:24): Right, it's based on the lens that you look through.

Neil Theise (01:07:24): Yeah. So depending on scale, perspective, the mistake we make is thinking that the scale we like best is the one that matters most.

Wendy Hasenkamp (01:07:33): Is real.

Neil Theise (01:07:35): And this is complementarity, from Niels Bohr. And when people hear complementarity, they think about: is light waves or particles? And Bohr said it's a complementarity. Depending on your perspective, depending on the experiment, you will either see the light properties, the wave-like properties of light, or you will see the particulate properties of light, but you can't see both at the same time. Bohr intuited that this was a universal principle, it was not just a quantum physics principle, and believed it so strongly that he put what he took to be a symbol of complementarity—the yin yang symbol—and put it in his coat of arms, and it's on his tombstone.

(01:08:17) Working with my physics and Kashmiri Shaivist collaborator on all this, Menas Kafatos, what we realized is that both are equally true. There is no way to favor one view over another view. So while it is true we are separate, it is always explicitly, expressly, actually true that we are a seamless whole. The parts of the universe are the whole, there are no parts. Every part is the whole. And so that's interdependence.

(01:08:59) And there's a curious thing about the math of complexity. How do ants form a colony? Well, if every ant is always doing the same thing like a machine, if the food source runs out, they're going to keep running back and forth even though there's no food source. But there's always some number of ants, some limited randomness in a complex system that allows it to explore new ways of being.

(01:09:22) And so Stuart Kauffman, friend and mentor, I knew of him from afar before I got to get to know him, and he okayed that I'm talking about this all correctly. He's one of the founders of complexity theory and the preeminent thinker of biological systems and life as complex systems.

(01:09:41) So if you have too much disorder in an ant colony—or the cells of your body, cancer—you don't get any emergent properties of adaptive structures, like a food line. There's too much disorder. But if you have too little randomness, then when the food source runs out, every ant would be following the line. They wouldn't know how to change, know what to do. So there's always a few ants that aren't following the line. Those are the ants that are most likely to find the next food source while these ants are busy. There's nothing special about those ants, then those ants become the beginning of a new food line and some other ant is off doing the divergent, creative stuff.

Wendy Hasenkamp (01:10:21): A little bit off to the side.

Neil Theise (01:10:24): Yeah. So you need this low-level randomness in the system, this low-level unpredictability in the system, and that's what generates the ability to creatively adapt of living systems. You have to have that little bit of randomness.

(01:10:39) Now, talking mathematically, you might think that we can plot a graph of order in the universe, and here's where complex systems lie, and this complex system—this ant colony or my body—is this point in this area of this graph of order in the universe. But you can't do that because of the limited randomness. It's always going to be moving... Complexity mathematically exists, you can think of it as between fractal chaos and perfect order, like billiard balls or crystals. Complexity lies at the boundary between those two kinds of order in the universe.

(01:11:19) So you might think you could plot a complex system to a point in that space, but because of the randomness, it actually moves around in that space. And given enough time, inevitably, it will

wander out of that space into fractal chaos or rigid order, and you will have a mass extinction event of the complex system.

Wendy Hasenkamp (01:11:42): The system will collapse, in one way or another.

Neil Theise (01:11:43): The system will collapse. That means that the thing that makes us alive, creative, and adaptive necessitates that we die. There's no escaping this. You can mitigate mass extinction events, you can postpone them, you can prevent this one from happening, but there will be another one. And that's Buddhist impermanence.

(01:12:04) So this model of the universe as a complex system, when you take into consideration quantum physics, relativity, and complexity gives you all of Buddhist metaphysics. Is that an accident? Is that a happenstance? So then I turned to the Jewish mysticism stuff I knew and realized, "Oh, Jewish mysticism asked different questions than Buddhists, so they have different structures for how they describe the universe, but it maps just as well." And this is sort of the culminating parts of the book. That's where I ended my talk at Mind & Life.

Wendy Hasenkamp (01:12:43): Yes, which again, was so generative. Maybe just as we're wrapping up here, I've also heard you speak to how some of these ideas around interdependence and connectedness and no boundaries can kind of give us resilience in this time, which does feel like a collapsing time… of many things.

Neil Theise (01:13:08): Sure. Well, we're in the middle of mass extinctions. I mean that is happening as we speak, and we know that. The question is how much can we mitigate? How much can we prevent? One thing to think about is that [with] every mass extinction in a living system, new forms arise. We don't walk around in grief for the 25 to 35% of Europe who died during the Black Plague. But the way that changed European culture gave us the Renaissance and gave us our modern culture, so... You know, poor dinosaurs, that asteroid... we got mammals.

(01:13:45) So this is where I wrap up the book, because I realized... Mark, my husband, and I went out for an evening with some friends and we had some drinks. One of our friends is in his mid-20s and drank a bit and got a little disinhibited and started to let loose his anger at our generation, Mark's and mine, for how we left him to grow up in a world that is such a disaster and might come to an end. And I realized if my book didn't say something about that, then why even bother?

(01:14:26) So in thinking about that, I realized a couple of things. One is that I survived two mass extinction events. I grew up, as we discussed at the beginning, in a community of Holocaust survivors. And there were survivors I knew who survived with great resilience and capacity for joy and generosity, and there were those who were broken forever by it. What was the difference between them?

(01:14:53) And growing up as a gay man, coming of age in New York City during the AIDS era, I knew so many people who on their deathbeds were filled with anger or fear or regret, and died really hard deaths. But I also knew people who died with incredible grace and equanimity, taking care of the people around their deathbed when they were the person who was dying. What's the difference? And how do you be one person versus the other?

(01:15:29) I think that there are practices such as Buddhist contemplative practice—but there are not just contemplative pathways, there are paths of service, there are devotional paths, paths of study—that bring one to a sense of, "Oh, I'm not just me. No, I don't end at my skin," that reveal the truth of

interdependence and emptiness in whatever terms you put them in. And that if you have that sort of awareness, then you know things end. You know that there is nothing permanent, that it is the nature of existence to change. And every moment you're losing everything you had while you gain everything else you have in the next moment. So there's that. But that takes effort and that takes time. How do you develop all that?

(01:16:24) So that's one thing. Another thing which came out of talking to people about my book and complexity in sustainability world, I never really thought to bring up this story, but it's turning out to be a central piece of the narrative that's important for people.

(01:16:43) So my father's parents were killed in Riga. That's where most of the German Jews were sent to be killed. And a few years ago, I went there and visited. None of my family had ever been there, and I just always felt this really strong urge. There's this Jewish prayer that one says at grave sites for the dead, and no one had ever been there to say this for my grandparents.

(01:17:08) And when I went there, I discovered so much detail about what happened. I know the time of their arrival on the tracks. I know the temperature on the tracks. I know the path they walked from there to the ghetto. I found the house in the ghetto—because it was just a working class neighborhood they fenced off, the buildings mostly are still there—I found where my grandmother lived with way too many cousins in this little space. I found where she was killed in the forest.

(01:17:35) And it suddenly hit me, standing there over her grave, mass grave, few thousand people buried there, who was she in her last moment? She had sent my father off to England, had no idea what had become of him, said goodbye, and knew he didn't understand what was going on and sent him away. She thought with my grandfather of sending his older brother away to Amsterdam, but didn't. And as a result, he was in a work camp in Riga. With my grandfather, who now had died, but she didn't know that, she just knew that, "I'm about to die and I don't know where any of my children [are], and where my husband is. We made all the wrong mistakes. We didn't try to get out of Germany." I think that's who she was at the moment she died.

(01:18:30) And immediately, I had this really deep sense of, that I feel I met her, that I knew her. But what she didn't know is that the reason I'm here is because she sent my father to England. The reason my uncle survived the work camp is because had she sent him to Amsterdam, he probably would've been sent to Auschwitz and been killed. Not sending him to Amsterdam meant he was in a work camp and had the chance to survive, and wound up in Poland after the war and had children. She was the only one of her siblings and her cousins who didn't lose a child. So she made the right decisions, but she died not knowing that.

(01:19:18) And I think what that tells us in a time like this is number one, you have to make decisions, you have to make choices. And you have to make them as best as you can. And you have to make them with no expectation of knowing what the outcomes will be. And you have to make them with no expectation of ever knowing what the outcomes may be, because you may not be one of the people who survives the extinction event. But it may be something, some tiny thing you did in your little 'divergent ant' way—it may not be the people who are making big plans for changing society and preventing climate change—it might be how you held a door open for somebody in the morning and said hello that starts a chain of events that leads to some extraordinary change. So there's that. This is science, these are necessary implications of complex life. This is what it is to be alive. So... so there.

Wendy Hasenkamp (01:20:29): Wow. Thank you so much, Neil. This is, I mean, so rich and so deep, and it's leaving me with a sense of how much... it's so hard to put into words, but how interconnected we are, and because of that, everything that we do matters in some way.

Neil Theise (01:20:52): Yeah, everything we do matters.

Wendy Hasenkamp (01:20:55): Yeah. So anyway, I really want to thank you so much for all of your work in these many domains and for being who you are in the world, and thank you so much for sharing your wisdom with us today. This has really been wonderful.

Neil Theise (01:21:09): Thank you, Wendy.

Wendy Hasenkamp (01:21:14): *This episode was edited and produced by me and Phil Walker. And music on the show is from Blue Dot Sessions and Universal. Show notes and resources for this and other episodes can be found at podcast.mindandlife.org. If you enjoyed this episode, please rate and review us on Apple Podcasts and share it with a friend. And if something in this conversation sparked insight for you, let us know. You can send an email or voice memo to podcast@mindandlife.org.*

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