

Erin Welsh

Hi, I'm Erin Welsh and this is This Podcast Will Kill You. You are listening to the latest episode in our TPWKY Book Club series. In this series, which is one of my favorite things about making the podcast, we interview authors of popular science and medicine books, asking them all sorts of questions from 'how did you get the idea to write this book?' to 'what are your thoughts on the show The Last of Us, like how accurate is it?' and a whole lot inbetween. If you'd like to check out the full list of TPWKY Book Club books, those we covered last season, the ones we've covered this season so far, and the books that we'll be featuring later on this year, check out our website thispodcastwillkillyou.com where you can find a link to our bookshop.org affiliate account under the EXTRAS tab.

Once you click through to Bookshop, you can find a bunch of TPWKY book lists, including of course our Book Club books, nonfiction books and memoirs we use in our regular season episodes, and disease and epidemic themed fiction books. Which by the way, if anyone has any suggestions for more of those, please send them along. Send along also any thoughts you have about this book club series so far, which book has been your favorite, any questions you wish I had asked, any recommendations for other books to feature in future episodes. Whatever your thoughts are, we'd love to hear them. And one last thing before I introduce this week's book and that is if you're enjoying the podcast, please take a moment to rate, review, and subscribe. It really helps us out. Okay, now on to the book of the week.

Environmental journalist and award winning author Dan Egan joins me to chat about his recent book 'The Devil's Element: Phosphorus and a World out of Balance'. I'd wager that for most of us phosphorus doesn't factor into our everyday thoughts or vocabulary. But this element holds in it the key to life as we know it and thus the power to ensure our continued survival or map the path of our ultimate collapse. And that fork in the road is rapidly approaching, where we either decide to deal with the massive phosphorus imbalance we have or just let the clock run out and see what happens. Not to be dramatic or anything. But seriously this is not a problem that's just going to go away without intervention. But what is this problem? Like what do I mean by phosphorus imbalance? Great question.

Phosphorus is an element found in all living things. It helps to make up our DNA, our bones, ATP, and without it life would not be possible. As a resource, phosphorus is hugely important as a fertilizer and is widely used around the globe in agricultural settings, helping us maintain the enormous global food supply we need. Overuse of the element has led to this paradox where overexploitation of phosphorus for use as a fertilizer is leading to a global shortage at the same time that too much phosphorus in agricultural runoff is polluting waterways, promoting toxic algal blooms that have tremendous implications for ecosystem and human health. When we think of wars fought over natural resources, past and potential, oil or water probably springs to mind before phosphorus would. But that might just be the future we're facing.

In 'The Devil's Element', Egan takes readers through the past present and possible future of phosphorus. He shares the fascinating story of when phosphorus was first discovered and how it earned its devilish nickname. He tells the tale of Peru's quote unquote "inexhaustible" guano islands and the lessons we should have learned from them. He explores the impacts phosphorus has had on the Great Lakes and traces the increasingly frequent algal blooms in freshwater across North America to ethanol production in the Midwest. And he ends the book by turning to possible futures determined by our relationship with phosphorus. What might happen if we fail to correct this phosphorus imbalance and permit its continued overuse? How can we begin to bring the scales back into balance and give ourselves more time to recapture phosphorus from the most polluted areas. 'The Devil's Element' is an eye opening and gripping read that will have you wondering how on earth we're not all talking about phosphorus all the time. So let's get to talking about phosphorus right after this break.

TPWKY

(transition theme)

Erin Welsh

Dan, thank you so much for being here today. 'The Devil's Element' was such a fantastic and eye opening read and I am so excited to dig into this overlooked but incredibly important, essential really, element phosphorus.

Dan Egan

I'm happy to be here. Yeah.

Erin Welsh

So starting right at the beginning, what is phosphorus? Where is it found? What do we use it for?

Dan Egan

Well phosphorus is an element but it's not really found as an isolated element in nature. It's always bound with oxygen atoms to create phosphates and phosphates are really the backbone of our whole food system. It is a critical fertilizer that humans have become addicted to over the past 200 years. And it's worked miracles on the croplands. But the problem is we only have so much of it and we're burning through it at an unsustainable pace. And that's gonna have consequences on our food supply in the coming years and decades. Decades, I would say. But it has immediate consequences right now because we're using it, overusing it to such an extent that we're fouling our waters. Because it's not good at just growing soybeans and kernels of corn, it also when it hits water grows algae and increasingly it's spawning outbreaks of toxic algae. It's like we turned on a gusher and we can't really turn it off now without causing a lot of pain and suffering across the planet. At the same time, we should be able to control the flow much better to eliminate the downside of phosphorus and enhance the upside. And the upside is it puts food on our tables.

Erin Welsh

How did you first become interested in phosphorus and like this phosphorus paradox and the monumental problems that the world is facing with this element?

Dan Egan

I was like everybody else. I didn't know how to spell it, I didn't know what it was. But I was doing some research for a book that came out in 2017 called 'Death and Life of the Great Lakes'. And one of the chapters in that book dealt with Lake Erie and its history, how it was declared America's Dead Sea back in the 1960s and how we resuscitated it with basically the Clean Water Act. And what the Clean Water Act did was it put the screws to industries that were polluting the lake. And the big problem at the time was detergent, synthetic soap. It was largely in the 50s and 60s, when you buy a box of Tide or whatnot, it was almost a box of phosphorus. And once they figured out that that was causing Lake Erie to turn distressingly green and killing much of the aquatic life, they decided to do something about it. And so when I was doing this research, I was like whoa. The Great Lakes book was largely a product of like 10 or 12 years of reporting that I did at the Milwaukee Journal Sentinel. And I enjoyed doing that book. But I kept thinking boy, it'd be fun to write a book from scratch. And when I came across phosphorus, I thought well I'd love to do a book on it. I ended up doing that and it was quite a challenge but it was enjoyable as well.

Erin Welsh

So you mentioned the Clean Water Act and how powerful it was in that it really did kind of slow the progress of pollution in some areas. But as you point out in your book, this act included a giant loophole for agriculture. Why was that loophole left in? And what consequences did or does it continue to have?

Dan Egan

Well it made sense at the time because once they figured out that our waters from coast to coast and really around the world were turning green because of we were overdosing them with phosphorus detergents, which would just flow right through the wastewater, whatever wastewater treatment plants existed at the time, and into the water. So once we realized what was going on, that really spurred the Clean Water Act and they came down heavy on industry because that was the major polluter of phosphorus at the time with the detergents. Agriculture was largely left alone because in regulatory parlance they were referred to it as point source and nonpoint source. And point source is basically anything that comes out of a pipe or a smokestack. And the Clean Water Act and the Clean Air Act really required that we stop polluting wantonly from these pipes and smokestacks. And if not eliminated completely, then severely limit the amounts that we were discharging. And that worked and it worked really well for a couple of decades.

Agriculture was left alone because they thought this nonpoint pollution, which is basically stuff just coming off the landscape, was too diffuse and not significant enough to really warrant some heavy regulating. But that was in 1972. And 50 years later, we farm a lot differently than we did at that time. And I'm gonna talk specifically here about the CAFOs, the concentrated animal feeding operations or factory farms. It used to be that a herd of 100 cows was a big deal. Well now I live in Wisconsin, America's dairy land, it's not uncommon to have 8000 or 10,000 head of cattle. And they do more than produce milk, they make manure and they do it just like milk every day and it's gotta go somewhere. And historically the rule of thumb is it takes an acre to sustain a cow. And this is the beauty of the phosphorus molecule is it doesn't go away. So in simple terms, a cow in a pasture would eat grass, the cow would poop, that poop would have phosphorus from the grass in it and it would replenish the cropland. So it was like a virtuous cycle, a never ending loop. Cow poops, grass grows, cow eats grass, cow poops, and on and on and on and on.

Well we don't have the acreage to sustain these, that's why they call them concentrated feeding operations. They're basically today, the cows aren't typically out in pasture, they're in a barn being fed grains from wherever and the amount of manure that they create is substantial. It's bogglingly huge. A rule of thumb is one cow produces about 18 times as much waste as a human. The difference is human waste goes through treatment and largely cow manure just goes on the land, whether the land needs that nutrient infusion or not. And if it's overdosed, it does what everything else does, it flows downstream when it rains and it ends up in our water. As I said before, then it's not growing crops we want but it's growing toxic algae.

Erin Welsh

And I want to circle back to some of these downstream effects and the consequences of these algal blooms and so on. But I kind of want to talk about the title of your book as well, 'The Devil's Element'. Where does that name come from? And does it relate to when people first recognized the significance of the substance? There are so many good little stories that you share in your book about this name and sort of the magic of phosphorus.

Dan Egan

Yeah. It's been called the devil's element for centuries. And more recently people think of it because it was the 13th element discovered back in I think it was 1679 in Hamburg, Germany. And it was discovered by an alchemist who was trying to isolate the philosopher's stone, this mythical material that they believed at the time could transmute base metals into silver and gold and platinum. And the idea at the time was that all metals are slowly evolving to a more precious state and what we need to do is just find out what's causing that evolution and speed it up so you could turn lead into gold and get rich. So this guy, his name was Hennig Brand, operating out of Hamburg, Germany in the late 1600s, he thought it could be derived from the human waste stream. So he did a lot of tinkering. And these guys were serious laboratory operators at the time. I mean they had equipment that we can't even replicate today in terms of how high they could keep heat for weeks on end. We can do it on an industrial scale but we don't have the earthenware today that they did.

And so through a bunch of urine and a bunch of hocus pocus, he eventually baked out of the human waste stream these waxy, glowing nuggets. And this was phosphorus. It had been cleaved from its oxygen atoms and it was in its elemental form. And it was a real bewitching substance at the time because it glowed in the dark and if you like smudged it on a wall, you would leave a streak that glowed in the dark. But unfortunately if these little nuggets, not much bigger than like a marble, heated to just above room temperature, maybe 80 °F, they combusted and burned ferociously hot. And that's really where it got its name, the devil's element. And there was really no practical application in the late 1600s or early 1700s for this, other than it was just a curiosity. It didn't turn anything gold. Turned out urine can't turn anything gold. Maybe a snow bank but that's about it.

So it just became a curiosity for a while and then as how it goes with humanity, we eventually figured out how to weaponize it. And at first we were using it as match tips. Lucifer match tips. That may be another reason for the term devil's element. But eventually we made bombs with it, firebombs, incendiary bombs. And coincidentally, Hamburg, which is phosphorus's hometown, was basically burned to the ground in 1953 by the Allies dropping incendiary bombs that were largely made of phosphorus. And so the name persists today because the stuff is dastardly. When those bombs dropped in the 1940s, they would burn through anything that they hit, whether it was a roof of a home or somebody's skull. I mean it was really, really bad stuff. But if it hit water, it stabilized immediately.

And so it looked like fireworks, when you just see those globules just kind of coasting from the clouds down into... I had a 4th of July celebration, that's what it looked like. But when it hit the water, it wasn't like ash that just disappeared. It solidifies and stabilizes. And so unfortunately today, it looks a lot like amber. And the region around Hamburg is rich with amber because it used to be a conifer forest and all the resin over time, it became amber. So there's long been amber hunters on the shore of the Baltic Sea or the Elbe River. And sometimes what people grab and think is amber is not. It's one of these unburned chunks of phosphorus. And they put it in their pocket and boom.

I opened the book with a guy who was beachcombing on the Baltic Sea and he picked up what he thought was a fossilized oyster shell and put it in his pocket and his pant leg just exploded, or his pocket just burst into flames and he had to go into the sea, and this was December, to put the flames out. And every time he came back out, it would flare up again. And they were gonna take him away in a helicopter but they thought he'd take the helicopter down. They didn't know what was going on. And they finally took him away in an ambulance packed with wet towels and he survived but he sustained burns to about 40% of his body.

And it doesn't happen every day but it's not uncommon, you can google it and there's warning signs on the beaches and on the river banks in that region of Germany to stay away from things that look like amber. They're using it, they use it today too. It's not supposed to be used as an incendiary bomb. It burns so hot and so brightly that it's used to illuminate the night sky or to create smokescreens. It's not supposed to be dropped on people. But it is and the consequences of that are horrific. It'll burn to the femur and then some. And through a skull. And yeah, the devil's element.

Erin Welsh

Let's take a quick break. We'll be back in just a few.

TPWKY

(transition theme)

Erin Welsh

Welcome back, everyone. I've been chatting with Dan Egan about his book 'The Devil's Element: Phosphorus and a World out of Balance'. Let's get back into things. As you mentioned, we talked a little bit about this phosphorus paradox where there's both a shortage and an overuse or pollution issue. And in your book you discuss some of the issues with the shortage and what will happen as the world runs out of its phosphorus supply. What are some of the estimates for when that might happen, either within the US or just the globe?

Dan Egan

Well let me rewind just a little bit to just explain that ever since we've discovered it, we've craved it. And we've found new sources and we've inevitably run out of those sources. I mean it started in antiquity when farmers just intuited that you put certain stuff on crops and it makes them grow better and commonly that was manure, animal and otherwise, humans included. But there was only so much manure in the 1600s. So the British, they were really under the gun to keep their crops productive because it's an island nation with limited croplands. And they eventually figured out that bones, and they didn't know why, but bones worked really well. And that propelled them into some really weird places including... So the Battle of Waterloo was in 1815, I believe. And in the 5 and 10 years after that, the British went over and looted that whole battlefield. They haven't found any bones. They found one set of remains, it was like a curiosity, a few years ago. But it's just been widely held that there are no bones at Waterloo because the British took them back to England, ground them in these specially built mills, and spread them on the crops to grow turnips and wheat.

But there's only so many bones to go around. So then we chased after new substances and turned out bird poop is a spectacular source of phosphorus. And that sent the British and later the United States to the western coast of South America to these desert islands off of Peru that are just basically mountains of dried bird poop. And at the time they thought that there were so many of these islands and mountains of bird poop that it was an inexhaustible resource. And we're talking like the 1840s-1880s. By the 1880s-1890s, we'd run out of it and that sent us on the hunt for more. And now chemists were involved and they had figured out that it was phosphorus so they could just find phosphorus-rich material and use it as crops. And that led us to sedimentary rock deposits. They're relatively scarce and they're scattered around the globe. And that's what we've been relying on ever since like say the 1880s-1890s.

And in the United States, our main deposits are in Florida. And we are on course, we're burning through them at such a pace that we could run out in three decades or four decades. At that point, we're going to be dependent on other countries for our nutritional security which is a big deal. It's probably a bigger deal than energy security because there's workarounds to oil but there is no workarounds to phosphorus. It's in every living cell on the planet. There's no phosphorus, no life, no crops. And it just so happens that 70%-80% of the known reserves left are in Morocco in the occupied territory of Western Sahara. And that's a pretty volatile place right now and could become more so as countries like the United States and others start scraping for phosphorus to put on their crops to feed their citizens.

Erin Welsh

In addition to the these Peruvian guano deposits, and it does seem like at least in recent decades there's been like restoration of some of those areas where hopefully there can be a more sustainable cycle of this. But there's also been exploitation, not just of phosphorus as a natural resource but of people that live in these areas where phosphorus is located. And you shared one of these stories in your book. Would you mind taking us through that again?

Dan Egan

Yeah. Well the indigenous people of the Western Sahara, they are a nomadic people and had been for a long time and were all the way up until the 1970s when Spain opened up a phosphorus mine, a phosphate rock mine on their land. And then Spain pulled out real soon thereafter and Morocco occupied it and has controlled the mine ever since. And much of the native population of the area has been basically warehoused in these tent camps. They were supposed to be, we're talking over 100,000 people, it was supposed to be a temporary situation when Morocco came down and occupied the territory in the 1970s, right, mid 1970s. And the native people sought refuge in nearby Algeria. And it was just, at the time the thinking was just let's hold tight and we can go back home in a matter of months. And I talked to a young woman whose mom was born in the camp and whose grandmother was put in the camp when she was in her teens, I believe. And so you've got generations and generations of these people growing up exiled from their land.

And nobody really had an interest in that land until they found the phosphorus. And so there was a low grade war that went on from the mid 1970s to the late 1990s. And the UN brokered a very fragile piece that is kind of fraying. Now there's been guerilla attacks on the mine, more specifically on they built the world's largest conveyor belt, it's about 100 kilometers long, to take the product from the mine across North Africa and out to the Atlantic where it could be put on boats and shipped around the world. So this stuff is incredibly valuable. And it forces people to do things to each other that they otherwise wouldn't. And it's an old story for humanity but this is one that not enough people know about. They think about climate change, they think about oil deposits but they don't think about rocks, special rocks in the ground that really sustain the modern agriculture system.

Erin Welsh

Yeah. It's funny to think of when phosphorus first being discovered, people had hopes that it would turn substances into gold. But it seems like as valuable as gold in some situations or even more so.

Dan Egan

Absolutely. Absolutely. But it has its downside which we've talked a little bit about. I mean it's a life accelerant and we don't want all of that life, specifically we don't want these blobs of toxic blue-green algae that are getting worse almost by the year because climate change is warming up the waters and this stuff loves phosphorus and loves warmer weather. And they're getting both. And they also feast on the extra carbon in the atmosphere. So this isn't a problem that's gonna go away on its own by any stretch of the imagination.

Erin Welsh

Reading about these quote unquote "inexhaustible" supplies of phosphorus in certain areas and then just how rapidly we burned through them, it seems like we're not learning that lesson. Like over and over again, the same things are happening. And maybe this is more of like a philosophical question that can't be answered or the answer is just this is what humans do. But why do you think we haven't learned the lesson that inexhaustible doesn't really exist?

Dan Egan

Well because it's been relatively like these deposits, like the bird poop and like the bones and like the manure, it just seems like you have an inexhaustible supply but you don't. We're hitting a cap every time we think we find something new. I don't know, I think it's because it's been relatively accessible. But those days, at least on our side of the planet, are coming to an end. And it's not doom and gloom, we're not gonna starve to death. The beauty of phosphorus is it doesn't go away. It's just like I was talking about the cow and the grass and the poop, it cycles over and over and over. But we're overdosing croplands to such an extent that it just gets flushed off. It doesn't get taken up by the crop for which it's intended and it goes into our water.

And the water problem, I mean I think they're both coming to a head. In 2008, I think it was driven largely by the ethanol rush because everybody started growing corn for fuel. Today 40% of the corn we grow in the United States goes towards ethanol. And that's a huge demand of phosphorus. But we're coming to the point where we're gonna have to start recognizing the virtuous circle of life that phosphorus stitches together. What we did was we took that circle and we turned it into a straight line where it runs from mine to croplands to water. And along the way it does a lot of damage. We can be a lot more intelligent and measured in our application of not just phosphorus coming from rocks out of the ground but also the phosphorus in the manure, the waste stream of the American agriculture system.

We can engineer. We're never gonna repair the true circle of life but we can stitch it pretty close together. And doing that, we'll do two things. We'll preserve the resources, the phosphorus rock deposits that we have today and we'll also protect our water. You can just google toxic algae and you'll see it's just ravaging water from Florida to Washington State, the Great Lakes and around the world. And it's a phosphorus problem. We need to keep that phosphorus on croplands and out of the water. And by doing that, we won't be burning through it at such a reckless and unsustainable pace. We will also be protecting the water that we don't want just to swim in but we want to drink it. Safe water and safe abundant food should not be mutually exclusive enterprises. And when you start peeling away the situation, they are. And it's because of misuse of phosphorus.

Erin Welsh

And I want to get into some of this, like the interesting technologies or ideas on the horizon in terms of how we can repair this cycle. But I want to kind of get back into like where the sources of phosphorus pollution are coming from. So I know we've talked about agriculture. Are there certain crops or certain farms that are the biggest offenders when it comes to phosphorus pollution? Or is it just certain areas within the US that are the biggest offenders?

Dan Egan

First of all, I don't want to disparage the agriculture industry or farmers. There's nothing more noble than trying to put food on the table. But they're operating in a system that increasingly isn't working for them and it's not working for society in general because they're not regulated appropriately. We talked a little bit about this before but when the Clean Water Act was passed, the farms were small and the manure and the phosphorus that that contained was pretty diffuse. But that's not the case anymore. So because they're largely unregulated, they can with impunity just spread this stuff on landscapes and oftentimes the landscape doesn't need more phosphorus and it ends up in the water.

And so I think one thing that we need to think about is reworking the Clean Water Act and designating farm waste as a point source pollution. Because if you go to a modern farm and you see the size of those sewage lagoons, you can't help but think that that's a big source and contained source of pollution. It is time to I think rein in the agriculture industry and require that they treat their waste like any other industry. And we've got a history showing that this works. And it's gonna cost money. But we're already paying a price for the system.

For example, milk is relatively cheap but the price at the cash register doesn't reflect the true cost. The true cost is reflected when you go to your beach like in Lake Michigan, I'm thinking Lake Mendota over at the University of Wisconsin, I did a fair amount of research over there. They've got this gorgeous lake right on the edge of the campus and the kids who go to school there now don't expect to be able to swim in it because it's so polluted with manure from nearby farms and that leads to these toxic algae outbreaks. So we're paying a price for failing to regulate adequately right now, whether we know it or not. And the thing about proper regulations is that it levels the playing field for everybody. So if we do have to pay a little bit more for milk, what's the price of having a safe water supply worth? And it does jeopardize water supplies.

Toledo had a toxic algae outbreak in 2014 driven by manure overloading that knocked out the drinking water supply for a half a million people for several days. And it was a really scary situation because it wasn't like bacteria where you could issue a boil order and everybody would be safe. If you boiled the water, it just concentrated the toxin. So they had to call in the National Guard to bring in tankers of water and pallets of baby formula. It was bizarre because that city of Toledo is on the edge of the Great Lakes which hold 20% of the world's surface freshwater and they couldn't safely brush their teeth even with treatment.

So that's one thing in one industry that we need to think about. Another thing I would argue that we need to rethink is the whole ethanol enterprise. I just mentioned that about 40% of the corn we produce in the United States now ends up in our gas tank. And everybody who's looked at this issue who isn't a politician or a corn farmer knows that ethanol just isn't the environmental savior that many people pitched it as. It requires huge energy inputs and also fertilizer inputs.

Erin Welsh

It was a real moment for me in your book when you talked about like how presidential campaigns are basically started in this place where there's so much corn growing. And so it's like a real political career killer or just like a bad move.

Dan Egan

Oh yeah. I mean Al Gore, when he ran for president, he pledged allegiance to ethanol. And he rues that now and he'll say as much. But he said if you want to be president of the United States, you gotta do well in Iowa because at the time it's changed for the Democrats but that was at the front end of the primary season, it still is for the Republicans. So if you don't show well in Iowa, you don't have a very good shot at becoming president. And if you don't really support the ethanol industry, you're not gonna show well in Iowa. So there are some things that are relatively simple that we could do to just start addressing the problem. And I don't know what it's gonna take. It just blows my mind that this is just like...

Academics know about this. It's just kind of complicated and it's hard to paint the picture for people to connect the dots to show why our beaches are closed and why our drinking supplies are threatened and why from time to time fertilizer and therefore food prices just spike, not just in the United States but around the world. I mentioned in 2008 there were food riots and that to me is kind of a glimpse of where we could be headed. When I say food riots, they were not in the United States but they were in India and Haiti and a number of other places. And so as long as food is relatively cheap, I guess they're not gonna worry about it. But that's not going to be the case forever.

Erin Welsh

No. And speaking of like connecting the dots and closed beaches, one of the points in your book that you talk about is how these algal blooms in the Gulf of Mexico that were previously kind of like couldn't even imagine that this would happen and then they have started to happen and sort of tracing the roots of those blooms back to the Midwest. Can you kind of like take us through this downstream, how this all happened, and how these algal blooms really have their roots in the Midwest?

Dan Egan

Yeah. And in climate change. So it was really interesting. I went to Iowa to the State Fair where they have a thing called the soap box where all the presidential candidates get on the soap box and tell the people of Iowa what they want to hear. And that's both sides, Democrats and Republicans. When I was there in 2019, Joe Biden, I followed him into a bathroom. He didn't have the security that he has today. And he told me he supports ethanol and so did all the Republicans as well. And so that was in August. And after that I went down the Mississippi River because Iowa is big corn country. And at the same time that people were campaigning up there in support of ethanol and corn growth, corn crops, people down in the Gulf of Mexico were suffering hugely. And that's because this is where climate change comes into the picture.

There was, I can't remember, it wasn't a calendar year but it was a 12 month period that was the wettest 12 months on record in the Mississippi River basin which is huge, it spans across like 40% of the United States. But it all funnels into basically a narrow channel down by New Orleans. And so much freshwater came down that system and we went out into the Gulf that it basically turned the near shore area of the gulf during the summer into freshwater. So this toxic algae that I've been talking about is primarily a freshwater phenomenon. And phosphorus drives freshwater algae blooms. Nitrogen is a bigger factor in saltwater, they have different types of algae blooms.

In that summer, even as the presidential candidates were all loving corn up in Iowa, the people down in Mississippi were going out of business because so much freshwater hit their coast that it allowed for these freshwater algae blooms to take off. And so the beaches of Mississippi closed in late June of 2019 and stayed closed for the whole summer because of what was coming down the Mississippi River. It wasn't just water, it was excess phosphorus coming off of croplands. So it flowed down. I mean they were getting salinity readings all along Mississippi, like it's supposed to be I think 30 parts per 1000. I'll probably get the order of magnitude off. But they were just like 5 and they should be 30. It's bordering on just what you'd expect to not find. Well it just wasn't typical ocean water. And so they had atypical toxic algae outbreaks and that just ruined the tourist season.

I don't know if you've ever been to Mississippi in the summer but you wanna go swimming if you're down there because it's hot. And there was 40 miles of beach, I think 27 different beaches posted no swimming and it was because of the pollution coming off the farm fields in the upper Midwest. And I talked to one guy who had bought a fleet of jet skis for that summer. And by a fleet, I think it was like 20 of them or something. And those things are expensive, he took out a substantial loan. And he couldn't rent them out and he was prohibited from doing that. So when I talked to him he was just packaging them up and sending him to Georgia. It was like a fire sale so he could pay the bank. And he said something that really resonated with me and he's like look, I'm being regulated out of business down here because of what's going on up where you live. I said I live in Wisconsin. He said why aren't you guys regulated? Why am I paying the price? And these are the dots that we gotta connect. There's a great question and the answer is because we don't have the political will and I think we don't have the political will because we don't have an educated public knowing, realizing what's going on here.

Erin Welsh

We've talked about that this algae is toxic. What makes it toxic? Like what are the health effects on humans? And then sort of part two is what are the cascading impacts on ecosystems that these algal blooms have?

Dan Egan

Yeah. So I mean the phosphorus will grow lots of aquatic life. But there's a bunch of things that just kind of come together here, talking about connecting dots. But yeah, I don't know if you're familiar with the zebra and quagga mussel infestation of North America's fresh waters. But these little dreissenids, these little clam-like things came from the Caspian Sea basin and the region around that via ocean freighters, sailing up into the Midwest on the St. Lawrence Seaway. They had all these hitchhikers in the 60s and 70s. And today waters across the country are just infested with these tiny little mussels. You don't really see them very often. I mean most times people have any encounter with them, it's when they cut their feet on them. But they're just incredibly efficient at filter feeding. And they don't have brains but they're smart enough not to eat certain types of algae, toxic algae specifically.

So now today when we have... Like in the 60s Lake Erie was green but it wasn't toxic green because there was just a whole assemblage of species that were enhanced by the phosphorus coming from detergent. Today, because the mussels have just outcompeted everything when you get an algae bloom, it's gonna be toxic because that's the one thing they don't eat. And so the health effects of this are severe. I mean moderate exposure will just give you a cough and a headache. Significant exposure can cause liver failure. It's been implicated in a kid who went swimming on a golf course pond here in Wisconsin some years back and he died. And he died because of acute exposure to the algae called Microcystis and the toxin is called microcystin. And it's a liver toxin. And there's also increasing evidence that it's a neurotoxin related to some pretty nasty stuff including ALS. So yeah, it's not just a matter of icky unpleasant odors, it's a matter of public health.

Erin Welsh

And some people have, as you mentioned in your book, started to think about these things in an aspect of okay, how can we come up with innovative solutions to try to recapture the phosphorus that we're depositing on farms? Can you talk about some of these promising areas and especially manure and what we can mine from manure?

Dan Egan

The most promising thing on the horizon is people just waking up to the idea that manure is nutritional gold. You think about, we were talking earlier about the lengths the British were going to to grow a crop. They would not look at these sewage lagoons as a bunch of yuck, they would see it as yum. It's like oh my gosh, we are gonna have turnips and wheat galore. We don't see it as that. We see it as a waste that has to be spread on the landscape. And we all recognize that there's a nutritional value to that but often that action isn't done to nutrifly a crop, it's done just to get rid of the stuff that's in your limited capacity manure lagoon.

One of the obstacles right now to getting that manure on lands where it's needed rather than on lands where it's just convenient is figuring out how to concentrate the phosphorus in it. And there are technologies to do that where you could pelletize it. Right now most manure is liquefied so it can be easily spread. And the rule of thumb is if a farmer has to move that manure more than 10 miles, he's losing big money and he's not gonna do it. But if you develop wastewater treatment systems that can pelletize it, now you can put it in bags or bins or whatever and move it anywhere in the country or the world where it's needed. It becomes almost the same kind of, it is essentially the same product coming from a fertilizer factory that's using rock-based phosphate.

So we can do that. It's gonna cost some money. But it's gonna cost us a lot if we don't start doing this. That's one thing that we need to look at. And then I was talking about Hamburg earlier. It's where phosphorus was discovered, it was burned to the ground. And coincidentally, doubly coincidentally, Hamburg's kind of like putting on a clinic for the rest of the world right now in how to deal with phosphorus. Germany's got a law that's gonna require its major wastewater treatment plants to just virtually eliminate any kind of phosphorus discharges. And they're significant because phosphorus is in human waste as well as animal waste. And they've built a state of the art wastewater treatment plant on the banks of the Elbe River that basically strips all the phosphorus out.

And this is gonna do two things for Germany. It's gonna help protect their water quality and it's gonna give them a source of fertilizer that they don't have organically, if you will. Western Europe really doesn't have many if any available phosphorus deposits at the moment. So it's a far sighted thing that they're doing and it's something that the rest of the world can learn from. We've just gotta think of restoring the circle of life. It's really that simple. It's complicated but when it comes down to it, it's that simple. Stuff that decays is not something that's bad, it's something that's gonna provide life for the next crop, the next generation of humans.

TPWKY

(transition theme)

Erin Welsh

Dan, thank you so much for taking the time to chat with me. I definitely have a newfound appreciation and respect for phosphorus and I still can't believe that this isn't a topic that's covered on every news channel, every day, all the time. If you enjoyed this and would like to learn more, check out our website thispodcastwillkillyou.com where I'll post a link to where you can find 'The Devil's Element: Phosphorus and a World out of Balance' as well as a link to Dan's website. And don't forget, you can check out our website for all sorts of other cool things including but not limited to transcripts, quarantini and placebo recipes, show notes and references for all of our episodes, links to merch, our bookshop.org affiliate account, our Goodreads list, a firsthand account form, and music by Bloodmobile.

Speaking of which, thank you to Bloodmobile for providing the music for this episode and all of our episodes. Thank you to Lianna Squillace and Tom Breyfogle for our audio mixing. And thanks to you, listeners, for listening. I hope you liked this bonus episode and are loving being part of the TPWKY Book Club. A special thank you as always to our fantastic patrons. We truly appreciate your support so much. Well until next time, keep washing those hands.