Walter Jehne Interview

The Real Cause of Climate Change, the True Cure, and a 9X Increase of Nutrients in Our Food

Brendan [00:00:00]: This is Brendan Moorehead and it's my honor and pleasure to welcome our guest Walter Jehne. Walter is an internationally recognised soil microbiologist, climate scientist and innovation strategist with extensive field and research experience at a national level with Australia's Commonwealth Scientific and Industrial Research Organisation and at an international level with the United Nations. He recently presented at an invitation-only UN gathering of scientists and decision makers to discuss including soil in the next report of the Inter-governmental Panel on Climate Change. With his diverse experience in science, government and industry, he is an expert at transforming challenges into opportunities. And Walter has developed a new paradigm that connects Earth's ecological and atmospheric systems to provide powerful solutions for stabilizing climate, cooling the planet and even restoring high nutrient levels to our food supply. Walter, it's an honor and a joy to welcome you to the Eat4Earth event.

Walter [00:01:02]: Yes and vice versa, thank you, Brendan.

Brendan [00:01:06]: First up, you know you have some fascinating things to say about climate change and how we can reverse it by restoring global soils and water cycles, giving us more options and more hope than we might otherwise have. In fact, your model of climate change is a real paradigm shift, that really anyone can buy into. And your model differs in certain ways from the one used by the Inter-governmental Panel on Climate Change. The IPCC rather. How does the IPCC model … how did it come about, and how does your model differ from that?

Walter [00:01:39]: Right, Brendan. Just a bit of context there … of course it's not my model at all. It's really … this is the process, and if you want to call it the model or the blueprint that Nature uses and used to create the global climate and to actually maintain the stability of the climate, particularly the 10,000 years, the Holocene stability that we have been fortunate enough to experience and that has enabled our evolution as a, you know, as a species. So it's not my model, and all we have really done is sort of go back to, well what are the basic, natural processes that regulated climate. How do we understand how they operate? What have we done to them? What are the consequences? And what is it that we can and must do to try and restore them? Okay? So it's not me. It's just simply observation. It also goes back to Climatology 101. Look, it's—and this is really the crux of it—we have had for hundreds of years very, very eminent climatologists looking at these climate processes, dynamics, understanding it and in a very sophisticated understanding. Not that we know everything, clearly we don't. That's science. But they came to a very clear understanding. The punch line is that yes, everybody agrees, climatology agrees, It's actually water, hydrology, that governs 95% of the heat dynamics of the blue planet, has done for about 4 billion years. And this water, this hydrology, governs the climate through a whole sequence of processes. And it's that understanding of those sequences that we were pretty sophisticated, had a good understanding of. But then, basically in the mid 70's—or well, actually Charles Keeling from 1958 when he first confirmed the CO_2 rise—but then by the mid 70's this sort of "political" alarm and the political concern and pressure came very much on, "Hey this abnormal, human induced CO_2 rise," that Keeling's data had confirmed. And then the question was what the consequence of this CO_2 rise, by its small component of the greenhouse effect on the Earth's future climate. And it was really Jimmy Carter in a very positive way, back in the late 70's, who then commissioned Los Alamos and the Scripps Oceanographic Institute in San Diego to say, "Look, please model the actual CO_2 component of the greenhouse effect and give me a report to the President, on what are the consequences of this single process." Now, everybody said, "Yes, here's a component of the complex hydrological dynamic that runs the Earth's climate," and it's actually quite tragic because we have so much focused on this one process, that we've in a sense, ever since, I mean amongst some of us, ignored these far more important fundamental drivers of the planet. Now obviously that work was done, that modelling was done. Manabe and Wetherald sort of then reported on it and said, "Yes, it would actually have a minor effect on warming." If anything for the United States it would beneficial because agriculture would be able to extend seasonally into higher productive capacities and really, when that report to the President went to Ronald Reagan in the early 80's it was really sort of taken as fairly benign. But the problem is that that ever since then we've always focused on the CO_2 greenhouse effect, rather than the bigger issue of, alright, what governs the Earth's climate and what have we done to those processes? And all I'm doing is actually going back to revisit that knowledge, because in a sense what has been happening—and it was really picked up by Joachim Schellnhuber in 2005 at a big conference in the Hatley Centre—that we are now entering a period of dangerous climate extremes. Accelerating, intensifying, dangerous climate extremes. And it's not the CO_2 that's the real problem, it's these dangerous extremes. These extremes are all hydrological. More intense hurricanes, floods, the aridifications, systemic aridification of regions like, you know, California, South West US, droughts, wildfires. And in a sense it's these hydrological extremes that are now already impacting biosystems and their dependent communities. It's these hydrological extremes that really threaten you know, social wellbeing and our future within the next decades. And so I think it is just changing this whole perspective and debate away from yeah, the CO_2 greenhouse component and basically really saying well what have we done to the climate in the bigger scale, and what are the consequences? When will this happen, and what can we do about it? Because in a sense, the analogy is we aren't seeing the elephants in the room, because in fact they are far too big to be in the room. The actual driving forces are still outside whereas we have been spending 40 years in modelling, delay and denial, looking at this CO_2 component effect of the greenhouse, which quite frankly, governs about 4% of the heat dynamics of the planet and ignoring these processes that govern about 95% of it. And so it's really by only understanding these hydrological processes, this whole Earth heat dynamics, that we have any chance of avoiding and counteracting these dangerous climate extremes that we are going to be facing.

Brendan [00:08:28]: And you have a way of simply … I'm hearing an echo … okay, I'm not sure where that's coming from but it looks like it's stopped. So you have a way of simplifying a very complex heat dynamics, climate regulating system on planet Earth and the three fundamental processes that we can influence and which give us a lot of power to turn things around. Could you describe those three core drivers of heat dynamics and climate regulation.

Walter [00:09:06]: Right, well look basically right from 4 billion years ago it's water that has actually influenced the climate and obviously it's done that through the natural greenhouse effect substantially, because it's actually water vapor that governs 60 - 70% of the natural greenhouse effect. The amount of water vapour molecules in the air. That can be up to 50,000 parts per million. With each water vapour molecule able to absorb significantly more heat in that greenhouse process, than the 400 parts per million of CO_2 that we've got. So in a sense that's the fundamental starting point, the process of why the Earth's temperature and climate, because of the natural greenhouse effect, is 33 degrees centigrade warmer than it would otherwise be. But actually these hydrological processes, apart from that natural greenhouse effect, also govern the actual cooling of the planet. And so there's two other fundamental processes, first is the actual transpiration and evaporation of water from the Earth's surface because every gram of water that is evaporated or transpires, has to turn from liquid into a gas, and in doing so it has to take a lot of latent heat, heat that it needs to do that water to gas conversion and it transfers that heat back up into the upper atmosphere. And when that water condenses in the atmosphere, most of that heat is re-radiated back to space. And so we've got this very powerful latent heat flux, latent heat cooling effect as water is taken from the surface and with that heat, to cool that surface. The third part is of course in the hydrological cycle, now that we've got this water vapour and then water up in the air, how do we actually sort of both coalesce those humid hazes into dense high albedo clouds and then rainfall? Because that is needed to close the water cycle. And again, there is biological processes that drive that. You take water vapour that's in the air … it will form humid hazes, and those humid hazes coalesce into these clouds, and these clouds can reflect up to 36% of the incident solar radiation coming into the Earth, back out to space and massively cooling the planet. Over 50% of the Earth at any time is covered by these high albedo clouds, and they're having a fundamental regulatory effect on the Earth's climate. Once you've got these clouds, then the next step is how do those cloud droplets again coalesce into bigger rain drops to return back to the Earth to continue that cycle? And again, the formation of those raindrops depends on hygroscopic precipitation nuclei, and again this is where the physics and the science gets detailed. But it's these nuclei that actually then cause the rain, that allow both that hydrological cycle, but all our life on Earth, on land to be sustained. And again, it's the actual types of nuclei, the amount and their processes which then govern that cycle. We can go into the details of that.

Brendan [00:13:02]: Yeah, well I might have been over-simplifying it by describing three, I know you have ten hydrological processes and intervention points we'll get into. In terms of three, it sounds like, here's how I was trying to fit it into three, so you've got, you've described it that water is a very powerful greenhouse gas as a vapour and we've got the—and especially compared to carbon dioxide—and then we've got the … I have to re-orient myself … we've got another factor, which is the heat of, or rather the surface temperature of the Earth which is driving how much heat there is to be trapped. That's a fascinating one, I believe, for people to understand. Sort of like the third, if we're going to simplify the three main factors, before we dive into the ten.

Walter [00:14:00]: Okay, Brendan look, if I go back you see, okay, backtracking, right, what I was explaining is here are the three fundamental parts of the water in the Earth heat dynamics and you're right, but the question is specifically okay, what are the three components of the natural greenhouse effect, you know, what drives the greenhouse effect and then how we change that. And if we look at that element of the situation yes, there are three elements okay. And the first is how much heat is absorbed by the Earth's surface okay, because okay, let's go back a bit. We've got the planet, and every day continually it receives about 342 watts of solar energy per square metre average across the Earth's surface, right, 342 watts coming in. To maintain our stable climate, we have to re-radiate, well not we, the Earth has to re-radiate 342 watts going back out, and so it's this balance between incoming heat and outgoing heat for this stability. Because of our interventions we now basically are retaining 3 watts per square metre of extra heat, through this enhanced, abnormal greenhouse effect. That's less than 1 percent of this heat dynamics. So our imperative is, how do we actually cool the planet this extra 1 percent? How do we restore an extra 1 percent of heat leaving this planet? And what we've done is we've disturbed the greenhouse effect, and we've disturbed it through these three principle ways. And the first is, we've totally changed how much heat is absorbed by the planet's surface by clearing forests, by exposing soils, instead of the heat coming in and being reflected, we are basically absorbing it by the soil's surface. By disturbing the hydrological cycle, instead of having that heat being released and going up in these latent heat fluxes, it's heating the soil's surface. And we know that because if we've got a forest the soils under that forest you know, rarely get above 20 degrees centigrade. Whereas when we clear that same forest, have it open, exposed soils, then in summer that soil might go up to 40 degrees, 50 degrees centigrade. Really heating so hot that we can hardly walk on it. Okay, so that's the first thing, it's we fundamentally changed how much heat the Earth's surface absorbs. Just as another factor in this, people don't realise, but we humans have created over 5 billion hectares of man-made desert and wasteland on the land.

[00:17:20]: Okay, so now the point is we've heated the Earth's surface abnormally, massively, but the heat of course just doesn't stay on the Earth, it re-radiates back out into the atmosphere. And this is a critical point, because the amount of re-radiation, infra-red radiation that goes back out into the atmosphere is in fact the key driver of the greenhouse effect. It's how much heat is going up and then how much of that heat is absorbed by gas molecules that can absorb it, water and CO_2, two key greenhouse gases. But it's the amount of heat that's going up that you know governs it. And that's determined by simple physics of black body radiators and the amount of heat is related to the 4^{th} power of the temperature. So if we have two soils which are completely different temperatures, it's the difference in temperatures to the 4th power that regulates that amount of heat that goes up. So effectively, by having bare soils heating, we massively increase the amount of heat being re-radiated that's able to then drive the greenhouse effect. The simple conclusion ...

Brendan [00:18:44]: It's exponential is what you're saying.

Walter [00:18:46]: Well it's, yeah, temperature, times temperature, times temperature, times temperature. It's an exponential, massive thing. And the fact is, you see, by keeping the soil temperature cooler, we can massively decrease how much heat is going up which is driving the greenhouse. So effectively, in simple terms, we can turn down the heat. We can turn down the greenhouse enormously, by simply keeping our surfaces cool, because then there won't be the same amount of heat going up into the air that can be absorbed by these gas molecules, okay.

Brendan [00:19:30]: Yeah that is … that's like the key, mind-blowing new concept. It's, you know, it's not new to somebody like you but perhaps to those of us out here in the lay public we're used to thinking only in terms of you know, reducing the heat trapping gases, and we're not even thinking about water. And as I understand, the reason the IPCC model of climate change has not really included water, was previously we thought it was too big a factor to influence, is that correct?

Walter [00:20:00]: Right, we haven't included water, or they didn't include water, quite consciously for two key reasons. Water, because of these ten different processes, it's so variable and so dynamic and it changes, different times of the day, it changes in every location, it's effectively impossible to model on a global scale, on an average anyway. Secondly, because they accepted it's such a dominant, powerful factor, that we … the assumption was that we humans could not have possibly have influenced it, right. But what happened is then that they did the analysis, Manabe and Wetherald did the analysis of the CO_2 component, it only sort of, it showed that now without water vapour included, it was nowhere near accounting for the temperature increases that we're seeing. So the models have in a sense appropriated an element of that water effect and more or less sort of said okay as temperature increases there is more water vapour in the air so we will assume that that's a secondary feedback of the CO_2 warming effect. So they do include some of the water vapour, gas molecule properties but no, they don't include any of this hydrological dynamics in terms of heating and cooling land systems.

Brendan [00:21:31]: And those are the, no go ahead ...

Walter [00:21:34]: No, no, you go Brendan sorry.

Brendan [00:21:36]: So, these are … and that's where we get into the ten water-related elephants that aren't even in the room right now. And so tell us more about that, I mean we've got apparently ten ways that we can interface with the climate system and with the natural processes that govern it and turn this thing around. Can you tell us more about that?

Walter [00:22:04]: Right, yes Brendan, and in a sense that is exactly right, so Nature works as we said for the last 4 billion years using water to regulate the climate of the blue planet. And there is a sequence of ten sort of processes so they're not totally separate, but if you could imagine here's a water molecule travelling through the Earth's biosphere, the atmosphere, and what have you, and it goes through ten different stages each of which has a profound, you know, cooling or warming effect. And very quickly and we can detail this much more on paper, but the processes are initially these latent heat fluxes right, the actual cooling of the Earth massively as this water gets transpired and evaporated. That water then, so that's one. Two is when you say this water now is in the air, but once it's in the air, if it's there as micro droplets, as haze, micro droplets it will absorb into the solar radiation to warm the atmosphere, and that is in a sense happening at an increased level and we're seeing that as global dimming. And there's again lots of science of global dimming and up to you know, a 15—20% increase in water absorbing incident solar radiation which is causing that dimming. Those humid hazes are again number three, are very, very important in warming the atmosphere because, well, they have a dual warming effect, both in absorbing incident solar radiation, but also absorbing these re-radiated energy, infra-red energy going up by the greenhouse effect. Okay, so basically the water in the atmosphere is a key driver, and so that is why we have to get, we have to accelerate it being removed from the air. And that happens naturally by these haze micro droplets, forming clouds, which are then reflective and cooling and then rain which then returns that water to the soils to restart that cycle. Okay, so we have the sequence of processes. Once you have the rain clearing out the water from the air, you in a sense then allow heat to re-radiate from the Earth at night time, without it getting intercepted by these water vapour and water molecules in the air and these are these night time radiation windows. So when we look at the climate data, we find in fact that 60% of the warming is associated with warmer nights. Nights, you know, not being able to release that heat because it's being trapped in at nights. And that's because there is all this water in the atmosphere. The same thing happens with urban heat islands in cities where you end up with hazes and water in the air and those cities not being able to cool off, compared to the adjacent countryside where it has rained and it can cool. So there are these radiation windows. Another one that follows then, where you've had rain, you've created low pressure zones on that land, because in a sense the rain has taken those water vapour molecules out of the air and created low pressure. And that induces more humid air to flow in, and you end up with these biotic pumps, whereby you get more moisture coming in, more rain, enhancing this whole hydrological cooling cycle. And that's most dominant for example in big regions like the Amazon. So there's this whole sequence of processes, all of which are involved with both cooling and warming and regulating the Earth's climate. And yeah we influence those, each of those in a significant way, because we've disturbed vegetation; we've cleared soils; we've changed the amount of aerosols in the air that make the hazes; we've changed the precipitation nuclei that are critical in forming these dense high albedo clouds and rainfalls; we've blocked off these night time radiation windows; and we have completely disturbed these low pressure, formation of these low pressure cells to let the biotic pumps operate. So, I appreciate it's a bit complex, but there is this sequence of hydrological processes where we've disturbed, and in doing so have induced these dangerous climate extremes and global warming.

Brendan [00:27:18]: And where does soil come into all of this?

Walter [00:27:23]: Well, look soil is fundamental in this sense, because it's the Earth soil carbon sponge that is critical in being able to infiltrate, retain and sustain the availability of water to drive these processes. 420 million years ago we didn't have any life on land, we just had oceans and bare rock and all the water that fell on the land just ran off more or less instantaneously into the oceans. And so we didn't have any of this terrestrial, hydrological cycle. It was only when fungi started forming soils, you know the soil structures so that that soil, that organic matter was able to hold the water, that we created the sponge, with its water, that was able to accelerate these hydrological cycles. It's the formation of soil and then biosystems, terrestrial biosystems, that over the last 100 million years that have enabled the planet to progressively cool, because of these hydrological cycles, in contrast to the actual sun, or the solar intensity increasing progressively. It's a major nuclear reactor that's getting hotter and hotter, but the Earth has been cooling while the sun's been getting hotter because of these hydrological processes. So, look, the soil being the sponge is fundamental in holding the water to drive, enable, all these hydrological cycles. It comes to perhaps the next question of yes, we humans, by oxidizing the carbon out of our soils, by degrading and structurally collapsing those soils, we have completely impaired their capacity to infiltrate and hold water and very much impaired that hydrological cycle. You know, so our soils now hold a fraction of the water that they did pre-industrial humans. You know, whereas we had soils that had up to 10% in carbon, that were very effective, active sponges. We now have soils with often much, much less than 1% carbon, not able to hold water and of course as a consequence, we've got increased floods, increased erosions, increased aridity and all the compounding heat effects.

Brendan [00:30:16]: So what I'm hearing is that, the soil carbon sponge you know holds water, it makes it possible for terrestrial biosystems, in other words forests, grasslands, savannahs and so forth to have a water supply and then the plants transpire that. Let's define transpiration quickly, I'll leave that to you. So transpiration, what is that, we talked about that a couple times how it brings the moisture up in the atmosphere, but how does that work?

Walter [00:30:53]: Well okay, it's very simple, it's basically yes the transfer of water from that reservoir, that in soil reservoir, that sponge … it's basically plant roots taking that water up and releasing it from its leaves, its stomata and its leaves, and in doing so, taking massive quantities of, as we said before, energy, you know, 590 calories per gram of energy for every gram of water that's transpired. So it's that massive flux of energy cooling the surface as that heat and that water's taken up into the upper atmosphere. Without the sponge, without the soil, there wouldn't be the water to sustain that process. It's the longevity of green growth that's critical in that transpiration, and the longevity of green growth is determined by the quality of your sponge, the capacity of your sponge. So that whole heat driver, that first process is all determined by the quality of your soil, its water holding capacity. And that's the starting point of that process.

Brendan [00:32:10]: And then when water gets up into the atmosphere through transpiration carrying all that heat energy, it's either going to be, as I understand, it's going to either turn into humid hazes that keep warming the planet if we have a lot of aerosols and you know dust particles up there from the deserts we've created, from the farms that we're drying out and over-tilling and leaving bare soil and from the particulate matter spewed by our industries and diesel engines and so forth. And so it's either going to turn into water as part of that heat trapping, heat absorbing layer we call hazes, or it can be incorporated into clouds, dense clouds, more natural clouds that have a high reflective capacity to block incoming radiation and then also can be nucleated into rain, and then that creates the heat windows and in that process, actually doesn't it release the heat that the water was carrying in the cloud?

Walter [00:33:16]: Well the … yes, and the heat is released when the water condenses from gas back into liquid, into droplets. But because it's up in the upper atmosphere most of that re-radiates back out to space. Absolutely right, I mean you asked the question about soils … if we have a lot of bare soil, by definition we've got dry, desiccated dry soil, massive amounts of dust, we are now putting 3 billion tonnes of extra dust into the air every year, compared to natural conditions, because of this increased area of desiccated bare soil. We are obviously putting massive quantities of particulates, carbon particulates and pollution into the air, so much so that we've got vast areas of the planet, the whole of the Middle East, the Asian brown haze, where literally the top 3000 or the lower 3000 metres of air is really just a soup a haze of pollutant particles, water molecules and its actually sort of 50,000 parts per million water trapped in that air, and if anything that's from a health point of view is now getting to extreme levels, where that wet heat condition, once it gets above 37 degrees centigrade, is actually terminal for human survival. Humans cannot survive you know, once you get wet heat above 37 degrees, because we lose our whole capacity to cool ourselves through evaporation. And so we are approaching that in large parts of the Middle East and in tropical areas, where if we don't get that haze out of the air humans won't be able to live in those regions anymore.

Brendan [00:35:20]: Wow, wow. And I was just going to say we could visualise—I was just thinking of a way of describing this heat transfer to outer space, from Earth to outer space through transpiration and then rather precipitation of the water and releasing the heat. It's sort of like a geobiotic heat pump, is that accurate enough?

Walter [00:35:52]: No, it's spot on, and it's geobiotic, but it's also sort of, in terms of your heat from the surface, is taken up in these fluxes, taken up into the atmosphere, and then it gets released and then of course that's the whole power that we see in our thunderstorms, you know all the energy in the thunderstorm is all that latent heat energy being released. But from there, that heat very much basically dissipates back out to space, and that's a key part of that 342 watts per square metre of heat, that has to leave the planet continually, to maintain its stable temperature, right. So that and the radiation windows are two of the key means of which to get the heat back out of this planet.

Brendan [00:36:44]: So that's what we need to support, instead of supporting humid hazes. They are going to kill us.

Walter [00:36:48]: Well okay yes, we have to reduce these humid hazes for the simple reason of survival because this wet heat will … is killing us. I mean literally in the Persian Gulf, communities are now getting to the point where hey, they can't survive. So we have to find a very rapid way of doing that, and the way we do it is yeah, stop the production of these hazes, stop the pollutants, you know the brown haze that sits all over Pakistan, India, all the way to Hong Kong. I mean, it's a massive sort of an Asian brown haze. We've got to get rid of that, and the way you get rid of it is by actually coalescing these hazes into these high albedo cooling clouds and then into rain, and that's what Nature does.

Brendan [00:37:41]: And how do we do that? Yeah, tell us how that works.

Walter [00:37:44]: Okay right. And again, all the physics is all, the atmospheric physics, is all documented by a gentleman Schaefer back in the United States back in the 1940's was you know, leading this. We had a major program in Australia, the CSIRO on this as well, and it's very simple. Water can't fall out of the air as rain unless it is actually formed into raindrops, so they are actually large and heavy enough to fall out under gravity. And to do that, you have to coalesce millions of these haze micro droplets into a larger cloud droplet and then a raindrop which is even bigger to get out of the air, you know, for it to be able to fall out. And the way Nature does this, is through hygroscopic precipitation nuclei. And these are really just simple suckers that actually just suck in millions of these haze droplets into a larger drop, until it's big enough and heavy enough to fall out. There are three types of precipitation nuclei, hygroscopic precipitation nuclei. Ice crystals which form in high latitudes and high altitudes, naturally. Salts, particularly sea salt. And you know that when you're having salt, and it's a humid area its hygroscopic, it's absorbing water. But the most important and the most effective by far and we've done all the work in cloud chamber studies and stuff, are a group of bacterial cells that have got very, very high hygroscopic water suction absorption capacities. And these are being produced by trees from forests, and they actually are driving much of the hydrological cloud forming, rain forming dynamics above those forests. So the whole Amazon, over half its rainfall is driven by these microbial precipitation nuclei produced by those trees, those canopies. And again, a lot of documented evidence of the importance of these microbial, hygroscopic precipitation nuclei in driving cloud formation and rainfall. And again we've disturbed those, we've actually impaired them enormously as we've cleared those forests and have any amount of evidence where we've cleared forests and completely changed the rainfall, because we've removed these precipitation nuclei. So we've got other case studies, exceptional case studies, whereby reforesting areas, by restoring these processes, we have significantly enhanced the natural rainfall of those areas, that can only have happened because of those processes.

Brendan [00:40:53]: Wow, so it really comes down to in, at least for this process, restoring forests. And I think what I'm hearing overall is revegetating the planet so that we have, we are covering soils and not generating so much dust and you know, that creates the humid hazes. But we also need plants for building soil, right, and creating that soil carbon sponge as well.

Walter [00:41:21]: It's one synergistic system, yes we've got to rebuild the sponge, that rebuilds this cooling hydrological cycle, that allows then of course trees to grow. These trees are producing these precipitation nuclei and again the rain in these forests is really a biological symbiotic part of the cycle, right. So rain is actually microbially, biologically driven to a significant degree.

Brendan [00:41:50]: That's a real eye-opener I think, to realise that our system is so biologically driven, even up in the atmosphere.

Walter [00:42:00]: Totally, our rain is a biological determinant, right. Both in terms of the sponge, the transpiration, the cloud formation and its precipitation. And the powerful point is not us, but Nature and we know this, Nature has evolved this over 400 … [inaudible] … and in so doing, has been able, over the last a hundred million years to significantly cool the planet to the point that we were then able to induce the Ice Ages, whereas previously in the Jurassic and Triassic it had been, you know, 4—5 degrees centigrade hotter. And we have basically … the Earth has been able to self-regulate and cool biologically through these hydrological processes.

Brendan [00:42:56]: Would it be accurate for me to say, I've got the echo again… Would it be accurate of me to say that the … I wonder, is there just something that changed on your end that would have created the echo?

Walter [00:43:14]: No, I don't think so, no. No.

Brendan [00:43:19]: So would it be accurate for me to say that the main reason to draw down carbon in the soils and restore vegetation on all landscapes to help build soils and of course grow food and regenerate water cycles … would it be fair to say that one of the main reasons for drawing carbon down into the soils is not just to reduce atmospheric carbon, but to drive this soil sponge, hydrological cycle, that controls even more of the process than carbon dioxide levels?

Walter [00:43:52]: Look excellent and absolutely. And look, that's exactly how Nature created the terrestrial biosphere, through pedogenesis, through …

Brendan [00:44:06]: Which is soil-building.

Walter [00:44:07]: Through the formation of soil building, pedogenesis, which is, by putting organic matter, carbon into those soils to build the structure, to build the sponge, to build its hydrology, to build resilience and productivity, right. So that's how Nature works. We, *Homo hubris*, have come along and sort of said no, we're in the business of oxidizing, burning that carbon out of the biosystem, clearing that biosystem. We've been extremely effective in that destruction. But now, the feedback is, in doing that we have killed that or destroyed a big part of the hydrological cycle. Clearly, the thing that we have to do, and the only thing we can do is what Nature did; we have to put carbon back into those soils, massively, urgently. The beautiful thing—and this is where your colleague, our colleague, Colin sits in—we can do this safely, naturally, profitably. You know we can put 10 tonnes of carbon per hectare, per annum, back into our soils, through more productive grazing, crop management, you know managing our animals and crops more effectively. You've got leading players all over the States, we've got these innovate, regenerative farmers all over the States doing that. David Brand, Gabe Brown, the list goes on and on and on. And so the power, the tool, we've got is to put carbon back into those soils, yes, to rebuild the sponge, to rebuild the hydrology, to rebuild, you know, the cooling and that whole biological system. What we are seeing and what Charles Keeling documented, was in a sense the symptom of our arrogant, ignorant carbon oxidation from our biosystems. You know we have been basically releasing about 10 billion tonnes of carbon net, back into the air every year, you know, basically because of our land mismanagement and of course also use of fossil fuels. And so that's what we have to reverse. But we don't just have to stop emitting … the key issue (is) we've got to put it back into the soils to build the sponge, to build the hydrology. Only that has a chance of now restoring that extra 3 watts per square metre of cooling effect and restabilising the climate of the blue planet.

Brendan [00:47:07]: And you know in terms of how soil affects us very personally with our health, I know that how healthy soil affects how nutrient dense the food is that we grow in it and therefore how healthy we are and I'm curious, what are the nutritional differences that you may have observed or researched between foods grown in healthy living soils, versus foods grown in unhealthy soils? And can you give us an example?

Walter [00:47:40]: Oh yeah, yeah. Look Brendan we are now in a slightly different angle or aspect of this, but it still comes from the sponge, right. As we put carbon back into our soils, we rebuild the structure of those soils. So we rebuild the surface configuration of those soils. Instead of that soil being dense, you know, with a bulk density of 1.8 up to 2, we've got soils that have got a bulk density of 1 gram per cc, which means that basically 60% of that soil is actually made up of voids, of spaces and surfaces. The nutrition of plants is governed not by how many nutrients are in the soil in total, or how much we add as fertiliser—again that's a complete, you know, sad, you know, aberrant—it depends on the availability of those nutrients to the plant, which depends on that surface exposure of those mineral nutrients and the capacity of the plant to solubilize, to access, to uptake and cycle those nutrients in that biosystem. Healthy soils in a sense, are totally, radically different from an industrial collapsed soil because they support the microbial life that is actually driving 98% of the fixation, solubilization, access, uptake and cycling of those nutrients. So 98% of the nutrition of natural plants is driven by these microbial processes. These microbial processes of course need carbon as their substrate, and they need that soil environment to function in. Okay? So it just comes back to a healthy soil will have this healthy soil biology, and so it will have a nine-fold nutritional fertility enhancement, even with the same amount of level of nutrients in that soil. Okay? So it's not the quantity, you know, it's not the amount of nutrients in my soil; it's the life in my soil. It's what Mae West said isn't it? Well, you know I won't go into what Mae West said, but it's the actual life in my soil, not the quantity that matters, right.

Brendan [00:50:28]: That is, I was just going to say that's a really, right there a very Earth-shaking, no pun intended, point right there what you just said. I'm glad that we covered this so thank you, keep going.

Walter [00:50:44]: Yeah, okay, but now it gets a bit more sophisticated. If we go back to 3.8 billion years ago, we had a chemical, toxic, physical world. There was no life. But then 3.8 billion years ago we believe the first bacterial, proto-bacterial cell formed. And it formed because there was a semi-permeable membrane, a lipid sort of membrane film that formed, and that lipid film was able to concentrate essential mineral nutrients across it and exclude toxic minerals, and so the internal cell had a completely different chemical composition to the toxic outside world. And in a sense life evolved through the formation of that first … Okay, we … our connection is unstable now. Hello?

Brendan [00:51:52]: Yeah you got a little choppy but you're coming through still.

Walter [00:51:56]: Okay, okay well I'll continue. Okay, so life evolved through that concentration of essential nutrients and exclusion of toxin into the cytoplasm of that first cell.

Brendan [00:52:13]: So it's not the absolute amount of nutrients in the soil, it's the availability that determines its presence in plants, in our food, in our bodies. And so we'll talk more about that I think at another time because that's a whole other realm, and we need to dive into that because that's fascinating. But so … what can we do now with what we've just discussed in terms of these leverage points that we have, in the hydrological cycles to reregulate the climate and cool the planet? What can we do now?

Walter [00:52:50]: Well Brendan, yeah it's what we can do, but also what we <u>must</u> do. You see because really this is the last chance solution that we've got, but we are extremely fortunate; we are extremely fortunate because there are simple, safe, natural mechanisms that can bring us back to stability. And of course, they are what Nature has used right at the beginning. So if we go back 420 million years ago, how did Nature create the soils, the hydrology, the terrestrial biosystem, our stable climate? What is it … what are the processes? How do we actually rebuild those, regenerate, accelerate those? And it comes down very simply as in Nature, yes, we've got to put carbon from the air back into our soils. As we've said we can do that, drawing down 10 tonnes of carbon per hectare per annum through regenerative agriculture as our leading innovative farmers all over the world are doing. We've put a big paper to the UN. Yes, we can do 20 billion tonnes of carbon drawdown per annum sustainably, practically, by simply adopting a whole lot of these practical processes. You know, carbon draw down, stopping wildfires, those sorts of things. That is twice, that is twice our current net emissions. So we are going to go negative emissions big time. But it's all about rebuilding that soil carbon sponge, rebuilding the hydrology and from that hydrology, restoring the natural cooling, buffering processes. It is only that cooling, only that hydrological cooling, that can offset the dangerous climate extremes that are now already accelerating, locked in. So the simple action is very much that every square metre of land, every farmer, every community, grass roots community empowerment, of growing green plants, of stopping the oxidation or the burning of that green plant and instead, encouraging its composting, its incorporation, back into stable soil carbon, humates, and glomalin. And very simple, elegant, you know there are long-proven ways of doing that. But it's really just getting the narrative, the information, the imperative across to communities. Yes we can, yes we must. It's that simple. It's that beneficial. Because from that sponge comes our water, comes our food, comes our bioresources, comes our ecosystem services, comes our economies, and comes our social stability. All of them are now at crisis points, you know these planetary boundaries that we are exceeding. All of them can be addressed safely and naturally by rebuilding the Earth's soil carbon sponge. And of course, it's that simple, that simple and that positive, right. And it's that empowering, and it's just a matter of saying, stop talking politics, stop expecting, you know, somebody from upstairs to come down with the solution. The solution is with us, the imperative is with us, it's just rebuilding our soil, rebuilding our hydrology, rebuilding stable, buffered eco systems.

Brendan [00:57:00]: And so what that means for each of us individually I guess, begins with our food choices and supporting regenerative agriculture and making sure that we are buying food that grows soil, instead of food that destroys soil.

Walter [00:57:013]: Wonderful. Yep, absolutely and so that's in a sense, we vote every day when we spend our dollar. Forget about the politics, it's when we spend our dollar and making sure that your food dollar is actually reinforcing and driving these regenerative agricultural practices. Making sure your food dollar is going to food that you know where it is grown, where it has come from, how it has been grown. That it's been grown through these regenerative, carbon-enriching soil processes. As you said we'll talk a lot more about the actual preventative health, nutritional, you know, benefits and dividends that we're going to get if we do that. But let's do that on another day. But the whole thing of using our money that we invest in food, the energy we invest in our communities in re-greening, rebuilding those soils, rebuilding those hydrological, you know, dynamics.

Brendan [00:58:20]: And to do this, to avoid catastrophic climate change and resulting refugee crisis and political and economical chaos, social collapse, God forbid, how much time would you say that we have, to turn things around, and what happens if we don't?

Walter [00:58:37]: Right, so there's an old Chinese proverb that says the best time to plant a tree was 20 years ago. The second best time is now. Right and we are very much in now. We've wasted 50 years since Keeling gave us the information. We've wasted 30 years since we had the UNFCCC committing itself on paper, and we are already seeing these dangerous climate extremes accelerating, be they hurricanes, floods, sea level surges, wildfires, droughts, aridification. And you know, British Columbia was burning, Portugal was burning, Alberta was burning, things are serious. And so the bottom line is, in the next couple of decades, we are going to find that things get very, very tight. And biological systems just don't come down to a soft landing, they collapse. And so we're going to find that yeah, systems are stressed, and then there's a very, very dangerous, rapid collapse and with that comes social instability. And it's that social instability that will be then multiplying, catalytic disruption. You know, so we're going to be the main culprit through that social instability of our risk and crisis. So the more buffering, the more resilience we can put in now at that community level right across the planet is critical. So I would argue yes, we've got ten years perhaps, right. Because we need to build that buffering, that resilience, that secure water, that secure food, you know that secure social stable system. And if we don't, we are going to get that feedback, that blowback from instability. And I mean, you know, I don't want to go into examples, whether you know, it's Syria or now Puerto Rico or whatever. But the point is we are seeing it happening and the challenge, the imperative is what are we doing to void that level of instability? Our, you know, strategic leaders, they get this 100%, they know exactly what it us. Up to know they've been saying hang on, we've got to have security measures to address it. But you can't address it with security measures, you can only address it by rebuilding your soil carbon sponge. Because only that gives you the food, the water, the buffering, the stability, you know, that we rely on.

Brendan [01:01:26]: Well amen to rebuilding the soil carbon sponge. Amen to that.

Walter [01:01:33]: Yeah totally. And the other last thing perhaps on this one —and it's a bit of an ironic thing— is, look we can be very, very confident and relieved that Nature is going to do it, whatever we do, right? I mean Nature is going to rebuild healthy resilient biosystems exactly through the same process she used 420 million years ago and many times since after every Ice Age, after every volcano, after every meteor. That's exactly what she's done, every time, successfully. The only question we have got is, are we going to help her do that, or let her do it after, and without us. Thank you very much.

Brendan [01:02:21]: Yes, ouch. Ouch if she does it without us. So let's avoid the big owie. Walter thank you so much for a real tour de force introduction to an understanding of our planet with staggering implications for each of us and for our world. You're a true renaissance man, you know, in physical science, biological science, agriculture, human nutrition. And on behalf of myself and the Eat4Earth community, I want to thank you for taking on the leadership of bringing this powerful information to the world's stage and to each one of us individually in this conversation.

Walter [01:03:06]: Well thank you Brendan and in all that wrap up, a simple word is don't forget our friendly fungi. Thank you very much.

Brendan [01:03:14]: Amen.

So what Walter just explained to us is that it's actually water that governs 95% of the heat dynamics of the Earth. And he's given us a toolbox for cooling the planet by drawing down carbon from the atmosphere and putting it back into soil and plants and trees around the world. So essentially what Walter is saying is that our current climate models are based on carbon dioxide levels, perhaps for the wrong reasons. We need to get excess carbon dioxide out of the atmosphere into soil, to create the soil carbon sponge that will cool the planet. And also, we need to build forests because that is one of the tools in the toolbox, because of how important forests are for creating rain events, frequent rain events that, instead of you know, infrequent, catastrophic events, frequent gentle rain events, that open up the windows in the atmosphere for heat to escape. And I'll add that we need to get the excess carbon dioxide out of the atmosphere to reduce atmospheric carbon dioxide levels so that the oceans can release their excess carbon dioxide that has turned into the carbonic acid that is acidifying the oceans, dissolving the shells of the phytoplankton and other organisms, but especially the phytoplankton that produce almost two thirds of the oxygen for the planet. So what we're essentially, our goal essentially, is to create a carbon sponge, excuse me, a carbon pump, via the carbon sponge, that pumps carbon dioxide out of the atmosphere, out of the oceans and puts it back in soil and trees and so forth in the biosystems of the planet. And that's where regenerative agriculture comes in, and that is what John Roulac is talking about when he says that we need to create a regenerative agriculture system that heals the oceans because the oceans are arguably our most urgent threat, our most urgent crisis. And regenerative agriculture creates agricultural ecosystems that draw down carbon into the soil and keep it there. And we're going to learn about some specific types of agricultural systems that do that in the presentation from Eric Toensmeier from Project Drawdown and also from specific agricultural innovators that are doing phenomenal things. They're growing carbon, carbon levels in soil, you know, the organic matter in soil, that are beyond what any soil scientists have ever thought was possible. And so stay tuned and enjoy the empowerment and the inspiration.

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