Bruce Damer and Terence McKenna in Hawaii

Terence's home in Hawaii

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Bruce Damer: If you want to render this asteroid that you convert into basic elements and engulf into structure, you would dispatch a kind of lichen that uses solar energy. The code is the light. It occupies that space and it starts to manufacture, to absorb the asteroid, and then it produces pollen which goes out, and it's networked pollen. Then it's in the Oort cloud, as Freeman Dyson says, and then life is off the earth and it's a very different kind of life. It's certainly not sentient life, but it's very effective. Some of the spores get stuck into themselves, basically. Of course they'll need atoms — at least as far as we know — to actually have a matrix of life, very ordered atoms. In the long view we're the ladder that life is trying to climb. Along the way we'll get great terraformers and we'll make lots of living space inside the earth.

Terence McKenna: You don't sound like you're of the school that thinks that we're close to some kind of AI and that when it goes over the threshold, within a matter of hours it will just inflate into some kind of thing that we can't even relate to and will be of no interest to.

BD: No, I think, of course, that it's hard to define intelligence and consciousness. I think that people underestimate the trial-and-error, the error-proneness of living processes.

TM: But on the other hand, the iteration speed of this machine life is so fast.

BD: There's a difference: the ecosystems that they're living in are extremely arid. They're basically life living in these very narrow tubes connected by very chancy processes.

TM: You mean the wires…

BD: The wires and the servers, if that's how it stays. Whereas an ocean is a billion trillion parallel processes, and black smokers and superplumes going up and carrying hydrons. It's a massively different ecosystem where you can have a lot of things happening at once in the same beast, a lot of reactions that happen at the same time, and I think that the error rate is always the crippling factor. Why, for instance, didn't we invent, of all the science fiction, something that eats all silicon, or that comes down into the earth and eats all carbon-based life and we're all gone — I think it doesn't happen because general-purpose things are really ill-suited for survival and when you're specific-purpose you're prone to lots of errors. So I don't think there are going to be planet-eaters any time soon.

TM: I don't think it was the planet-eater scenario so much as the idea that once something became sentient it would immediately design something beyond itself and you would get a cascade of self-perfecting machine intelligences that would go over the horizon before you knew what was going on.

BD: I think — and this is the theme of the next Biota conference: symbiogenesis — that every life form contains the code of the previous ones, like the cell absorption of mitochondria, that things are built that way. For instance, that human life as an organism is a bolus of biological organisms surrounded by metabiological forms called culture, and that in fact there isn't a way to regenerate a Frankenstein that's separate from all that. It's always going to contain the errors and the powers of the previous organism. Now, of course, if we generate code-based lichens, they would be so simple that they would be like a slime mold and won't achieve consciousness. They would achieve the ability to survive on the Oort cloud surface and evolve through error and process over tens of thousands of years. But they may evolve to be giant, coral-like slime molds and simply consume resources, because that's what life seems to do when it enters a new ecosystem.

TM: But doesn't it also tend to modify the ecosystem to make it easier on itself? At 1000 MHz for 10,000 years, you don't really know what you're going to come back and find.

BD: I agree. I think that what will happen around 2040-2050 is that the transmissions between the organisms, between the biomes, will suddenly not be interpreted. For the first few years they'll be spreading across objects, even an asteroid with bits and pieces of dust this big is enough for it to colonize, as long as it's got certain ingredients and it's facing the sun. So you'll be able to track and understand it and then suddenly you'll be messaging and you'll get something you can't understand, and there's no way for anyone to interpret what communications it will have. They'll understand fundamental operating-system calls, the organism will be making a kind of housekeeping, but there will be a metalanguage that evolves.

TM: It'll be contextualized for the organism.

BD: It'll be like bird calls. That will be the moment when we have first contact. In two weeks there's a conference called Contact 16, Jim Funaro's conference, it's anthropologists and space scientists and science fiction writers that meet every year and talk about this kind of stuff, and this is what I'm going to talk about.

TM: There's a lot of study going on of the genetics that control bird song and how it localizes and what's actually going on, and it begins to look like there's a pretty seamless process right straight through to complex language that's just a mutation of this signal-generating impulse.

BD: I think language will tell us the date, and then we'll have something, not necessarily sentient, but something that is no longer anything we can understand. And it will be from that point on an attempt to contact this mass, this bolus, that will be in a ring around the solar system, and it will be tracked. It will become the second Terran ecosystem. They'll do work to support us. They'll render down comets and feed mass drivers and so on. But like any good farmer with his seeds and his crops, there'll be a lot of unpredictability.

TM: These nano-colonizations of Oort cloud material, that originally is established for mineral recovery?

BD: Probably, and for fuel construction.

TM: Why the outer solar system and not the asteroid belt?

BD: There's not enough elements, or variety of elements. I think the Jovian system is going to be where the action is.

TM: So many interesting satellites and so much incredible electrodynamics and magnetodynamics in that system.

BD: If you want to do anything to Mars you have to drop a whole lot of water onto it.

TM: But they're obsessed with Mars for some reason.

BD: It's kind of a mistake. But NASA again, I think if you picked any planet that is reachable in reasonable budgets and spacecraft sizes, it's Mars. Venus is kind of a lost cause.

TM: No reason to go there.

BD: They mapped it with radar and it wasn't very good. Mercury is too strange and small. It's basically a moon. It has an atmosphere that forms in twenty seconds when the sun comes up, the atmosphere's four inches high and it freezes on the other side, and it's a four hour day.

TM: But it is tidally locked to the sun, so you do have this interzone.

BD: The sun is half the size of the sky. But Mars has got enough stuff, it's got volcanoes and extinct oceans, icecaps. And the next one out is Jupiter.

TM: And Europa.

BD: They're going to drop Galileo into the Ionian atmosphere in August. It's a really crippled spaceflight. Galileo is an example of an early bio-instance, it's a model. I remember seeing Galileo being packaged to be launched on the shuttle, and this was the shuttle after Challenger, so it never shipped out. So, I went to see the Galileo spacecraft being crated up. It had a high-gain antenna which was this great big mesh thing in this tiny satellite dish that was all folded up, and when they did launch a few years later, it never opened.

TM: So instead of huge bitstream and bandwidth and all kinds of power, they had to work with…

BD: A low-gain antenna, the size of a pizza pie. When the Challenger shuttle blew up, NASA was no longer permitted to carry liquid fuel upper stages in the cargo bay, which was considered too dangerous. They had to carry solid fuel. It's safer but it packs very little punch, it doesn't generate much thrust, about a third. So they had to design a new way to get to Jupiter where they go around Venus twice and steal some of the angular momentum of Venus by slingshotting around it and coming back again and getting faster and stealing from the planets. Then they passed the earth twice, and on the way into the sun the high-gain antenna, which was still wrapped up, got heated and flexed and shrunk, because it was never designed to go into the inner solar system — it was supposed to go straight out on the express — and when they tried to open up on the second time it came out like this. [*gestures*]

TM: It was a screw-up.

BD: It was a huge screw-up, and so the mission planner said, "It's two billion dollars down the tube, there'll be congressional hearings and we scrap it or we figure something out." So on the way to Jupiter they changed Galileo's brain to think differently, process differently, see differently and hear differently. By the time it got to Jupiter with this tiny little pizza pie dish — it had a reentry vehicle, this saucer-like pod, to be dropped into the Jovian atmosphere; they'd never build another one in their lifetime, so to lose that… and they got to the Jovian system, and by that time it had learned to see in this "jailbar" method — it would take strips out of the sky and the ground controllers would say, "Look, there's more rings, now take smaller scripts and compress them as much as you can and send them to us." So they couldn't change the hardware but they could change the software. Galileo was sort of a very early 20th century metaphor of the visual biome moving out, being transmitted massless into a receiver.

TM: It was smarter when it got there and smarter when it left.

BD: Yes, and it's been in orbit for 2.5 years now.

TM: But they had to stream these pictures back — instead of in real time, it takes months for the data to come back.

BD: Yes, at 8 bits a minute or something. But they've done fantastic science with it. They dropped the probe, they ran the recorder and the probe went down into the Jovian atmosphere down to Levy-9 and, like that, it collapsed because of the pressure, it was on chutes; and now they're going to do a close approach, it's only four times higher than the highest volcanic plume above Io — Io has sulphur volcanoes — and they're going to graze the top of the volcanic plume and it may not survive. They're going to try to do as much they can, and it may just burn up and destroy it; but it's all being recorded and that comes back, bit by bit. The Jovian system is like its own solar system, and Galileo has been in orbit for 3-4 years, just sweeping by different moons.

TM: What you really need up there is several tons of state-of-the-art imaging equipment and all kinds of fancy steering engines. What an interesting system. This mission to Saturn is pretty epic.

BD: Cassini is the last big heavy mission, six tons of spacecraft.

TM: So, it's going to drop a probe into the atmosphere of Titan that will land on the surface.

BD: Titan is the only moon with an atmosphere.

TM: There may be methane hydrocarbon oceans.

BD: With outsized tar blocks and the greatest surfing in the solar system, 600 foot waves.

TM: It's like Solaris, Titan, it's a really strange world.

BD: And yet our moon is way out of proportion, it's way too big. That's why they think now that our moon appeared because of a massive collision. There's no way the earth could have captured something the size of the moon, so it had to have been a very bad hair day.

TM: A Mars-sized object crashed into the earth and it separated and went into orbit.

BD: The Biota group goes back through time, to fossil sites. We went to see the Cambrian fossils at the Burgess Shale and then we saw the human fossils in Cambridge, England. On the next trip we're going to go back 3.5 billion years ago, to western Australia, where you have the oldest evidence of life that's certain — the stromatolites. The stromatolites are these towers that were the smokestack polluters in the pre-Cambrian, they're colonial forms of microbial mats that have blue-green algae in the top. If you went back to the earth then, you'd have to wear a spacesuit because there was no oxygen. These things lived around all the continental margins and they'd pump oxygen out into the atmosphere, which was very poisonous, a very toxic substance. In Shark Bay at Hamelin Pool, if you lie down at night next to the last remaining living stromatolite column, you get high on the oxygen, there's so much.

TM: There's a living column?

BD: Yes. It's hard as rock. What happens is that the top is this mushy layer with up to three billion individuals per square meter, it's colonial, it would be the only thing you could have seen with your own eyes that was obviously alive for two billion years, and underneath there's chemosynthetic stuff. Basically the stromatolites sucked iron oxide and calcium out of the atmosphere and built these towers below it. Ocean levels would rise and fall with the tides and these towers supported the top of the pond, and they're hard as rock. In fact, half the iron ore in the world is stromatolites. Life made the continents.

TM: So, the earliest life on earth built the American railroads.

BD: That's right, it was a biological process.

TM: The accretion of iron.

BD: And not oxidized iron. So what happened was that the stromatolites pumped and pumped, and then at one point 2.5 billion years ago, this sudden fantastic thing happened: the Oxygen Holocaust. The oxygen levels just flew into the stratosphere. Earth has been through many mass extinctions, but this was a really horrific one. Any single-celled organism that could not handle incoming high densities of O_2, which is very poisonous, it basically ripped these cells apart. So there was this mass extinction, and there were a few cells which could absorb the oxygen called mitochondria, and they basically turned it into an energy factory.

TM: One in trillions of cells; but all present life is traced back to the survivors of that challenge.

BD: When you go jogging and suddenly your body runs out of oxygen, the cells in your muscles switch back to the old system of metabolizing chemosynthetically. You get lactic acid and it makes you sore because you're going back to the ancient system before mitochondria could get energy quick, but at a price. So stromatolites — there's this tiny pond they found that's very saline, and they're there and they're 3.5 billion years old.

TM: And they're just fine, thank you!

BD: Stromatolites go back to 3.5 billion years, and the earliest evidence of life is 3.86 billion years, so they're very close. The meteorite impacts stopped at about 3.9 billion years. So life actually popped up pretty quickly after the cometary inflow ceased and you didn't have the surface of the earth getting all molten every once in a while. But we're going to thank the stromatolites for giving us oxygen and apologize for the fact that we're putting all this CO_2 back.

TM: But plants like CO_2.

BD: Earth of two billion years ago was really weird. Chances are the oceans were brown, because the continents had no plants that could hold the land, so the outwash was eight times higher or more. There were huge river systems pouring off the continents. The Himalayas and the Rockies are mountains that will never appear again, because there's never going to be that kind of deposition again. They're unique, they're creations of life, they're full of life. They're finding more and more that life and water are the reason why we have plate tectonics in the first place and why we have mountain ranges.

TM: Why do life and water drive plate tectonics?

BD: There's several interlocking factors. One is that water lubricates and allows this kind of continuous movement. Water also absorbed a lot of the crap that came through volcanism early in the earth's history and created a cleaner atmosphere, which in turn supported the rain, which in turn supported all the outwash. Life sealed the continents in this hypersea of roots coming into the ocean and sealed all that land in, so the outflow of the erosion wouldn't be at all what it used to be; so the future generations of mountains will be quite different. Now, in the past ten years, they've discovered these black smokers, in the mid-'80s, huge jets of water full of sulphates pouring out of the bottom of the ocean, and there's tons of life in and around it, eating chemicals and not needing sunlight. Bacterias and tube worms and crabs...

TM: Tube worms up to six feet long.

BD: Yes, they're eating the pollution. They were always wondering, if life evolved around one black smoker, they don't last long. How did they get all across the planet? All the black smokers have about the same lifespan. They found these things that are called superplumes, which are underwater Mount Saint Helens'. You get this block of hot water, which is the same as a pyroclastic ash explosion that comes out at 12-15 miles across, boluses of very hot water, and they come blowing off as a mushroom cloud at the bottom of the ocean and then they get caught by waves and currents that carry them hundreds and thousands of miles, and they're full of microbes that have been carried in this express bus system and they're raining back down on other plumes. This superplume system may have been the engine that transported life around constantly. Underwater volcanism is our roots. If we ever get to Mars we'll see the great granddaddy of all solar system volcanoes, Olympus Mons at 80,000 feet. The top sticks out of the atmosphere, so the atmosphere at the caldera is different.

TM: I didn't realize that… the Hawaiian shield volcanoes are the closest thing to it on the Earth.

BD: The volume encompassed by Mauna Loa, you could fit all the Sierra Nevada inside it. In effect, it's the single largest structure on the planet, and it was created by one process.

TM: It's the world's largest mountain by volume, and if you measure it from its sea bed floor, it's the world's tallest mountain. It's 13,000 feet above the sea; that's 16,000 feet that it rises from the ocean bed.

BD: There's a fair analysis of why there's a hot spot under here, it's that there's some sort of a constructive harmonic that's going on that's actually breaking up the crust, and there may be one on the other side. They've looked.

TM: At the exact antipodes of Hawaii?

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BD: It's kind of a semi-conscious push, the drive that human beings have had to build and to make things and make life and create. We're creating, tool-making things. Perhaps they don't know why, but they'll make the next phase.