

CLAREMONT

MUSEUM OF ART

MULTIVERSE

Conversations
between
Art and Science

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What is knowable, what is real?

Sebastiaan Bremer and Dr. Vatche Sahakian

SB: Hello Dr. Sahakian,

How are you? I hope this email finds you well.

My interest in science has arisen because of things I noticed while working- how the mind flutters from subject to subject, how time stretches and shrinks- how memories are vague and manipulated and intersecting and overlaying, and how intuition and parallels occur often. Some have a religious set of explanations, some have biological explanations for all these things, others physics.

I travel through time by using photography. I work on photographs from a short or long time ago –usually, but not always taken by me, but always with a personal significance- and draw on them. The photo is an image of a state of something in a second or less, and the drawing takes hours, days, months. Ideas that occur slowly, because of the photo, or my state or events surrounding me, find their way in, and become a filter, something that changes subtly, but sometimes completely, the original meaning and look of the photo.

Especially at the outset- and more in my larger works, I would start with one idea which just by events and time would be infused and overrun by other ideas. I would start with one reality and end up changing the meaning completely, just because I was like a cork on the ocean sometimes and the waves of time would alter everything. I started to really enjoy this, and I still do. My grasp of my work and my ambition has changed a bit perhaps and now I make larger drawings on larger pieces so there is less that falls through the cracks as it were. It's a different scale. My first works were more streams of consciousness, now there is more consistency to the works perhaps- the ideas more crystallized. This might also be age. I have more knowledge perhaps, experience- from 29 to 37 is a change- and I have kids, and time may be more precious to me now? And of course, I do not want to do the same thing over and over again.

I draw usually by making dots- small marks that can coexist with the photograph by not hiding too much, not being too much of a net to look through, but an intervention that is able to set itself in between and not cover. A way to alter without killing the image of the photo underneath and the dot by dot drawing also feels like a needle that records a sound on a record. It's a clear recording of the passing of time, like the notes in a symphony- following each other but building something that is felt as a whole, while unfolding in time, gradually and always changing subtly due to its complexity; its dependence on how and where it's viewed (heard) and at the same time all *now*.

I feel that by remembering you pull things from a long time ago into the now and they are alive, in the present. I have come to kind of believe, without being dogmatic, that things and times coexist. That there is not such a thing as a linear line of time that we can step back from or go forward to. I sometimes have the feeling that things are interlinked and that it's more of a ball with knots; and that there are many crossovers. I use this in my practice, but without any real understanding of this, except intuitively perhaps.

When I really start to consider this it hurts my brain. It's the same way I have a problem with the constructs of the universe- like what is outside the solar system? And what is outside that? The concept of "un-ending" is impossible for me to envision and therefore really understand. Yet still we all live our lives with some things just not thought about because otherwise we would be off kilter and uncomfortable. The notions that walls stand, objects fall to the ground and the roof stays where it is are just hopes, not real realities.

A friend of mine survived a plane crash once. The reality of that was so strange to him- the seats in front disappeared, behind him also tragedy, but he made it out fine. He told me later that for him the reality of your apartment being transformed from one moment to the next into a disaster zone was quite a reasonable thing to consider, and was more truth than our agreement that things just go on and all is well.

George Carlin passed away and he had a short piece called *The Secret News* (everything dies, people talk behind your back, etc. etc.) which is a good truth about the way we live. If we really had to confront all the truths- all the things that happen- it would be a sad world, and we might be immobilized. We need a little faith, a little hope. I am by nature, I think, a pretty hopeful and positive person, although I have a dark knowledge of all the sadness in the world. There is one person I know who doesn't like talking to me because I tell her too much about our world and that makes her depressed. So we have agreements in the world, I do as others, to keep going.

Kind of the same: the notion that we spin at high speed around our Earth, and that we are flying through space is not parallel to our day experience with our clouds and trees and wind and life around us.

When I looked at the stars as a kid, a strong feeling of vertigo would hit me when I had to consider it all. The thoughts would just become too much and I would just have to pull myself away from that look into the past- into nothing- and the reality of our span in time that is just a blip. It was just overwhelming and cascading. I also remember a dream: perhaps while falling asleep- wherein I would lay down, the bed would fall away to reveal something akin to an elevator shaft and I would go down, horizontally- faster and faster all the time- and a sound wave growing louder and louder until there was this point where it was impossibly loud and fast and then... zip- white- quiet- nothing. Now I always imagine this as going through the speed of light or something- or death.

Art is funny that way. It's a loud yell outside of your time span. It's confronting death and outliving - cheating it. Trying to ignore it perhaps. But that also will go up in smoke at some point. Real forever does not occur, unless in an atomic or molecular sense (we are stardust?). That brings me to another question: isn't something like 75% of space built out of unseen and unknown components? Does it follow that since we are all built from the same materials that we are also constructed out of 75 % of unknown stuff?

Then the issue of multiple realities unfolding in the same time is very hard for me to contemplate. I heard someone talk about not just two, but five or more? I live in the pleasant assumption that I do not have to worry that the neighbors' grass is greener. It makes my life easier. I don't use any computers in my work for that reason. Each work has its own reality.

Every mistake or happening needs to be followed by the next mark. There is no going back or what ifs. I just try to get the now right and not have too many options. Life is filled with regret and mistakes, but peace comes with the knowledge that you can only work on things going forward. The past is gone. I cannot imagine things having a different outcome than the now which is here, because I just cannot see outside of my own perspective really. Except when in meditation or hallucination where the interchangeability is sometimes felt- where you can actually see the relation between us and our surroundings and where you can walk around your mind and grab the hand of your younger self and talk to it. This is, of course, in contrast of what I think is true in my work. The past and present and future are all alive in now and there is nothing but that. It's all here, right? Rolled into a big ball, a big knot.

See- ramblings and hopscotch. I was going to ask you this: perhaps if you have a moment you could look at my website? In works like *Ilha das Cobras*, *Whirlpool* or *Superman* - and many more, perhaps you can see what my interest is to your area of study - or not.



Sebastiaan Bremer, *Superman*, 2006.
Courtesy of the artist and Hales Gallery, London.

VS: Hi. I looked through your work on your website and liked it very much. The style is unusual, with a mixture of complex order and contrasts. I like how you have started using colors; I assume these are later works? It seems you have come up with unique shapes that lie between fractals and organic forms that convey emotions very efficiently. I have always had an interest in painting, oil-based exotic landscapes and stills. At the age of 16 I had to make a choice between pursuing a career in science or attending art school in Rome. I wonder if I made the right choice... since then I have stopped painting due to lack of time but have resurrected my interests in the visual arts through photography. The technique you describe to create your works from

photos sounds particularly fascinating to me. I am surprised however that you do the work by hand, avoiding the use of the computer as a tool. I've resisted the use of computers in my own research work for years; but I have finally succumbed to it... perhaps you will fall in time as well...

In physics, you usually allow your imagination to guide you within the confines of experimental data, the real world. In the branch of physics that I work in, string theory, experiments are not technologically possible at this stage. Hence, one substitutes logical self-consistency checks in the place of experiments. Perhaps all that is logically possible and mathematically consistent is to be real, or at worst must be checked by experiment. This leads to very unusual directions that stretch imagination and intuition. While this may sound a strange venue for physics, in fact it is not uncommon. The most celebrated historical instance of this mindset is the development of Relativity by Einstein. There were no experiments to warrant Einstein's crazy proposal, only the logical self-consistency of the physical laws.

Imagine you find yourself in a dark room with absolutely no light; and you are to find the door to get out. One strategy is to find a wall and then cautiously proceed your way around the room by feeling the surfaces of the walls. At every step, you are leaning against something real that guides you; gradually you map out the room. This is the usual way physics works in conjunction with real world experiments. Alternatively, you can try to randomly zigzag yourself through the room, from wall to wall, each time discovering a totally new unfamiliar area of the room while walking aimlessly in the dark. You hence map out the same room and, with luck, you hit upon the door sooner rather than later. This is how string theory attempts to understand the physical world. One takes wide leaps in imagination from one wall to the other.

In this way, I think a subject like string theory is similar to an artist's way of thinking. Your paintings are leaps in imagination, often disconnected from the real world while being inspired by it. The collection of works is a map of your understanding and view of the world. In string theory, at the end we are still accountable to the real world. It seems art, on the other hand, doesn't have to abide by common rules, a single perception. I think what you describe in terms of thought process for creating artwork, while different in its ultimate goal, sounds very similar to this mode of physics research in the means and mindset used to reach its goals. I don't think it is surprising that you instinctively have developed an interest in fundamental science.

SB: I think you are right, but one rule I do have and is that of communication. I do have to transfer ideas from my brain to someone else's. That's not a rule true for all artists I think, but I am really concerned with not being isolated and hard to get. I think it's important to bring things down to a point where they are able to be intuited by another, if not understood. Part of that is esthetics. You need to draw people in, or at least contact them. That's possible in another way: to shock and to create horror. But what you really want is to engage I guess is the word. As in the words of a friend: it's a sin to be boring in art. I am paraphrasing here, but you get the idea.

VS: You ask about unknown forms of matter that fill the universe. This is one of the most profound and important questions of physics nowadays. While some of the ideas involved were pioneered decades ago in the context of theoretical and abstract ideas, only recently have we been able to make measurements that confirm some of the strangest realities of the state of our universe. Here's the verdict so far: 70% of the universe is made of a form of energy that

anti-gravitates! While gravity tries to collapse matter and energy onto itself, this form of energy - often referred to as “dark energy” - wants to swell up under gravitational forces. This is why the universe is expanding; it’s the consequence of having too much dark energy pervading space. Dark energy is believed to be uniformly spread out throughout the universe, including everywhere around us, through us. It is believed to be vacuum, emptiness. So, a totally empty box of space apparently has energy and (negative) weight. We have been able to measure the density of dark energy and its value is billions and billions times smaller than predicted... in traditional physics, we do not have a resolution to this inconsistency. String theory does provide a better understanding and accounting, but its answer is not yet complete and fully satisfactory.

Of the remaining 30% of the stuff in the universe, 26% is termed dark matter. We know it’s there because of its gravitational pull on the remaining 4%, but we can’t see it using light, X-rays, microwaves, or any other means of observation. It is believed to be less exotic than dark energy in terms of fitting within the realm of the laws of physics we have today. Yet, we do not know what it is fundamentally. We can tell however that we are not made of that stuff ourselves. Only 4% of the total energy in the universe is in a form we are familiar with!

SB: This could easily be the place where some see some other powers coming in to the picture -a god, a spirit, an energy for sure? I have made many works where I made things or links visible. Some think of it as air. It could very well be the dark matter holding it all in check, or pushing it all apart as you said.

VS: There are several amazing coincidences and paradoxes that arise from recent cosmological observations. Some even more striking (and disturbing) than what I just talked about. It appears that our state, our universe, is quite special and unusual. If one wanted to create a world from scratch one would need to arrange things very, very, very carefully to get the universe we see around us. The generic junk looks very different... *These ideas connect with the picture of multiverses, of multiple realities.* Recently, some physicists, including string theorists, have raised a proposal known as the anthropic principle that pushes physics into the realm of philosophy: the notion that the universe is such because it is; because otherwise we wouldn’t be around to ask the question. The suggestion is that there are some questions in fundamental physics which have no answers. The questions are ill-posed, the premise beyond our comprehension, *the dark room has no door.* This is very controversial as you may expect. Have you heard of this idea?

SB: This is where I have felt to be a long time already. We just know enough to know we cannot understand. A very frustrating place to be- to have a brain that just can barely fathom the lack of brainpower to comprehend, to encompass. Are we just smart enough to know we are stupid? Or at least we need more of something to envision anything like this?

This also sounds a bit like the whole issue in philosophy - is something happening if there is no viewer? Or is this more like “things are like they are like they are.” It sounds a bit like a parent too: “Because I said so!” Or like my aunt who is a nun who is comfortable, while being a very intellectual and smart person, to accept not knowing- not being able to understand.

I gave up writing a narrative and decided just to lob you questions-

1. Is what you wrote me the end of reason? What new questions should we come up with? I have heard of people who are very smart and said that its sometimes a good idea to start with a solution before you know all the problems. We are doing that already aren't we, as humanity and specifically in science?

I am always struck by the messiness of our tools, our brain and our eyes with their defects. Our senses in general are really, really limited. And the arrogance of us to think we can handle all that power and insight in a controlling way is always amusing to me. The gall! It's really sweet in a way. Although even in that limitation we can see something helpful. I always find limitations helpful. Too many options as offered in computer work might be confusing too. I like having to deal with cards as they are dealt. I like chance and I like not being at the mercy of a complicated tool that might break and I won't know how to fix it. I really want to have my head and hand as close as possible to each other and having no one interfering. I am a receptor of experiences, smells and sounds anyway, and that is already so much interference. That, and really wanting to enjoy my whole process makes me happy to work like I do. I am sure it can change, but that is where I am. No steps in between. It's all pretty direct. I think and draw straight on the paper. My frustration with waiting and technical issues put me in this place and so far so good.

2. You said perhaps we are asking the wrong questions- any new questions? Perhaps the old ones of Gauguin are good. Where do we come from? What are we? Where are we going?

D'où Venons Nous / Que Sommes Nous / Où Allons Nous

I just read an article in *The New Yorker* about the Post String Theory period now- and I don't even really know what string theory is! What is string theory, really? Could you explain?

I have imagined, as others have, that our evolution now includes our own tinkering with DNA, setting off change at warp speed. Perhaps our tinkering can adjust our brain so we might actually come closer to understanding the more complex issues that are now just too confusing and big for our smaller brains to understand?

I have always been inspired by a quote from an artist called John McCracken in *Art in America* in which he describes a feeling that seems to be, for me, a great explanation of the nature of time. Could you let me know what you think about this?

Between Two Worlds

By Frances Colpitt
Art in America, April 1998

FC: When you talk about the simultaneity of real time, I'm reminded of the story you once told me about an experience you had in high school, which seems to summarize what you're talking about.

JM: It happened on my last day at high school, after graduation. I lived about 20 miles from the school in the country in Northern California. That evening when I got off the school bus, my mind was full of thoughts about where my life might go next. I was thinking big, wondering thoughts. "Is there a God?" "What is the nature of everything?" I stood next to the almost-deserted highway for quite a while, looking off to the west toward the mountains, where the setting sun was turning the sky into a beautiful riot of color. And a strong, curious feeling came over me: I felt like I was being watched from behind, from up in the sky. It unnerved me a little, but it was kind of a spiritual and good feeling, as if God were watching me.

And that, for a while, was that.

Then one evening, about 15 years later, I was in a contemplative state, remembering things, and I remembered that experience. And in remembering, I did what I think people often do, which is to remember from the outside, as if viewing a photograph of the event. So I saw myself standing there by the road, looking at the sunset, with the countryside spread out all around me. I drew the scene into focus in my mind, pulling it closer into view, moving closer to it. As I did this, I suddenly realized that I was “coming into” the scene exactly at the point in the sky from which I had felt I was being watched 15 years before. I was utterly shocked. Something like a lightning bolt snapped between me and my past self, and I felt myself rubber-banding perceptually back and forth from one location to the other--from one body to the other. In a flabbergasted state I realized I had been watched then, and that the watcher was me, my future self.

The fact that I had thought I was being watched by an exalted spirit--something like God--was not, I had learned in the interim, so strange. People who have near-death experiences often meet a dazzling spiritual being who later turns out to be themselves, or a part of themselves. That experience of mine was a small but effective illustration of the existence of a wider reality. To perceive the total reality--something close to the “real picture,” in which everything really is simultaneous--would be, I think, incredibly confusing.

Some more: *Does the anthropic principle indicate the end of reason?* On that note, I had an epiphany when I realized that DADA and Surrealism came logically out of the madness of total slaughter in the WWI. What sense is to be made of such total destruction? What meaningful end can you ascribe to such death and destruction? I guess laughter and absurdity are as appropriate as solemn behaviour, perhaps more so.

VS: Indeed, it is strange how human progress somehow gets born in destruction and war; remember that much of modern science was driven at the beginning of the 20th century by the race to make “better” weaponry... at the same time, it is these periods of turmoil and destruction that occasionally also roll back the clock on science. A great deal of our knowledge in the sciences is discovered more than once: first in ancient Egypt, then to the Chinese, then to Athens and Rome, followed by the Arabs, and finally back to Europe... knowledge appears to be very fragile; it can be destroyed and lost rather easily. I wonder if it is the same for progress in the arts?

SB: True, if you look at the paintings on the walls in Pompeii or on the late period mummies, the painting is better than anything people were able to do for another 1500 years. I read a great book about the weird way knowledge goes back and forth: how the Irish saved Civilization, a treatise on how the knowledge hibernated in the hands of the Irish monks during the end of the Roman empire, when that crumbled all order was gone and Europe was a mess, and libraries went up in smoke. The Irish brought it back to Europe in the dark ages.

Well there we are for today- not a lot of clarity, not a lot of words from my own mind but something to think about. Hope this mail finds you well. I look forward to your response- if there is one. In my mind, the response to large complicated matters becomes a wordless yelp. That is always most eloquent in a dream. There is a reason I called a book about my work *Monkey Brain*.

VS: Hi. Here are some answers, and questions, with regards to your last email:

Does the anthropic principle indicate the end of reason? In some sense, I think it does.

There are two types of questions we struggle with, and I think this may apply to Science and Art equally. One type of question addresses deep fundamental issues; its answers lead to changes to the way we see the world and stretch our intuition into new realms. A second type of question stays within our beliefs and perceptions. The answers are more technical, yet can still involve imagination. More importantly, they affect our daily lives directly. String theory addresses questions of the first type -as does the anthropic principle. Applied sciences, technology, and engineering address questions of the second type. I think the anthropic principle indicates an end or a horizon for deep fundamental questions. This does not however mean that science or technological advance reaches a conclusion. Hence, you could say it's the end of reason; but some pragmatic people may say, "so what?"... I wonder if there's a similar division of labors in the arts such as in painting. It is perhaps the analogue of reaching the end of discovering new styles of expression or artistic communication, versus the production of art within established norms, but still producing them and affecting people with it.

Gauguin's quote is very much to the point. In some sense these are the type of questions that the anthropic principle may purport to be dead ends. It's like trying to find intricate meaning in something that simply does not have any.

As for what is string theory... I don't think we really have a concrete answer to this question yet. I think we can answer it by stating what we want it to be, eventually. Basically, string theory is the rewriting of the laws of physics so as to reach the most fundamental understanding of the physical world. The theory should be able to compute and predict all observable measurements based only on knowing the initial conditions. All fundamental constants such as the mass of the electron or the density of dark energy should be computable from principles first, without anything put in by hand. At this stage, we have parts of this program. But there is a lot missing and one of the hurdles has to do with multiverses and the anthropic principle. If the latter is the correct line of thought, then we are perhaps in trouble: even if we formulate the ultimate laws of physics within string theory their predictive power would be limited because these laws could not answer some of the most fundamental questions we pose through them...

I find these recent DNA tinkering in biophysics fascinating as well. I'm not sure where it fits in the grand scheme of things. Perhaps as you are saying a fast-forward in evolution is needed before we can comprehend deep issues such as the anthropic principle. It's like the story of the intelligent fish who becomes sentient and asks why the temperature of the water is such. If the temperature was very different, the fish wouldn't be around to ask the question... but then, one day perhaps the fish needs to walk out of the water to pose the proper question: where did the pond come from?

I like the article you sent. It has an interesting physics twist. Reminds me of some of the Twilight Zone episodes! One of the most fundamental questions that we still do not have a good answer to is, "What is the nature of time? Why does time appear to move in a given direction?" String theory does not tell us the answer yet.

It is also one of the cherished axioms of physics that time does not loop. It's sometimes called the causality principle: the cause and effect link. Also, there are ideas about understanding time flow that tie the answer to cosmology and the laws of thermodynamics. Some suggest that time

is linked with disorder or complexity level in the universe. A measure of the level of disorder in a system is often called entropy. It is an axiomatic law of physics that entropy of the universe is to always increase. We do not know why but it seems to hold universally. And some believe that this is linked with the arrow of time. Perhaps the two questions are the same: Why is time moving forward? Or why does the entropy in the universe always increase? So, instead of two puzzling questions with no answers we have one confusing question with no answer. I guess that is still progress...

I think engaging the public with one's work is indeed a difference between science and art. Historically, many of the greatest scientists didn't care much about bringing their understanding of the physical world to the public. I've read that Newton had to be persuaded to write his thought by his friend. The attitude is often: if I understand it, I'm satisfied and let's move to the next question... In the arts, it seems you are saying that that's not the norm. The artist thrives on interacting and talking to the public through his/her works. That is a very interesting distinction.

SB: I like the first [type of question] a bit more. I think the way we look at our surroundings is a more successful tool to happiness and understanding than changing the world piece by piece. It might be more realistic as well.

VS: I would have guessed that you would, since it is the approach closest to an artist's heart.

SB: Have you every researched Kabbalah principles? I heard a talk in which they compared the way the Kabbalists say to change your perception of your surroundings- to change your world- is neatly paralleled in the thirteen or eleven universes some people believe there are. I forget how many, does that really matter? What is the number?

VS: No, I don't know about it. It is interesting how some philosophies sometimes can make correct leaps of faith. I never understood how the Greeks were able to formulate the existence of atoms as building blocks of Nature. Or how the Egyptians could guess that the Earth is spherical, and even computed its radius to within 10% accuracy!

SB: Isn't that great? Perhaps some things we see as deja vu or intuition are actually representations of communications between parallel universes or little jumps back and forth in time. I am so fundamentally unsure about our ability to observe clearly, our point of view getting in the way as it were, that I consider anything like that possible.

Did you read *Time's Arrow* by Martin Amis? It's the arrow reversed- a great idea. The book is maybe too much of an exercise but interesting nonetheless. In literature I think the most successful describers of time and space problems are Vonnegut and Murakami (and Borges, although I haven't read enough of his work).

VS: Again, don't know much about the references you mention. The Amis book sounds intriguing; I may need to check it out...

SB: It's short, worth the read, and deals with an idea that is as old as the Arthur mythologies, like Merlin who lives backwards, but with foreknowledge. The Amis book character is not as lucky as

I remember. The moment of turnaround of the time's arrow is related to a traumatic experience, a singular moment (a singularity!).

"Historically, many of the greatest scientists didn't care much about bringing their understanding of the physical world to the public." (VS)

I think that perhaps that is a mistake on the scientists' part. By bringing things down to a comprehensible principle or language, the thought gets purified and perhaps it will help the scientist with its next step. My dad is a lawyer of the old school and he always told me about language: to be able to condense complicated principles to short sentences with easy words is very difficult, but sometimes half the solution. Most art or science is too hard to be communicated in normal words. And this is my take on the work of making art- that it has to be clear. Not meaning that there is one meaning or a rebus, but communication is the goal, transference perhaps. And mind you, I am sure this is not always the case in art.

VS: Reminds me of Richard Feynman, the physicist. He apparently was once asked to explain a rather complicated but well-understood physics phenomenon in ordinary words; he replied, "I don't understand it deep enough to explain it in ordinary words". I think this is very true. As a teacher, as I explain something in physics to my students, I feel I understand it better myself.

SB: So true. It's like hanging a work on a wall in a new surrounding. You suddenly see its limitations and possibilities, and realize where to go from there. It's like ejecting the idea (or artwork) from your biological entity and bringing it out in the world, to be held and looked at, tilted to the light, see the thing for what it is and compare notes with others to see how wrong or right you are. It's a jumping off point.

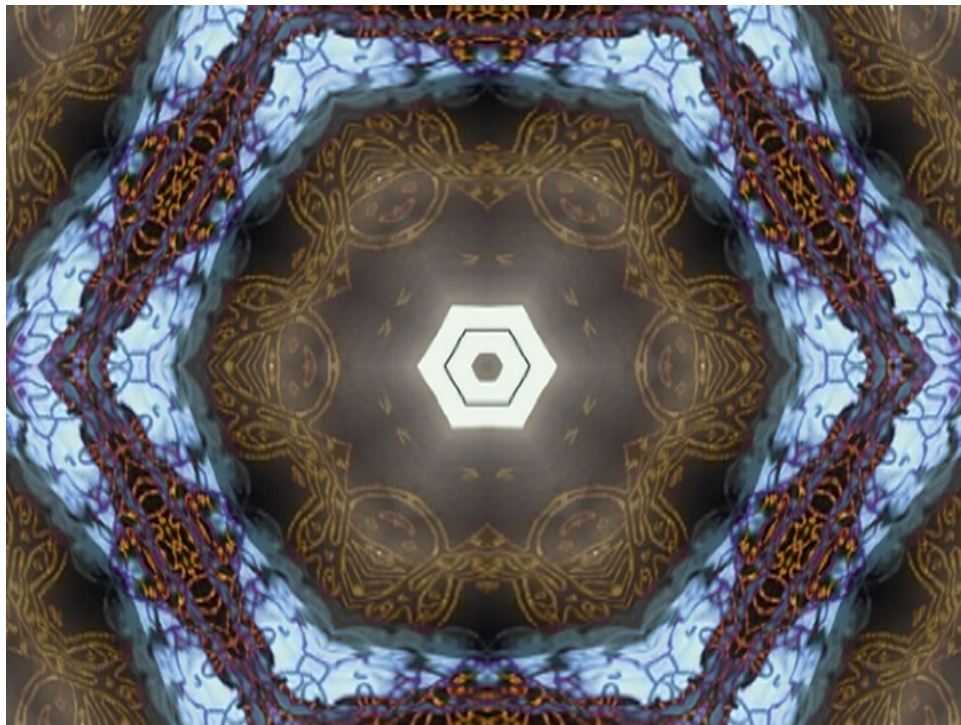
This was a great little conversation- I hope to meet you when I come up to the show in November. Thanks for your patience and insights!

Bee Stories, Broken Symmetries

Nancy Macko and Dr. Stephen A. Naftilan

NM: Hi Steve - I hope you are having a wonderful summer and that this message will be a nice addition to whatever you are doing. I just learned that my work will be included in the upcoming exhibition *Multiverse*, set to open at the Claremont Museum of Art on September 20.

The piece that will be in the show is a video I did called *Bee Stories*. I am writing to ask if you would be willing to have a short dialog with me about *Multiverse* as it applies to astronomy and astrophysics in the next few weeks. I would be happy to give you a full-length copy of *Bee Stories* (8 min.) to watch. Although my interests in astronomy and astrophysics are not literally represented in this particular piece, you might see some connections I am unaware of.



Nancy Macko, *Bee Stories: Still 46*, 2006. Digital Video, 8:11 min.
Courtesy of the artist.

In researching a little bit on multiverses, I came across this citation:

While the idea of a parallel universe may sound farfetched, a recent book from an Oxford physicist named David Deutsch entitled, *The Fabric of Reality: The Science of Parallel Universes and Its Implications* describes the possibilities of tapping in on parallel universes. He proposes that through a parallel universe one computer would be able to find an identical counterpart computer from the other universe, and collaborate with it to increase knowledge of the other universe. This involves the

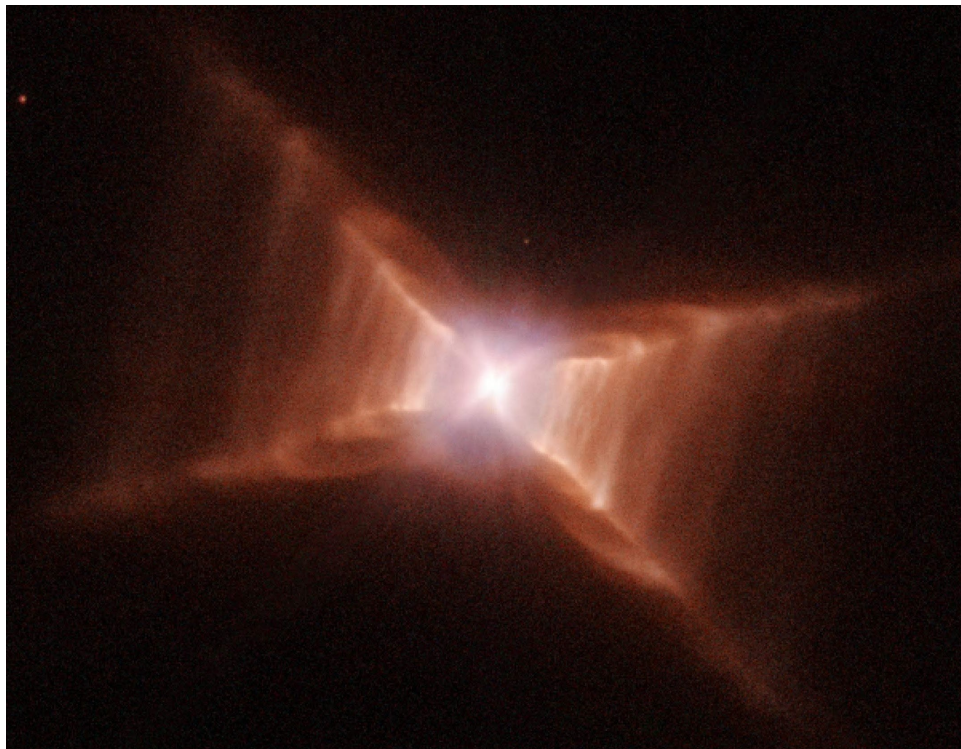
collaboration of many theories that have yet to have much proof. However, it is another arm of the Multiverse theory that has become more accepted in recent years that could possibly yield positive benefits for society.

Do you think this is a good text for me to read to learn more about the idea of parallel universes? Or do you have something I might borrow?

SN: I have not read the Deutsch book, but I have heard good things about it, so I would say it is a good place to start. I have also heard good comments about Leonard Susskind's book *The Cosmic Landscape: String Theory and the Illusion of Intelligent Design* (which is NOT about THAT intelligent design).

NM: I will look for it. I read an excerpt on Amazon... so is a megaverse the same as multiverse? After you have screen my video, please let me know how you see a relationship between it and the multiverse theory of cosmology or any other ideas in astronomy that it might resonate with for you.

SN: After watching your DVD, I thought you might like to see a photo the Hubble Telescope took:



HD 44179, *The Red Rectangle Nebula*
Courtesy NASA and the European Space Agency.

NM: That is a great shot... what am I looking at?

SN: The picture is a Hubble Space Telescope shot of a planetary nebula. Planetary nebulas are old stars that have thrown some of their outer material off into space. No one quite understands why they form the patterns they do, and no two are alike, but the one I sent reminded me of some of the images in your *Bee Stories* piece.

NM: A few years ago I read this interesting sci-fi book called *Brain Plague*, by Joan Slonczewski. In it, a microscopic civilization was about to become extinct. The only way it could survive was to be hosted in the iris of a human being. This was done through an injection or pill, I don't remember the actual way they were moved. Then the hosts would meet and the individual citizens would transfer between hosts to "visit." They could also communicate with the host... kind of like a voice in your head. For the iris civilization, they were living ten thousands of years which went by in an hour of human time. They had individual leaders and names. It was fascinating. I always liked this idea because I used to think that our world culture could be living in the leg of a chair in some other civilization or universe. So would the iris civilization be an example of a multiverse or does it have to be more physical than that in order to be true?

In my piece, *Bee Stories*, what I found fascinating after it was completed, was how I found myself picturing where these voices were. Where did they exist? Were they in an actual physical place like a garden or were they free in space? As the piece continues, I wove the voices together in different groupings thinking about chanting and ancient temples. The fact that they resemble hive sounds was unexpected. The image is meant to be engaging although disorienting. No, you don't know where you are or what is being said, but you are safe to explore and experience. Perhaps our experience of other universes could be as gentle and familiar as this. As familiar as having an ancient microscopic civilization living in your iris and talking to you in your head.

I'd love to hear your thoughts on this, the video and multiverse(s) in general.

SN: Regarding *Brain Plague* and multiverse ideas:

I would say that it does not quite fit. As I see the idea of parallel universes, they are universes where the cosmological quantities and even the physical laws are completely different from those we know in our universe. Hence, there might be no atoms, gravity might not exist, or be much stronger, or weaker, etc. So, any critters that were in that universe would probably be so different from anything we know, that we could hardly even imagine what they (it) would be like.

String theory says that there are many dimensions, perhaps 10, and that we only know of three or four because the others are curled up so tiny that we cannot see them. One option for a parallel universe is for other dimensions to be "unwound" and the ones we know of to be invisible. This would affect the fundamental particles that make up OUR universe, and the fundamental forces, in unknown ways.

Another issue is that from the inside, each universe might appear infinite, so we could never see into another universe, and never know of its existence. These "bubbles" could however run into each other, which might destroy our universe. There was just a paper by Alan Guth at MIT about

this. He and his coauthors calculated the odds of such collisions. They say that such a collision would launch a “wall” at us that would annihilate us. Anthony Aguirre at UC Santa Cruz and Matt Kleban at NYU each wrote articles claiming that such collisions might not destroy us, and that the signature of such a collision between parallel universes might be observable. The observed consequences do in fact match something we have observed, but it is unclear whether that is actually what we are seeing. But, they came up with a great name for it, the “axis of evil”, a huge cold, empty region of space.

In quantum mechanics, parallel universes are talked about as the result of quantum probability. When a Uranium atom, as an example, is sitting there, it may or may not decide to undergo alpha decay. We can NEVER predict whether it will or not, we can only give the probability. However, one interpretation says that it does BOTH, each possibility creating its own parallel universe. Since these sorts of things happen all the time, there should be countless parallel universes, each representing a different outcome for a possible event. Hard for me to say if I would call this science, or science fiction!

Bee Stories. There are a few websites that actually try to depict what bees would really see. Examples that are scientifically based include:

<http://gears.tucson.ars.ag.gov/ic/vision/bee-vision.html>

<http://andygiger.com/science/beye/beyehome.html>

I enjoyed *Bee Stories*; it seemed to me to be similar to looking through a kaleidoscope. The images were often disorienting and borderline disturbing; I assume that was intended. I also found myself reminded of the images produced in fractal geometry. Have you looked at these? One of the things that made the images unsettling for me was the frequent disruption of symmetry. Broken symmetries are a BIG topic in physics these days. I certainly found the audio parts even more disorienting; there were only hints of understanding, most of the sounds sounded like a badly broken record player. For a scientist, it was upsetting because there was no obvious pattern or “laws” being followed. It was the whim of the creator (you), and if the universe operated that way, we could have no science. Just when a given image had been on the screen long enough for me to begin to relax, there would occur a sudden shift, or drastic change in color and intensity, and I had to begin the readjustment from scratch. Definitely NOT what I would want to see right before trying to get a good night’s sleep. Did you have a more or less complete vision of the work before you began, or did it start, and it had a life of its own?

NM: My first response is: Can you tell me more about broken symmetries, since it seems to have a relationship to the piece? And yes there was another video work that this one is derived from. In fact, we put the first one through a kaleidoscope filter set with 6 points like the hexagons in the hive. I am really interested in your response to the piece and the unsettling nature of it that you experienced... especially since one of my goals was to create something disorienting yet non-threatening and something beautiful that would keep the viewer engaged. Your experience was just about the opposite so I need to look at the piece that way too.

Even though nothing seemed to be symmetrical there is certainly an organization with the audio. There were ten tracks and we divided them into male and female for some of the time. Started

them in a fugue-like manner with one overlapping another like waves breaking, had them all speaking at once in a distorted tiny zone with reverb to try to give them a location (this is the part when it gets louder and louder), then it reduces down to one voice that subdivides twice and repeats over itself and this happens again with a second voice. For me these methods follow ideas I see expressed in nature like waves breaking, cell division, cycles or rhythms of seasons and growing systems... none of this is of course about parallel universes as you have defined them.

Do broken symmetries have any relationship to the parallel universe theories and ideas?

SN: Spontaneous symmetry breaking is very difficult stuff, that I am no expert on. Basically, picture a perfectly formed mountain peak, a uniform cone on the ground pointing upward. Now imagine a small round ball on the very top. This situation has exact rotational symmetry, walk around it and it looks the same from all sides. However, that ball on top is very unstable, and at any moment will roll down one side or another. Now, the rotational symmetry is lost, as you walk around things look different from different directions.

That sort of symmetry breaking is part of the so-called “standard model” in physics. Breaking involving the Higgs boson, a particle we think exists, leads to the masses of the W and Z bosons, particles that do exist and we have seen. In the so-called Yukawa interaction, symmetry breaking gives masses to fermions, another family of particles. All this is very difficult stuff, with lots of attached math. I will root around for a source that might make some sense and send you a heads up when I find one.

SN: Symmetry breaking, another example:

A group of people, say a dozen, sit down around a dinner table. There are a dozen plates laid out, and a dozen napkins. Each person reaches down and takes the napkin to his/her right. Ah! We have symmetry. Another possible scenario, each person sits down and reaches for a napkin, but now one reaches for the napkin to the left of her plate. Now there is an extra napkin on the table, and one person does not have a napkin. Symmetry has been broken. Well, nature is often like that, but unpredictably so.

NM: Don't we need to have broken symmetry in order to have change? Change being the operative energy necessary for things to change. Don't we rely on change for life? So how does the desire for symmetry fit into a picture of a universe always changing on numerous levels simultaneously? I thought one of our duties in this lifetime was to be able to adapt to change since that is the only constant we can count on. This starts to get into different kinds of spiritual practices like yoga, meditation, and Eastern philosophies since they seem to be more ok with change than Western thought and practice. I know I have just crossed disciplines here, but don't all these things point toward the same desire for knowledge and understanding? Personal as well as universal... since they are the same... each inside the other. For example, when the drop lands in the ocean it merges with the ocean but at the same time the ocean merges with the drop. Too metaphysical? Are there overlaps or connections to make if we go there?

SN: I would say yes, we need broken symmetry to have change.

NM: I was reading the links you sent on how bees see. I thought this was interesting:

“Honey bees are extremely sensitive to rapid movements. This has been called their *flicker fusion* potential. To a bee flying at 15mph low over a flowering meadow, the flowers must twinkle on and off like stars in the night sky. The analogy is often made that if you put a bee in a theater, the moving film (going by at a mere 16 or 24 frames per second) would be seen as distinct still images by the bees. You would have to greatly speed up that same film to achieve the motion effect for a bee moviegoer.”

I wonder how a bee would see the kaleidoscopic images of the video?

SN: I suspect the bees would see your images, and be far less disturbed by them than I was.

NM: This is interesting because this is what I mentioned to you prior to when I got off into the metaphysical world of universal dynamics. The idea that asymmetry leads to movement or change, which we need for life or living as we know it. Maybe a parallel universe could exist that is based entirely on the symmetry of the laws of physics... that would be ideal, no?

One of my last questions for you would be: Where if anywhere you thought the voices existed or were located in my video?

SN: Well, in a parallel universe, there may, or may not be, symmetry. In ours, the laws have a great deal of symmetry, but a resulting universe does not. As for the video, I really would have a hard time saying where the voices came from, perhaps in the distance, behind the images.

NM: Thanks so much for having this dialog with me. I just read through it and I think we covered some interesting ground, and even some new ground for me.

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