Local Brains, Universal Consciousness

Orch-OR vs. the de Broglie-Bohm Panpsychist Cosmos

The Vallico Academy Lecture Series

1

Count Backwards From Ten

I imagine most of you have never had a general anaesthetic. Those of you who have know exactly what I am about to describe. The anaesthetist asks you to count backwards from ten. You get to about seven. And then, not sleep, not darkness, not a dream: *nothing*. And then a nurse is saying your name and it is four hours later and someone has cut you open with a big knife and removed one of your internal organs or something and you were not there for any of it.

Notice how strange that is. Not that you were unconscious: that we can measure, that is just chemistry. The strange part is the *you* that went away. Where did it go? What, precisely, was switched off? Hold onto that question. We will find a possible address a bit later, and it's not where you would guess.

2

Two Ways of Paying Attention

At the end of the first lecture I told you there was a single question hidden under this whole series, and asked you to try to spot it. I have called it, each time, the same thing: there are two ways of paying attention to the world. A narrow, grasping, useful kind that takes things apart to measure them, and a broad, open kind that holds things whole and lets them stay alive. I have not told you whose theory this is. I am still not going to. That's next time.

But look at what we've done. Three lectures, three roads. Burton was a life lived almost entirely in the second mode, omnivorous, embodied, allergic to the specialist's blinkers. The second lecture was two thousand years of a buried tradition that saw the world that way and got steamrollered by people who did not. The third was a buried *physics*: a picture of the quantum world that most physicists were trained to stop asking for. Three roads. Tonight is where I show you they were never three parallel roads. They meet. And where they cross I'm going to do something I've avoided for three lectures: tell you what I actually think, rather than telling you what other people think..

3

I Promised You Orch-OR

Now before anything else, a correction. At the end of last time, in actual writing, on the last slide, I may have accidentally on purpose implied that this talk was going to be largely about the consciousness theories of Roger Penrose and Stuart Hameroff called Orchestrated Objective Reduction, or Orch-OR, together with some suggestions about what the universal field might be. Well, that was the original idea.

But, when I went back to Florence for the weekend, and I had a bit of peace and quiet - no dogs, no students, a clean house with the washing up done automatically after meals (hint hint) - and I went back through the argument I was going to make to you. And I found that I'd built it the wrong way round. I had nine slides of somebody else's theory standing in front of my own, like a support act, and then I was going to take it apart and hand you mine. That is a perfectly respectable way to build a lecture. But it's also the first mode of attention doing exactly what the first mode does: line the options up, knock the losers over, declare a winner.

And so the argument I came up with over the weekend is not shaped like that. Penrose and Hameroff have not been demoted. They're still present enough to be in the title of the lecture. Instead, they have been moved. They were the act in front of the argument and they are now a component inside it, and it took me a while to notice that this was the best way.

Notice that me standing here and telling you my plan was wrong is the more uncomfortable option than pretending I always get it right, and that is also, precisely, the thing these five talks are about. Look at the whole instead of isolated bits! So: a broken promise, on purpose, in the first three minutes. Hopefully I won't break any more.

I set you a piece of homework at the end of last time. Here it is again: If we assume that the universal field of the ancients, the One, the All, 'God' if you're a pantheist, (a) exists, and (b) is *conscious* - for some reason that at the moment we can't begin to understand - *what would it be like to BE the undivided field?* Not to observe it, not to believe in it: to be it. There are some people who would find such a question blasphemous, but I think it's useful to ask and I promised you an answer. I promised something else too. I said that tonight I would give you my suggestion: my candidate for the field, the one I kept back while we did the history. Both promises come due now. I am going to make you wait for both, because the waiting is part of the argument, but we'll get there in the end.

I say I'll make you wait. Why don't I change my mind about that as well!

Here is the whole of tonight, stated naked, with nothing whatever underneath it. The wave function of the universe is what it is like to be everything. You are a piece of it, walled off from the rest. The wall is the thing you have been calling your brain. And time began when the first wall went up.

So, new thing for this lecture. Little grey boxes will appear periodically containing objections to what I'm saying, as if from some annoying bastard in the front row. This is necessary because I'm veering off into the realms of speculation far more than I have so far. I'm going to need some volunteers to read them out when they appear and thus play the role of 'Annoying bastard'.. so I'm going to volunteer all the boys, starting with the one on the left, then you, then you etc. Wait until I tell you by saying something like: I understand there's an objection.

So, does someone have an objection?

THE OBJECTION

You have asserted five things and proved none of them.

Correct. Give me an hour.

What I just said is either an excellent idea (thank you very much) or a very elaborate mistake, and I honestly cannot tell you which, and by the end of the talk you should have what you need to decide for yourselves. What changes, now that it is on the table, is what the next hour is for. It stops being a survey and becomes an audit. Every philosopher I bring on from here has a job: to show you why that claim is needed at all. Every physicist has a job: to show you what it costs. So I'll talk about ledgers, and debits and credits a lot.

4

The Hard Problem

Start with the thing everyone skips. A philosopher named David Chalmers drew a line down the middle of the study of the mind. On one side, the *easy* problems, easy not because they are simple but because we know what an answer would even look like. How does the eye detect light, how does the brain move a hand on command, how does it tell waking from sleep. Hard engineering, but ordinary science. On the other side, one *hard* problem, and it is this: why is any of that accompanied by *experience*? Why is there something it is like to see the colour red, rather than the seeing just happening in the dark, like a thermostat reading a temperature with nobody home?

You can imagine, in principle, a creature that does everything you do (drinks beer, flinches from fire, writes poems about it) with no inner light on at all. Historically, this was called a philosophical zombie. A machine that reproduced everything we do would raise a cousin of the question, though it is not quite Chalmers's creature, which is a physical duplicate of you. The unsettling thing is that nothing in physics, as we currently have it, rules that creature out. That gap, between the machinery and the light being on, is the hard problem. Keep it in view.

5

The Person Next To You

The cleanest statement of the problem is a question Thomas Nagel asked in 1974, and it is a good one for archaeologists because it is about getting inside a way of being that is not your own. *What is it like to be a bat?* Not: what would it be like for *you*, hanging in a cave. What is it like *for the bat*, emitting little peep-peep noises and getting echoes back, navigating by sound? What is it like wearing a body that maps the world in echoes? There is, presumably, something it is like. But no quantity of description from the third person hands you the first. Picture the most complete bat-brain manual ever written, every neuron mapped, every echo-pulse timed, and notice that you have still not been told the one thing the bat has for free. The map can be finished and the territory still withheld.

That inside-ness (philosophers call it *qualia*, the felt quality of experience) is the thing. It's the most certain thing any of you possesses; it's the one thing you cannot doubt. *Cogito ergo sum*. I think therefore I am. And it's precisely the thing our most successful science has no room for. That is not a small embarrassment. That's a hole in the middle of the map.

Now do the harder version, the one Nagel is too polite to ask for. Forget the bat. Turn your head and look at the person sitting next to you.

You know a great deal about them. You know they are conscious, you would bet your house on it, and you would be right. You have incomparably more evidence about the inside of that head than you will ever have about any bat: a shared species, a shared language, a face that does exactly what yours does when it is tired or amused or lying. And you have precisely the same access to what it is like to be them as you have to what it is like to be the bat, which is none. Not a little. None.

The bat is a rhetorical convenience. It puts the problem safely in a cave in another country. The wall you actually cannot see through is a short distance to your left, it has been there all evening, and every one of you has spent an entire life on one side of it without once getting round to the other. Hold on to that, because in a bit I am going to suggest what that wall might be made of.

6

Generator or Aperture

There are, broadly, two stories you can tell about the brain and this inside-ness. The first is the standard view, and the left-hand card states it in one line. The brain *generates* consciousness. Somehow in the middle of that sentence is the whole hard problem. Kill the organ, kill the glow, because in this way of looking at things the organ is the origin.

The second story is older and stranger and it's the one this whole series of talks has been circling. The brain doesn't generate consciousness; it *receives* it, shapes it, filters it, reduces it to the trickle a single animal can use. On this story the brain is not a lamp. It is an aperture. And here is the honest part: the evidence you have been given your whole life is equally consistent with both points of view. A radio goes silent when you smash it, but that doesn't prove the radio was generating the music. Damage the brain and the mind changes, of course it does, on *either* story. The data doesn't choose for you. So let us look at what each story would need.

7

A Valve On What?

The aperture idea isn't, believe it or not, New Age bullshit; it has a serious pedigree. William James, widely known as the father of American psychology, floated it in 1898: that the brain might *transmit* consciousness rather than produce it, like a prism modifying and transmitting light it did not itself produce. Henri Bergson built a whole philosophy on the brain as an organ of *attention to life*, its job to *exclude*, to keep out the vast irrelevant mass of noise so you can focus and catch the bus. And Aldous Huxley, high on mescaline in 1953, gave it the phrase that stuck: the brain as a *reducing valve*, which can be briefly opened wider than it ought to be by psychedelic drugs, or in the esoteric tradition by repetitive mental practice, meditation, contemplation, using the brain in particular non-standard ways.

Now, notice what a valve requires. A valve is not a source. A valve reduces the flow of something that is *already there*, on the other side, under pressure. If the brain is a valve, then the obvious question, the one James and Bergson and Huxley all gestured at and none of them could answer, is: *a valve on what?* What is the reservoir? What is the field the brain is filtering down? Hold that thought. This is a hole into which we can pour stuff.

8

Mind All The Way Down

One answer, taken seriously right now by sober analytic philosophers, is *panpsychism*: the idea that mind, or something proto-mental, goes all the way down. Not that rocks have emotions, necessarily, but that experience is not a late arrival that switches on in brains; it is a fundamental feature of matter, like charge or mass, present in some minimal form everywhere. There's a guy called Galen Strawson who argues this is actually the *hard-headed* physicalist position: Like I said last time: to the disappointment of many, physics tells you only what matter *does*, never what it *is* intrinsically, and the one scrap of intrinsic nature any of us has direct access to is our own experience. So why not assume that is the missing intrinsic nature all the way down. Chalmers, who drew the line in the first place, takes it seriously too.

This is a real move and it dissolves the hard problem by refusing to let it start: you never have to get mind *out of* mindless stuff, because there was no mindless stuff. But almost everybody who takes it up takes up one particular version of it, and the version matters enormously. That version is *micro-panpsychism*: the glimmer belongs to the smallest things, to particles and fields, and a mind is what you get when you pile enough of them up. Start there and you inherit a nightmare of your own, the *combination problem*: if every particle has a little glimmer, how do a billion glimmers add up to the single, unified *you* now hearing this sentence as one thought? Nobody has answered that, and it is the standing objection to the whole programme.

There is a second way to be a panpsychist, and hardly anybody takes it. Instead of beginning with a crowd of tiny minds and trying to build one big one out of them, you begin with a single undivided mind and ask how it comes to look like a crowd. That has a name too: *cosmopsychism*. Both are panpsychism; they simply run in opposite directions, many into one or one into many. And notice what happens to the nightmare in the second case. It does not arise, because nothing ever has to be combined. There is a bill to pay instead, and it is the opposite bill: not how the many become one, but why the one would ever divide. Philosophers have a name for that bill. They call it the decombination problem, and I would rather owe a debt that has a name than one that does not. Put that in your pocket. I am going to come back to it with the equations, and when I do you will be able to see for yourselves which of the two I am selling you.

Hold that too. Two unanswered questions on the table now: *a valve on what*, and *how do the many become one*. I am collecting them deliberately.

Two words you may hear in the same breath, and it is worth knowing which is which. *Panprotopsychism* is panpsychism with the edges filed off: the fundamental stuff is not quite conscious, but carries *proto*-conscious properties, ingredients with no experience of their own that can nonetheless combine into the real thing in something as complex as a human brain. It is Chalmers hedging his own bet, and it buys nothing until you can say how the ingredients combine, so the same nightmare follows it home. You might also hear the word *Pantheism*, which is a different animal altogether: not a claim about particles but about the whole, the old idea that God and the universe are one and the same thing, that there is nothing outside it to do any creating. Keep that one in mind. We're going to walk straight into it later, from the physics, whether we want to or not.

You have met one of these panpsychist people already. You will remember in the second lecture I introduced Federico Faggin: the man who designed the first commercial microprocessor, the chip that everything you own descends from. A lifetime spent inside the machine, and the conclusion he came out with is that the machine does not make the thing that matters. Consciousness first, hardware second, and, crucial for tonight, it is *quantum physics* he reaches for to say it.

I mention Faggin yet again because he is the hinge. He is a serious technical person, not a mystic, pointing at the quantum world and saying: the field is *there*, that is where you should be looking. He does not, in my view, land the punch, but he is pointing in exactly the right direction. Do read his very interesting book Irreducible, which we have in the library here. So let us go and look where he is pointing.

And to do that we have to take one more step back, because there are two camps in this argument and each of them is missing something, and it is the same thing.

9

The Philosophers and the Physicists

The philosophers have a universal field with no mathematics. The All, the One. the Ungrund, All That Is. etc. The physicists have mathematics with no universal field.

10

Second-mode vs. First-mode Thinking

It should be clear that the philosophers - in general - are doing second mode thinking and the physicists - in general - are doing first-mode thinking. Which is interesting and probably telling us something important, though I'm not entirely sure what.

11

Everyone Is Missing the Same Thing

To repeat with a little more detail, stand back and look at the whole thing. This is a massive over-generalization about many individuals who do a lot of things and therefore it is not, strictly speaking, you know, true or anything like that, but in general it's fair to say that: On one side you have the philosophers: the panpsychists, the idealists, the filter theorists. They have the *vision*: one universal something, mind-like, that brains tap into. What they do not have is a single line of mathematics. They gesture at “quantum holism” with their hands and reach for vaguer and vaguer words the closer they get to the centre.

On the other side you have the physicists. They wrote a suitable object down in 1926. They use it every working day, in every laboratory on earth, and it has never once handed them a wrong answer. And most of them have spent a hundred years insisting that it is not a thing at all: that it is bookkeeping, a device for computing odds, a formal convenience with nothing standing behind it. Which is exactly the position you watched being taken apart last time. So they have the mathematics and, by their own insistence, no field. There is one physicist of the first rank who asked the question anyway, and we will meet him shortly.

So here is the strange situation I want to leave you in before I show my hand: the philosophers have a field with no mathematics, and the physicists have mathematics with no field. Each half is

holding what the other half is missing. And there exists (has existed since a certain conference in Brussels in 1927, which you now know all about, having taken part in it) one physical theory that has *both*. A real, universal field, with real equations. Nobody put it here because it was career suicide to take it seriously. You met it last time. Tonight I am going to marry it to the question of consciousness, out loud, and see what happens.

Ah, I see someone has an objection?

THE OBJECTION

Or physics is right, and there is nothing it is like to be an equation.

I am not going to answer that now, because I have not earned an answer yet. I will answer it at the very end, when I have something to answer it with. Hold me to it.

12

Mike Speculates

So. Here's the suggestion, as promised. We're going to stop touring other people's ideas for a bit (well, partly stop): it's just a speculative idea, put to a room carefully, for once. Let me be exact about its status. *Quite obviously I'm not making a claim that I've proven anything. I'm claiming simply that the question is real*, that there is a piece of genuine physics sitting exactly where the mystics have always pointed, and that it takes both halves of a training to notice.

13

The Candidate

Last time you met the de Broglie-Bohm picture of the quantum world. Let me remind you what it says, stripped bare. There is a *real field* (the wave function, Ψ) as real as the electromagnetic field, not a bookkeeping device for our ignorance. It fills the world. It guides the motion of every particle there is. It is *one* object, not one per particle: a single field for the entire universe. It is undivided. It is nonlocal: it links things that are light-years apart without anything travelling between them. And it does real work: remember the dying star, the white dwarf that does not collapse because this field pushes back? That was not a metaphor. What the textbooks bill as a mysterious 'degeneracy pressure' arising out of the Pauli exclusion principle (no two electrons can be in the same state) is, in this picture, the field itself pushing back. This field holds up stars.

Now hear it as a claim about the reservoir. The panpsychists want one universal substrate. The filter theorists want a field for the brain to be a valve *on*. And here, mathematically precise, causally potent, genuinely universal, is the only literal candidate physics actually offers. Not “quantum holism” waved at with the hands. One real field, guiding every particle, undivided. *That* is my candidate for what the mystics have been pointing at. The candidate for the field is the wave function of the universe.

You'll see on the slide the Schrödinger equation again, and you might recall that I spent a large part of my professional career developing new methods to solve it accurately. For decades, considering that the solution to this equation, the wavefunction, might map onto a real object in the real universe, has been treated as an embarrassment and physicists have tied themselves up into metaphysical knots trying to avoid that conclusion. It's knowledge, it's potentiality, all of that.

If we consider that the wavefunction might map onto a real field, that might just gives us our candidate for the universal consciousness field.

14

One Into Many

The first thing a universal field has to explain is why it does not *feel* universal. If there is one field and it is all of us, why can I not read your mind? Why am I sealed inside this one head? The theory has an answer, and it is clean. Let's seal off one part of the field, and for want of a better name, let's call it Adam. Under ordinary conditions the one field can then be written as a *product*: Adam's factor, times the whole of the rest of the universe. If pieces corresponding to us have been sealed off as well, then it's Adam's factor, times your factor, times my factor, times the whole of the rest of the universe etc. Physicists call that *separability*, and in this theory it means something sharp rather than something poetic. Once the field has factorised, the part of it that steers Adam's particles stops depending on where anybody else's particles are. He is not cut off from the field. He is running on his own factor of it, and your memories are in somebody else's factor. That is the wall, and it is nothing more exotic than the ordinary mathematics of separated quantum systems. Do I hear an objection?

THE OBJECTION

Last time you told us the wave function was a sum of possibilities. Now it is a product. Which is it?

Both, and the two operations are doing entirely different jobs, so it is worth thirty seconds to keep them apart. *Adding* is how you write one system being several ways at once: this state and that state, held together, a superposition. That is what you spent last time looking at. *Multiplying* is how you write several systems each getting on with its own business: this one alongside that one, each with a state of its own. A sum is one thing being many ways. A product is many things being one universe. The wall is what you get when the second one holds: the field puts it up by dividing itself, and that is why you are one person and not everyone. And now hear where you have met this before. A single thing that fractures into a crowd of apparently separate ones, no one of them truly severed from the source it came out of. That is Plotinus. That is the One pouring itself out into the many and losing nothing in the pouring. Two thousand years ago he wrote it as metaphysics. I am telling you it drops out of the equations as arithmetic. Plotinus, made quantitative. And that settles the question I left hanging earlier. This is the second kind of panpsychism, the one hardly anybody takes: cosmopsychism. We never have to assemble one mind out of a billion small ones, because we never began with a billion small ones. We began with the one, and the many are what the one looks like once it has divided. So the combination problem is not being solved here. It is being dissolved, and it turns out to have been an artefact of starting at the wrong end.

There is a real question hiding under that and it is the sharpest objection anybody has to this whole picture, so I am not going to walk past it. Who chose the slicing? The mathematics is perfectly happy to factorise the universe any way you like: into people, or into left-halves-of-people, or into a thousand arbitrary lumps that cut across every skull in this room. Nothing in the bare equation stamps one carving as the correct one. If the wall between us is real,

something has to have put it in that particular place.

The picture I am selling you has an answer that most of its rivals do not, and it turns on the one thing that makes it different: in the de Broglie-Bohm theory the particles are actually somewhere. Take the one universal field, and feed into it the real, actual configuration of everything that is not you: every atom of this room, the walls, the valley outside, the rest of the universe. What comes back out is a function of your variables alone, and it has a name: the conditional wave function. It is the piece of the field that is effectively yours, and it is what does the guiding while you sit there. Notice what fixed it. Not a convention and not a choice, but where the particles actually are. The carving is done by the world, not by us.

I will not oversell it. It tells you how a subsystem comes to have a state of its own once you have said which subsystem you mean. It does not tell you why *you* are the subsystem rather than your left hand, or you and the chair, or half of you and half of me. It moves that objection from fatal to serious. That is progress and it is all I am claiming for it. Though hold that question rather than filing it, because there may be a second answer to it that is not mathematics at all, and we will be looking straight at it in twenty minutes.

15

Then Why Can Eve Punch Him?

So the wall is up. Now watch me knock it down, because the objection that follows seems serious.

If we call, as I said, the first piece that gets sealed off Adam, then he finds another sealed-off piece in the room and calls her Eve. I will do something more careful with those two names in half an hour; for now they are labels for the two sides of one wall. So, I believe we have an objection?

THE OBJECTION

If Adam is genuinely sealed, nothing can reach him. And yet Eve can break his nose.

I concede it completely. Taken as it stands, the picture I have just drawn is false, because you are all sitting there being demonstrably reachable.

Push on the Adam picture and you hit a problem: if the field couples to Adam through gravity and light, if Eve can punch him in the face, then surely the wall leaks and his mind is readable after all. But there is a real physical distinction hiding here. And another objection?

THE OBJECTION

And gravity couples everything to everything. Your wall was never sealed in the first place.

Also conceded, and it is worse than it sounds. I am going to bank that one and pay it later, because it turns out to be the most interesting thing in the lecture rather than the most damaging.

But take the first objection first, and let me try to answer. What is sealed is not Adam. Adam is a body in a room, and bodies in rooms are the most thoroughly public objects in the universe. What is sealed is some sector *inside* Adam. A part, not the whole. The wall does not run round the outside of a person. It runs somewhere inside one, and the entire question becomes: around what?

16

Two Channels

The answer is standard physics and I want to be clear that I am not inventing anything to get myself out of trouble. It turns on the fact that a body is not touched in one way. It is touched in many, and they are not equally fragile. To see it you need two words, and then a third.

It's important that you try to understand these bits of jargon, because the whole gamble stands or falls on it. First, coherence. When a physicist says a quantum system is *coherent*, the picture to hold is a set of waves marching in step: the things that describe the particles keep a fixed relationship to one another, and for as long as they do, the system is allowed to be several states at once. Not undecided, not merely hidden from us: genuinely all of them together, a superposition, right up until something reads it out and you find a single definite answer. Though hold that phrasing, because on last time's picture nothing forces anything. The alternatives simply stop interfering, and the particle was only ever on one of the roads. Decoherence explains why the world looks classical. It is the actual configuration that makes one outcome the one you get.

There is a second word in the same family that you are going to hear a great deal in the next few minutes, so let me hand it over now too: *entanglement*. Take that fixed relationship and let it hold not between the parts of one wave but between two particles, or a thousand. Once they are entangled they stop being separate things with their own private states and become a single joint system: one wave that will not split cleanly back into this-one-here and that-one-there. The consequence is the notorious one. Measure one of an entangled pair and you instantly fix what its partner will do, even on the far side of the room, or indeed the galaxy, with nothing passing between them; Einstein called it spooky action at a distance and never quite forgave it, though nobody can use it to send a message, because randomness washes it out. Coherence is a wave keeping step with itself; entanglement is that same discipline shared out across many particles at once.

The catch is that coherence is delicate to the point of comedy. Let the system so much as brush against its surroundings, one stray photon, one jostling molecule of water, and the marching falls out of step. We call that *decoherence*, and it is the reason your everyday world looks solid and classical instead of shimmering with possibility, like Bob the Angry Flower's superposition of some beers and no beers in the fridge, going wom, wom, wom... It is also why a quantum computer costs a fortune: you have to hold thousands of particles in step, and cold, and utterly alone, or the thing quietly turns back into ordinary matter. Which is exactly what makes the next slide sound insane. Nobody expects coherence to last any useful time in something as warm, as wet and as noisy as a brain, awash in the very water that destroys it fastest. Hold that objection in your hand. In a moment I am going to show you the one room the theory says stays dry.

So put all three to work on the punch. A punch arrives on the loud channels: momentum, heat, pressure, the gross distribution of charge in a fist. Every one of those is a variable the surrounding world is already measuring, constantly, whether anybody is looking or not. Air molecules, photons, the thermal riot of the tissue itself: the environment reads Adam's position something like a trillion times a second and has done since before he was born. Those variables are not fragile. They cannot be made fragile. They lost their coherence long before there was anybody

there to ask about it.

A punch travels through the coarse, already-classical parts of Adam: momentum, heat, the loud stuff. *Reading his mind* would mean touching the delicate, coherent quantum structure: the fragile part. And you can be battered on the one channel while the other stays sealed, *if* something in the brain shields the delicate part from the noise.

That is the whole reframe and it fits in one line: different channels, different fragility, one body. You can be battered and stay unread. And notice what the sentence needs in order to be true, because it is a debt and I am writing it down in front of you: it needs there to be something in there actually doing the shielding. Which is a question about biology, and the biology is genuinely extraordinary, and it is where we go next.

17

Microtubules!

Behold, a microtubule! Hollow, built out of two kinds of a protein called tubulin, about twenty five nanometres across, and there are hundreds of thousands of them inside nearly every cell you own. The textbooks file them under the cell's skeleton, which is true and is also the dullest thing anybody has ever managed to say about them. Look at how regular it is. Nothing in a warm wet cell has any business being that ordered, and in a few minutes I am going to ask you to care rather a lot about it: not about the hollow down the middle, but about what is tucked away inside the protein bricks the wall is built from.

18

A Neuron, and a Synapse

Behold, a neuron! Here is the picture everybody gets at school. The neuron: a cell body with the nucleus in it, a spray of dendrites at one end to collect incoming signals, and a long insulated cable, the axon, to carry the answer away. And beside it, what happens where two of them meet. The axon terminal of one arrives at the dendrite of the next, they do not quite touch, and chemicals cross the gap: neurotransmitters out of one side, receptors waiting on the other. That gap is a synapse, and you are carrying something like a hundred trillion of them around with you.

19

Neurons and Microtubules

Behold, what happens when you put the two pictures together, which is exactly the thing almost nobody does. Practically every theory of consciousness on the market is a theory about the connections: how neurons wire up, how they fire, how the traffic between them adds up to a mind. The neuron itself gets treated as a switch, a dot in a diagram, and whatever is going on inside it is somebody else's department. But there is an inside. Every one of those eighty six billion dots is a city, and running all the way through it is the scaffolding you were looking at two slides ago. If anything quantum is happening in a brain, it is not going to happen out in the wet gap between two cells. It is going to happen in there.

20

Spindle

Behold the spindle! One last thing about these microtubules before I set the whole theory down. The same tubulin that builds the scaffolding in your neurons builds something else: the machine that divides one cell into two, the mitotic spindle that you can see on the screen. Hameroff argues the whole ballet of division is organised by entanglement, and he leans on a suspicion the biologists have had for a long time on their own account: that the coordination of it needs some kind of organising field, because nothing you can measure seems enough to account for it. Hold the word. *Division.* One thing becoming two, the humblest division there is, running on the very same scaffolds. A while ago I showed you the whole of reality doing exactly this, splitting all the way down, and it was the same shape. I offer that as a visual rhyme and not as evidence.

21

The Shelter

So. The argument requires somewhere in a warm, wet, noisy brain that could possibly act as a shielded chamber hosting delicate, coherent quantum structures. The microtubule is the candidate, and it is the one I promised you and then appeared to take away at the start of the talk. It arrives a little early and doing an entirely different job from the one it was advertised for. Roger Penrose wanted something quite specific out of biology, for reasons of his own that we will come to shortly and that are not my reasons.

Penrose needed a place in the brain where quantum effects could actually live, and he was handed the microtubules by an anaesthetist named Stuart Hameroff. They jointly proposed that these are not just girders; that quantum coherence can be sustained inside them, and that consciousness is tied to a particular quantum event happening in there: they call the theory *orchestrated objective reduction*, Orch-OR. Quantum processing, inside your head, right now.

A lot of people think this sounds mad, including most physicists, if they thought about it at all. The brain is warm and wet and noisy, and quantum coherence is the most fragile thing we know; it usually dies in a fraction of a fraction of a second in conditions far calmer than a living skull. That objection is real and I will not hide it from you. But before we weigh it, let me show you the piece of evidence that keeps this idea alive, and it is the answer to the question I opened with.

How do you keep a quantum superposition alive in something as warm and wet and noisy as a brain? You build a shelter. Inside every microtubule there are hydrophobic pockets, oily little chambers that hate water and so keep it out, and water is the great destroyer of coherence. Tucked into those pockets are the benzene rings of tryptophan, one of the essential amino acids that the body can't produce on its own and you have to get it from your diet or supplements. Tryptophan contains the same six-carbon rings you may have seen in school chemistry with benzene, and they sit close enough together, Hameroff argues, to entangle. Their loose electrons ring like struck bells, and the ringing runs up a ladder of frequencies, from megahertz all the way down to the forty-hertz gamma rhythm that shows up whenever you are conscious.

Whether or not it is the seat of consciousness, it is the most interesting piece of architecture in your body, and almost nobody knew it was there.

22

The Anaesthesia Clue

Remember the counting backwards. Something switched your consciousness off cleanly, completely, while leaving your body running, heart beating, lungs working, the machine on, the light off. What does an anaesthetic actually *do*? For a long time nobody quite knew. And it turns out that a good number of the general anaesthetics act on exactly the chamber we just looked at: they slip into those same oily pockets, still the ringing electrons, and the light goes out. The switch has an *address*. Whatever consciousness is, you can turn it off by reaching into the quantum scaffolding of the cell. I should say at once that this is not the textbook story: the textbook story is receptors and ion channels at the synapse, and it is well established and I am not disputing it. The claim is narrower and stranger. The switch may have more than one address, and one of the candidates is not at the synapse at all. It is inside the neuron.

Now, I have to be scrupulously fair, because being fair is the whole method of this series of lectures. This is suggestive, not settled. The famous objection, that the brain is too warm and wet to hold quantum coherence for long enough to matter, was made sharply, and answered, and re-answered; the argument is still live and honestly unresolved. What I want you to take from the anaesthesia is smaller and firmer than a proof: it is a *clue* that the light we are hunting has something to do with the quantum, and something to do with a place delicate enough to be switched.

And keep hold of the word *address*, because the cold open is not finished with us. There is a second and stranger reading of what happened to you on that table, and it cannot be said yet.

23

What the Last Two Years Did

Now hold that clue up against a calendar, because the last two years have not been quiet ones for this idea. While nobody in this room was watching, it has been sitting in laboratories being tested, and some of what came back is worth your time.

The shelter got stronger. Take first the one that follows straight on from what I have just told you: a review last year in *Neuroscience of Consciousness* gathered the strands together, and the first strand is that the inhalational agents have microtubules as a genuine functional target rather than an incidental one. Then a number that lends weight to that. Two decades ago the going estimate for how long coherence could survive in warm biological material was short enough to be quoted as a refutation; in isolated preparations it has now been measured at something like ten nanoseconds, four orders of magnitude in the other direction. Then the strangest item on the list. Superradiance: whole lattices of tryptophan emitting light in concert, the network behaving as one object rather than as a bag of separate molecules. Objection?

THE OBJECTION

Laboratory preparations are not brains.

Conceded, flatly. Every one of those measurements was made on isolated material in glassware. Whether any of it survives inside an intact, functioning, blood-supplied brain at thirty-seven degrees is unconfirmed. Not refuted. Unconfirmed. If you take one thing away from this slide, take that sentence and not the exciting ones above it.

That said there is one experiment! A 2022 experiment out of Dublin read the water in living brains with MRI, and its authors interpret what they saw as a macroscopic entangled state that tracks conscious awareness and short-term memory. That reading is disputed, and even if the signal is genuinely non-classical nobody has identified what in the tissue is producing it. And then the one that actually matters, because it closes a circuit rather than opening a door. Give the preparation isoflurane, or give it etomidate, and the excitation travels a shorter distance and the coherence dies sooner. The anaesthetic does not merely correlate with the effect. It degrades the mechanism.

And the same two years did something to the other half of the theory as well, but I cannot show you that yet, because you have not met the man whose half it is.

24

The Join In The Chain

Now I have to show you the weakest join in the entire chain, and I am going to show it to you here rather than saving it for the objections at the end, because saving it would be a way of hoping you had stopped concentrating by then.

Everything in the last few slides is a shelter that protects delicate quantum structure from Adam's own body: from his metabolism, his water, his heat, the thermal riot of being alive at thirty-seven degrees. That is what the hydrophobic pocket is for, and it is what every one of those experiments is about.

But look at what I need it for. I need a wall between Adam and the rest of the universe. Between Adam and the field. Those are two different claims. They are not the same wall, and nothing whatever forces the structure that does the first job to do the second one as well. Objection?

THE OBJECTION

Shielded from his own body is not the same as hidden from God.

That is right, and it is mine, and I haven't found a way round it. It is an extra postulate riding on the back of the first, it is doing a great deal of work, and it is not paid for. I am not going to repair it tonight because I can't.

And let me put the charge in its most general form, because it is worse than a microtubule problem. I have been using one word, wall, for a great many different jobs all evening. The physics proves that partitions exist. It does not prove that these partitions coincide. That they are all one partition is my bet, not my result.

25

The Undescended Soul

Before we leave this, stand still a moment, because we have just walked into something and I do not want to walk straight back out. What I have described to you, without setting out to, is a very old idea, and its being old is the thing that should keep us honest and awake.

Now look what that is. “Body freely interacting, mind specially insulated” is exactly, *exactly*, the bet Orch-OR is making about microtubules. The theology and the physics turn out to be the *same*

structural wager, arrived at from opposite ends of history. And it has a third witness. Plotinus taught that part of the soul never fully descends into the body: that a piece of you remains always in contemplation, untouched, however much the rest of you suffers. He illustrated it with a man being roasted alive in a bronze bull. This was supposedly a real torture device used by Phalaris, the tyrant of Akragas in ancient Sicily, before he lost one battle too many and got roasted in it himself. So being roasted alive is definitely going to be very painful but Plotinus insisted the highest part of the soul feels none of it. The undescended soul. Twenty centuries before microtubules, he described the shielded sector. And as it says on the slide, physics did not discover this. Physics *rediscovered* it, and did not notice whose door it was knocking on.

26

The theoretical side of Orch-OR

OK. I have been using this man's laboratory all evening without introducing him properly, and he deserves better than that, so let us meet him now, at the point where he is needed rather than as a rival to be knocked over.

Roger Penrose: Nobel laureate, the man who proved black holes must form, about as far from a crank as the physics establishment produces. The image on the slide is the first photo ever taken of a real black hole by the way, which is kind of cool. He nearly came here for the de Broglie-Bohm conference in 2010, and I have a lovely email from him thanking us for our 'tireless efforts to promote quantum realism', and he said it was a goal with which he greatly sympathizes.. Sadly he was in the process of finishing seven books and his publisher was nagging him so much that he couldn't find the time to visit Tuscany.. Anyway, Penrose has spent forty years arguing something his colleagues find deeply embarrassing: that consciousness is *not a computation*. His route in is peculiar and mathematical. He thinks human mathematicians can see the truth of certain statements that no fixed set of rules could ever prove, a kind of argument going back to Kurt Gödel, and concludes that whatever the mind is doing when it does that, it is not running an algorithm. No program, however large, is having the experience of understanding. Something else is going on.

You do not have to follow the Gödel argument. You only have to notice its shape: here is a first-rank physicist saying the mind can't be captured by the ordinary, computable, left-mode picture of nature: that whatever consciousness is, it needs physics we do not yet have.

Now the mechanism itself, what Orch-OR says is actually happening in there, moment to moment. The tubulins go into quantum superposition: not one state but many at once, and, the audacious part, entangled with each other right across the brain, millions of them, a single linked quantum system. That superposition evolves, smoothly and lawfully, by Schrödinger's equation, the way every quantum system does. And then it collapses. Not smoothly, not by Schrödinger, it falls, all at once, into one definite state. And here Penrose and Hameroff make the claim everything has been climbing toward: each of those collapses is a single moment of conscious awareness. Your stream of consciousness is not a stream at all. It is a rapid series of these reductions, one after another, forty or so a second, too fast for you to feel the gaps.

And now the question a physicist has to ask: what makes it collapse? Penrose's answer is the boldest thing in the whole edifice, and it is why I have brought you in here. It collapses because of *gravity*. In Einstein's general relativity, gravity is just spacetime curvature. A superposition of matter is a superposition of spacetime curvatures, two different shapes of space held at once, and spacetime can't hold that pose. It relaxes; and in relaxing, it chooses. Gravity is what turns the many into one, over and over, and every time it does, the light flickers on.

Note that when we say the superposition collapses because of gravity, we're not talking about an external gravitational field, like that of the Earth. So consciousness doesn't turn off if you go off into space in a zero-gravity environment! The Penrose collapse comes from the little masses in the superposition themselves acting on each other gravitationally. The technical term would be *gravitational self-energy*. Do I hear an objection?

THE OBJECTION

Last time you spent an entire evening telling us the wave function never collapses.

Yes. I did. And I meant it, and I still mean it, and I am about to hand the collapse back, deliberately, to the one physicist who has a serious use for it, because I want to see what he can do with it that I can't. If we only ever test our own idea against opponents we have already disarmed, then we are doing precisely the thing these five lectures exist to attack. So for the next few minutes the collapse is real, and it's all his, and we will find out what it buys.

Orch-OR is a collapse theory. Its entire engine is that the wave function really does fall: gravity picks one branch and destroys the others, forty or so a second. The picture you met last time says the opposite. The pilot wave field never collapses: not once, not anywhere, not in the entire history of the universe. The particle always has one definite position, so matter is never in two places at once, so there are never two shapes of spacetime for gravity to choose between. Penrose's trigger never fires. These are not two stations on one line: they are rival repairs of the same broken theory, and they cannot both be true. So let me be exact about what I am taking from Penrose, because it is not his mechanism. I am taking his two ideas: that consciousness is tied to the quantum level of the world, and that gravity couples everything to everything and cannot be screened off. Those ideas survive in any picture. The collapse does not, and I am leaving it on the table.

27

What Penrose Got Right

A while back I told you that the physicists have the mathematics and no field. I owe you the exception, because it is standing directly in front of us. Penrose is the one physicist of his rank who asked the question at all. He declined a century-long instruction not to.

It cost him a new law of nature. To ask his question he had to add something to physics that is not in physics: a real objective collapse, with a clock in it, set by gravity - as opposed to the collapse of an abstract concept, knowledge. Notice that I do not do this. I take mine out of gravity as it already stands, with nothing added and nothing invented. Mine is the cheaper theory. That is the only scoring point I will make against him all evening.

Let me be precise about what Penrose and Hameroff have and have not done, because I am about to lean on it and then step past it. What it *gives* us is on the left of the screen, and it is a great deal: a Nobel physicist's name on the claim, and the quantum finally standing in the room rather than gestured at from the doorway. It takes Faggin's pointing finger and turns it into a mechanism.

What it does *not* give us is the thing this whole series is actually about. Orch-OR is a theory of a quantum event *inside your own head*, tubulin to tubulin, one brain's business. It says nothing about a *universal* field. It is not a candidate for the reservoir behind the valve, or for the one substrate the panpsychists keep gesturing at. It tells you the mind might run on quantum hardware, a bit like a quantum computer. It does not tell you the mind is a piece of something vast.

And now the thing we actually want from him, which is not his mechanism and not his conclusion but the shape of his intuition. Penrose says: gravity will not let one thing be in two states at once. Superposed masses mean superposed spacetimes, and spacetime will not hold the pose, so it falls. I say something that sounds unrelated and is not: gravity will not let two things be genuinely separate. There is no negative mass, so there is no cancellation, so there is no screening, so an exact factorisation of the universe into you and everything else is unachievable in principle. He uses gravity to stop the world being two. I use gravity to stop the world being two. We have found the same stubborn fact and put it to opposite work. Gravity is the universe's insistence on being single.

[Slow here, this is a seed.] Hold that thought for a while. Later I'm going to tell you that the one field can never quite seal a piece of itself off in perfect privacy, that God can never fully let go of Adam, and the reason is going to be *exactly this*: gravity, the one force that couples everything to everything and refuses to leave anything alone. The same troublemaker is standing in both rooms. There is your God, coupling to God, by gravity.

28

And the Engine Got Weaker

I told you a while back what the last two years had done to the shelter. They were not so kind to the other half of the Orch-OR theory, and now that you have met the man, I can say what they did.

And in the same two years the engine got weaker. The most testable version of Penrose's gravitational collapse, the one with no free parameters, predicts that a collapsing superposition should radiate, faintly, and that the radiation ought to show up in a detector quiet enough to hear it. There is such a detector about four hours drive from where we are sitting, under the Gran Sasso mountain in Abruzzo. In 2021 a germanium experiment there went looking for exactly that radiation, did not find it, and the parameter-free model is ruled out. A second underground result strengthened the bound the following year. Softer variants of the model survive, and Penrose himself maintains that his own version need not radiate at all, which is a legitimate move and also, I have to say, the kind of move a theory makes when it is losing.

So the last two years have been kind to Hameroff and unkind to Penrose, and that is exactly the seam along which I want to cut. I am going to keep the room. I am going to hand back the engine.

29

The Roads Not Taken

So the obvious question: if the collapse is the part that has to go, can you not simply take it out and drop the pilot wave field in its place? Keep the microtubules, keep the sheltered pockets, keep everything Hameroff spent thirty years arguing for, and run the whole machine on an engine that never collapses at all?

Partly. And the part that fails is the headline.

What you lose is the flicker. Orch-OR's claim to be a theory of *consciousness*, rather than just a theory of quantum biology, is that each collapse **is** a moment of awareness, forty of them a second, strung together into something that feels continuous. Take the collapses away and there is nothing left to count. The moments go. What you get instead is consciousness that really is continuous, and the forty hertz you can actually measure in a real brain becomes the rhythm of the interface rather than a series of flashes.

Now there is a trap here, and I want to walk you into it and back out again, because if there were a clever physicist in the room he would suggest it within about ten seconds. The De Broglie-Bohm picture *does* have something that looks like collapse. Isolate a subsystem, let it get tangled up with everything around it, and its own piece of the wave function effectively branches: for all practical purposes it lands on one outcome. So why not say, there is your reduction, wire it to consciousness, go home? Because it keeps the wrong time. Penrose's collapse has a clock set by gravity, and that clock is the entire reason it counts as a new law of nature rather than as bookkeeping. The Bohmian version runs on ordinary decoherence, which is old physics, and it destroys nothing: every branch you did not take is still sitting there in the field, real and unoccupied. That's not objective reduction.

Which is where I want to give the loan back, with interest, because there is something in that last sentence that I have never seen anybody make anything of.

In this theory the branches you did not take are not destroyed. They are *abandoned*. The particle walks one path; the others stay exactly where they were, real, structured, unoccupied, permanent features of the one field. Nothing is deleted. Something is declined.

Now read Penrose's claim through that. On his picture a moment of awareness is the moment the universe throws away every road but one, forty times a second, for the whole of your life. On this one, a moment of awareness is the moment a road is declined, and the road is still there. Not destruction. Restraint. What you call your life is the walked path. What you *are* includes every path you did not walk, still standing, in the field, unentered.

There is a well-known jibe from David Deutsch - the parallel universe freak - that theories of this kind are his many-worlds theories "*in a state of chronic denial*". The honest answer is: not denial, restraint. And it doubles the return on something I showed you twenty minutes ago, because the part of you that never comes down into the walk is now not only an image from late antiquity. It

is the branch structure. You borrowed a collapse, and you are handing it back rather larger than you borrowed it.

Which, I will be honest, suits me. A stream of separate little collapses inside one skull was always the most stubbornly *local* thing about Orch-OR, the part hardest to square with anything universal. What you get in exchange is one field that never breaks and a brain continuously in touch with it. That's not a repair I am making reluctantly. That's the theory I wanted.

30

Adam

I have been borrowing two names all evening without paying for them. Here is the payment.

Let me make it concrete with a deliberately mischievous thought experiment. Call the whole undivided field “God”, because it is shorter to say than “the universal consciousness field,” and I want you watching the idea, not the word. God factorises off a piece of himself and seals it behind the wall. Call that piece Adam. God has just done something strange: he has created something he cannot read. He has voluntarily made a region of his own being private from himself. The Jewish Kabbalah has a name for exactly this, *tzimtzum*, the divine self-contraction, God withdrawing to make room for a genuine other. Here it is not mysticism; it is what factorising a wave function does.

Two consequences fall straight out, and I quite like both of them. First: a *miracle*, in this picture, is nothing exotic. To reach back into Adam, God only has to switch on a coupling, an interaction term, between his part and Adam's. But that is mathematically the *same kind of thing* as a photon hitting Adam's eye. Divine intervention and ordinary physics are the same equation; the model refuses to tell them apart. Second, and better: for the separation to be *perfect*, the coupling has to be exactly zero, and it never is, because gravity couples everything to everything, always, if only faintly. So God can never fully withdraw. The separation always leaks. Which means this is not really a story about a God who left and occasionally reaches back. It is a story about a field that never actually let go of any of us, present in all things, faintly, always. That is not the God of withdrawal. That is immanence, falling out of the mathematics whether you wanted it or not. Which means that if you want a name for the theology the equations are actually doing, it is not the Kabbalah. Take the Hamiltonian operator of quantum mechanics seriously and you get Spinoza.

Look at the painting for a moment, because it has been hiding our argument in plain sight for five hundred years. Michelangelo's *Creation of Adam* on the ceiling of the Sistine Chapel in Rome: God reaches out, Adam reaches back, the two fingers not quite touching. Do you notice anything weird about it?

31

The Gap

What people have noticed, again and again, is the great red shroud that God and his angels are wrapped in. Its outline is, near enough exactly, a cross-section through the human brain: the stem below, the folds, the whole arc of it. The usual gloss is that Michelangelo smuggled in a second

meaning, that the thing being handed across that famous gap is not merely *life* but *mind*, intellect, the light coming on. I do not need to prove he meant it in order to enjoy what happens when you read it with our story in your ear. God is the whole undivided field. Adam is the piece factorised off behind the wall. And the thing travelling across that last small gap between the fingers is the coupling switching on, the miracle that is also, at the very same time, just an interaction term. So what did Michelangelo wrap God in? Not a decoration. The address. The gift is consciousness, and it arrives wearing a brain, because in this picture the brain is simply the shape the partition takes. He painted the shielded chamber four centuries before an anaesthetist went looking for it.

One last thing and then I will leave the ceiling alone. Everybody looks at the shroud, but look at the gap. That gap is the only part of the painting doing any work in my argument, and it is not small because Michelangelo ran out of plaster. It is small because the coupling is faint, and faint is not zero, and the whole of tonight lives in the distance between those two words. God cannot quite reach Adam. God also cannot quite let go of him. It is the same gap, read from either end.

And if that is right, then it has one consequence I will leave you holding. Total otherness is not merely difficult. It is unavailable. Whatever else the leak turns out to be, it is the reason there is no such thing as somebody who has nothing whatever to do with you.

32

The Wall Is Not A Law

Now here's a strange thing.

Everything I have said about the wall so far has treated it as a law, as though the privacy of your mind were written into the constitution of the universe. In the theory I have handed you it is not a law. It is an equilibrium.

Here is what that means. The rule connecting the field to what you actually see - which is called Born's rule, don't you know - the one that says the chance of finding a particle somewhere is the square of the wave function there, is not an axiom of de Broglie and Bohm's pilot wave theory. In the textbook version it is put in by hand. Here you can derive it: it is the state a universe relaxes into, in the same way and for the same reasons that a gas relaxes into thermal equilibrium. Antony Valentini proved the relaxation theorem for it thirty-five years ago. And the picture beside me is what it looks like when you actually run the thing. Six frames, and time runs downwards: the labels on the left are the three moments in the simulation. The right-hand column is the square of the wave function, which in this toy example does very little except oscillate back and forth between two states. The left-hand column represents the particles, something like the electron density, and it has been started off deliberately wrong, in a shape nothing like the column beside it. Watch it come down the page. By the bottom frame the field has stirred those particles into precisely the arrangement the textbook writes down as an axiom and never explains. And, exactly as with a gas, the relaxed state is not the only state the theory permits. It is simply the state everything has been in for a very long time.

A universe out of that equilibrium is a different place. In it the uncertainty principle can be violated. Measurements become possible that the textbook says cannot be made. And signalling

becomes possible that the textbook forbids: not signals travelling through space, but the nonlocality of the field itself put to use, directly, to send. In equilibrium the nonlocality is real and unusable. Out of equilibrium it is real and usable.

So the sentence I have been building towards all evening is this, and I want you to hear how strong it is before I spend two minutes weakening it. The privacy of your mind is not a law of nature. It is a statistical accident of the universe's current state. God cannot read Adam's mind because the universe happens to be in quantum equilibrium.

And I should declare an interest, because it is not an accident that I know this. I spent some time years ago, working with the ideas of Valentini, and indeed with Valentini himself, computing how long it takes a universe to lose the ability to read its own mind. That is a theatrical description of a paper about relaxation timescales, but it is an accurate one. The reference for our 2012 article published in Proceedings of the Royal Society A is on the slide.

33

Where You Would Actually Look

Do I hear an objection already?

THE OBJECTION

If the wall is only statistical, why has nobody ever read a mind?

Because relaxation is fast and it is thorough. Which is the first of three pieces of honesty I owe you here, and all three of them cut against me.

One. Nothing I have just said means that mystical experience is non-equilibrium physics. It does not. The theory has a slot. The slot is almost certainly empty and will almost certainly stay empty, because the relaxation happened in the first fraction of a second of the universe and it went to completion. I am not offering you a mechanism for telepathy. I am offering you a reason why the wall is where it is.

Two, and this is the part I like. The theory explains why nobody has ever demonstrated any of this under controlled conditions: it *predicts* that it does not work. A century and a half of failed experiments is precisely what this picture says you should find. It is a rare thing to hold a theory that is honest about a phenomenon it would obviously prefer to have.

Three. If you did want to hunt for a violation, you would not look in a brain. You would look at the early universe, before relaxation finished, and at whatever came out of it and then stopped interacting: the microwave background, where non-equilibrium at the beginning would leave a deficit of power at the largest angles and an asymmetry between the two halves of the sky, both of which are, awkwardly, mildly present in the data; and relic particles that decoupled early enough to be carrying the anomaly still. That is a live research programme with published predictions. It is not a hope.

Which leaves one thought, and I will leave it as a thought and not as a claim. If the walls were ever down, it was at the very beginning. And the light from the very beginning is still arriving.

Now we can try to answer your homework question. What would it be like to *be* the undivided field, before any of this factorising, before Adam, the whole thing, one, entire, omniscient, containing everything? We reach instinctively for something grand: bliss, blinding light, infinite awareness. I think the honest answer is the opposite, and stranger. I think it would be like...

34

Nothing In Particular

..nothing in particular.

Here is why, and it is not mysticism, it is almost accounting. Every experience you have ever had is a *contrast*. You only know red against not-red, here against there, now against then, self against world. Experience is difference; there is an old definition of information as “a difference that makes a difference,” and it is doing real work here. A thing that is *everything*, with nothing outside it to contrast against and nothing held back from itself, has no differences anywhere. It contains all information and therefore registers *none*. Maximally full, and for that exact reason, functionally empty. Not darkness, not bliss: the sheer absence of the contrast that experience is made of. The undivided field cannot experience itself at all. It has everything and it is nobody.

And now the opening slide comes back, and it comes back changed. I told you at the start that an anaesthetic switches consciousness off and leaves the machine running, and that the switch has an address. Here is the second reading. On this picture an anaesthetic does not switch off a light. It dissolves a wall. The partition stops being maintained, and what is on the other side of it is not darkness. It is the undivided field, which is nothing in particular. You did not go anywhere. You stopped being a *where*.

Notice that the report fits. Not sleep. Not darkness. Not a dream. A gap would be an experience of absence, and there was no experience of absence, because there was nothing left that could have had one. Everybody in this room who has been under a general anaesthetic has had the only direct experience of the undivided field that any human being ever gets, and has quite reasonably filed it as nothing at all. I flag that as interpretation and not as physics. But it is the interpretation the physics suggests, and it is why I opened where I did.

There is a second line of testimony, more embarrassing to cite but more useful. Psilocybin - the principal component of magic mushrooms - at a serious dose, reliably produces what the literature calls ego dissolution: the boundary between self and world stops being maintained, and it correlates with a measurable drop in the activity of one particular brain network. Long-practice contemplatives report the same state without the chemistry. Aldous Huxley is already on this stage; he arrived in an earlier slide with the mescaline. What both sets of reports say is that the state is maximally full and impossible to describe, and impossible to describe *because* describing requires the very split the state has dissolved. Which is, annoyingly, exactly what I predicted just now.

And here is the fork, because I'm not going to pretend it points only one way. That data is just as consistent with the boring story: there is no field, there is only a self-model, and the drug quietened it. I can't separate those two readings and neither can anybody else. What I can say is

that the interesting story predicted the shape of the report and the boring one accommodates it afterwards. That is a weak reason to prefer it. So I will.

35

The Equation With No Time In It

It gets stranger, and here the physics is real and I'm not embroidering. If you write down the quantum equation for the *entire* universe as one closed system (the Wheeler-DeWitt equation, a real thing, in the quantum gravity textbooks), a term drops out that you would have sworn had to be there. *Time.* There is no time in it. Ψ for the whole universe just... is. Physicists call this the "problem of time," and they say it with a frown, because it is a headache for their calculations. I want you to hear it as an answer, or perhaps a discovery, instead.

So, the undivided field does not exist in time. It stands outside it. What might that mean? A first, limited picture comes straight out of Einstein's relativity: a light photon follows a path whose elapsed time is zero. Between its emission and its absorption no duration elapses for the light itself. The whole history of the photon is, in the geometry, one fact. I once told myself that the undivided field must be timeless like a photon, riding a beam of light.

This is a logical extrapolation of a kind of mind-boggling real phenomenon called time dilation, where how fast you move through time depends on the way you move through space, though this only becomes really noticeable if you move at a significant fraction of the speed of light. Your own clock never seems odd to you: the elapsed time your own watch records along your own path through the world is what the jargon calls 'proper time', and a second is always a second. What changes is the comparison. Let's say you meet someone twice. The faster you travel between the two meetings, the less proper time your watch racks up between them compared to somebody who stayed put, and the closer you get to the speed of light the less proper time there is. As you approach the speed of light, the proper time approaches zero.

You will have seen the results of time dilation in the movie Interstellar, where the dad is an astronaut who spends too much time near a black hole and comes back to earth and meets his little girl near to death in an old-people's home, even though he's only aged a few years since he left. That's gravitational time dilation rather than kinematic time dilation, but it has the same effect.

You may have heard of the twin paradox, whose purpose is to force this geometric point into the open: identical twins take different journeys on high-speed spacecraft and end up different ages. At least half the explanations you will read - even in some physics textbooks - incorrectly say this happens because one twin accelerates differently from the other. That is not accurate. The difference is fixed by the lengths of their paths through spacetime, not by who accelerated more. Even if the pattern of accelerations is made nearly identical, a longer coast at high speed is enough to produce a significant gap in ages. Counter-intuitively, the more of a journey you spend coasting at speed, the shorter your own path through the four-dimensional geometry, and the less of your life it uses up. Acceleration is needed only to let the paths diverge and later meet. Do I hear an objection?

THE OBJECTION

That is a description of what the mathematics does, not an explanation.

Correct! But it turns out there is no deeper physical mechanism that most physicists agree on beyond this geometry of spacetime. The mathematics describes the difference very precisely; it does not yet explain why spacetime has this particular structure. Ask why a photon has no proper time and you will be told that the interval along its path is zero. Ask why the twins aged differently and you will be told that the intervals along their paths are different. That is true, but these are facts about the mathematical geometry, and not explanations of anything at all. It tells you what the mathematics does. It does not tell you why a clock, built out of real matter held together by real forces, ticks more slowly when you carry it about at high speeds.

So I agree with the objection, because the objection is also mine and it was also John Bell's. He wrote about exactly this, and Harvey Brown wrote a whole book about it. There is a way of doing physics that consists of finding the elegant geometry, drawing the diagram, and then treating the diagram as the reason. It calculates beautifully and it explains nothing, and it is the clearest specimen of first mode thinking I can show you from inside my own subject. The sad fact is that we simply don't understand what time is, like we think we do.

One consequence in passing, because it ought to be said in a room like this one. We permit ourselves interpretations of quantum mechanics: half a dozen of them, argued over for a century, taken entirely seriously. We do not normally permit ourselves interpretations of relativity; indeed even most physicists are unaware that there are alternative interpretations of relativity. There is no reason for that beyond habit, and John Bell (him again) wrote a paper making precisely that point. It is also why I am fairly relaxed about the fact that de Broglie Bohm implies a preferred slicing of spacetime, something like an absolute space, and Einstein is supposed to have disproved that in his interpretation of relativity, or at least made it unnecessary. But there's an alternative interpretation, the 'neo-Lorentzian' one, where absolute space is fundamental and to my mind it is preferable, but it's very hard to say so in public because contradicting Einstein in physics has come to be the very definition of 'being a nutjob'. But bear in mind this is an argument about quasi-philosophical interpretation of the mathematics, not about physics.

The timelessness of the photon remains only a partial image. Yes, from the geometry’s point of view the entire history of that ray is a single fact; emission and absorption are not sequential for the light itself, but it removes time along one line and we can never occupy its frame of reference. Yet it is the best ordinary object we have that already exists without internal duration. Scale the same idea up from one null geodesic to the whole undivided field and you have a workable image of the stronger timelessness we need. The residual connections that look instantaneous or nonlocal from inside time - the guidance of the Bohmian wave, the never-quite-sealed walls, whatever leak gravity still permits - need not be signals that travel through the time the partition has just created. They can be null with respect to the deeper structure: not fast, but non-sequential.

The same thought makes an old theological claim less remote. Writers in that tradition said that God knows everything *tota simul*, all at once and outside time. All part of being omniscient. The undivided field is the one entity for which the entire content is a single simultaneous fact. Finite subjects, once the walls are up, live inside the time the division itself produces; any residual

contact with the undivided is a residual share in that non-sequential knowing, which is presumably where the non-locality we observe comes from. The photon is only a local hint of the same mode of being.

From the perspective of the Wheeler-DeWitt equation, that doesn't seem quite right. This is a deeper and cleaner timelessness: not everything happening at once, but *no happening at all*. There are no events. No before, no after, no evolution, full stop. The One, undivided, is genuinely, rigorously outside time; for the first time in this series I can say that and mean it as physics, not metaphor. Which raises the only question left, and it is the beautiful one. If the field is timeless, where does time come from? If the field stands outside time, how does time begin?

36

Let There Be Time

Here is one of the most interesting things that we're discovering tonight. There is a result in quantum theory (the Page-Wootters mechanism, again a real thing, not something I invented over a drink) that says time can *emerge* from a timeless universe the moment you *partition* it. You split off one piece to act as a clock, and relative to that clock, the rest of the universe begins to have a before and an after. Time is not the stage the division happens on. Time is *born from the division itself*.

Put that together with everything we have built. The undivided field: timeless, contentless, everything and nobody. Then it divides, factorises, seals off a piece, raises the first wall. And in that instant, three things are born at once that could not exist before: *contrast*, so there is something rather than blank fullness; *an other*, so there is someone to be known; and *time*, so that anything can happen at all. And notice what I did an hour ago. I said the *first* wall, and 'first' is a word that already assumes the thing it is being used to explain. I did that deliberately and I am paying for it now. The partition is not an event in time. The partition is the *origin* of time. And now read the oldest sentence in the Western world back with this in your ear. *Let there be light.* Read it as *let there be separation.* Read it as *let there be time.* I think that is the best literal gloss that line has ever been given, and it comes out of a quantum equation about a dying star.

And read the rest of that first chapter while you are at it, because it doesn't stop. Light divided from darkness. The waters above divided from the waters below. The dry land divided from the sea. Day from night, kind from kind. The first page of the Bible is not a description of a universe being manufactured. It is a description of a universe being partitioned, over and over, in a particular order. It is a factorisation algorithm. I do not think whoever wrote it knew that. I think they were describing the only sort of creation there is.

Now let me turn the rhetoric into arithmetic, because there is a theorem underneath it, the theory of information. Now information is measured by a quantity called the von Neumann entropy. If the universe as a whole is in a pure state then that quantity is exactly zero. Not small. Zero. Information in this technical sense means missing knowledge, uncertainty, the gap between what is and what you have got hold of. Which means the universe, taken whole, has nothing missing, and therefore contains no information whatsoever. Every bit of information anywhere, in this room, in your head, in the physics library, is entanglement entropy: it belongs to a subsystem, and

subsystems exist only when you trace out the rest, and you can only trace out the rest once you have drawn a line. The universe knows nothing. Only its parts know anything. Knowledge is a symptom of being incomplete.

And notice that we have now done the same operation twice tonight without saying so. Page and Wootters: partition into a clock and a remainder, condition on the clock, and time appears. Entanglement entropy: partition into a part and a remainder, trace out the remainder, and information appears. It is one cut. Out of the one cut fall three things: time, information, and contrast. Nobody arranged for them to arrive together.

One more road onto this same slide and then I will stop. In 1812 Hegel opened the *Science of Logic* by arguing that pure Being, with no determination in it at all, is indistinguishable from Nothing, and that everything else has to start from the movement between the two. He got there from logic, with no physics anywhere in the building. It is the same claim. Everything, undetermined, is indistinguishable from nothing, and something only begins when a distinction is drawn.

37

Why Would the One Divide?

Which leaves one question, and it is the one a child would ask. If the field was everything, why would it ever divide? Why not stay whole? The lazy answer is boredom: God got bored of being everything, so he made a world to watch. When I was preparing this lecture I started off by telling myself that but on reflection it is not wrong so much as shallow. The real answer, I think, is not boredom. It is *necessity*.

Follow the argument we just built to its end. A totality with nothing outside it cannot experience itself: no contrast. It cannot even *know* itself, because knowing needs a knower and a known, a split. And it has no time in which to do anything anyway. So a perfect, undivided everything has exactly one move available if it wants to be *anything* in particular rather than merely *contain* everything in general: *divide*. Break the symmetry. Raise a wall. Make an other, generate a clock, and let contrast and time and self-knowledge come pouring into the gap between the pieces. Creation is not an indulgence in this picture. Nor is it an accident. It is the only route there is from blank undifferentiated potential into actual, felt, particular existence. The One does not divide because it is bored. It divides because that is the only way for anything to be someone. And you (each of you, sealed behind your wall) are how it finds out what it is. I will note only that people have arrived at almost exactly this thought before, by routes with no physics in them at all. We will come back to who, next time.

And that lets me settle an old quarrel, which is not a thing you often get to do from a physics slide. In the second lecture I laid out the Gnostic picture: the Demiurge, the botched craftsman who made this world; the Pleroma, the fullness above it; and the spark of divine light trapped down here in matter, in you, homesick. That spark is this lecture's shielded sector. It is the same object. A piece of the one, walled off, still belonging to what it came out of, unable to get back.

And in the same lecture I gave you Plotinus writing furiously against those people: the world is not a prison, the division is not a catastrophe, and there is a kind of spiritual vanity in insisting that it is. I laid that quarrel out in front of you and I deliberately declined to settle it, because I had nothing to settle it with. Tonight I have. If the argument on the last slide holds, the division is not a mistake, not a fall, and not the work of a botched craftsman. It is the only route there is from blank potential to anything in particular. The wall is not the tragedy. The wall is the condition of there being anybody to feel tragic. Which settles it on Plotinus's side, out of the equations, seventeen centuries late.

38

Now I Argue Against Myself

The voice in the grey boxes has been doing some of this work all evening and it has beaten me more often than I intended. Now I want to do the job properly, at length, and against myself.

Now. If I stopped there, I would be doing the thing this entire series has been an argument against. I would be in the *first* mode, seizing a beautiful pattern, selling it to you, and quietly hiding the seams. The second mode, the one I keep gesturing at, does the harder thing: it holds the whole of a thing at once, the strong parts and the broken parts together, and does not flinch. So I am going to spend the next few minutes arguing against my own idea, as hard as I honestly can. This is not false modesty and it is not a disclaimer to cover myself. *The honesty is the argument.* A thing that can survive you looking straight at its weaknesses is worth more than a thing you were only shown from its good side.

There are, in the end, about eight objections. Two are fatal to calling any of this *science*, and I want to give you those two straight, because they are the ones that are still standing after everything.

39

Where Does the Field Live?

Is there an objection?

THE OBJECTION

It does not live in the world. It has no address in the room you are standing in.

The first objection is the one that took me longest to feel the force of. I said the wave function is a real field filling the world. A philosopher of physics will stop me at once: *it doesn't live in the world.* Forget the mathematics for a second: the point is only that this field does not live where you live, and that is a genuine problem for the story I am telling. Here is the difficulty in full. The electromagnetic field has a value at each point of the ordinary three-dimensional space you are sitting in. The wave function does not. In principle, to get one value out of it you have to feed it the position of *every particle in the universe at once*: it lives on a space with three dimensions for every particle there is, billions upon billions of dimensions, not on the three we inhabit. So when I say “the field is *here*, in this room, in your head,” I am, strictly, cheating. The thing does not obviously have a “here” at all.

I have a partial answer: there is honest work showing you can rewrite the theory as fields living on ordinary space after all, and the white dwarf from last time is my witness that this field does its pushing right here where stars actually are. But I will be straight with you about what survives even so. Even granting the field a home in three-space, its behaviour at any point still depends, instantly, on the configuration of everything everywhere. I have managed to relocate God into three-dimensional space. I have *not* managed to make him keep still. The strangeness does not go away; it just moves from *where the field is* to *how it behaves*. That is a real cost and I am not going to pretend I have paid it in full.

I told you just now there is honest work rewriting the field into ordinary space; let me tell you who does it and why, because the *why* is the strange part. Bell had the cleanest way to name the worry. The particles, he said, are *local beables*: things you can pin to a definite patch of the space we live in. The wave function is a *non-local* beable: it does its guiding from a space that is not ours. Every field we have ever trusted, electric, magnetic, sits at each point of this room; this one refuses to. So a few people, Travis Norsen who was here in 2010 chief among them, have tried to rebuild the whole theory out of nothing but honest fields in ordinary space, propping up the missing correlations with extra local scaffolding. And you might ask, as I did, why on earth bother, once you have already swallowed the nonlocality whole. They are not trying to kill the nonlocality; they know they cannot. They are trying to evict the *high-dimensional object*, to make the furniture of the world look like the classical physics we grew up trusting, everything laid out in the space you can point at. It is a quarrel about what you will let yourself call *real*, and the honest alternative, for those of us who would rather keep the one universal field, is to stop calling it a *thing* at all and call it a *law*: closer to the rule the particles obey than to any stuff they are made of. I'm not sure about that, because I don't really know what it means.. I only wanted you to see that the fight here is about taste in ontology - i.e. what you want to believe really exists - not about whether the physics delivers. The physics delivers.

One more thing. On the slide with no time in it I said the connections that look instantaneous need not be signals travelling through time: that they might be null with respect to some deeper structure. OK, now you know I just spent the weekend in Florence and I had my peace and quiet. Well, in addition to rewriting this talk like I said earlier, I also thought it would be fun to see if I could write a paper - not done that for a while! - based on this idea of null connections, whilst investigating whether AI has come on enough to help me with the drafting. So I sat down with this idea and wrote a paper about it. And here it is! "Null structure on configuration space: from the photon's zero proper time to the guidance equation" by M.D.Towler, Vallico Academy, via del Collegio 22, Vallico Sotto. If the Academy can have a first lecture series, it can have a first paper! I would explain the paper but you genuinely wouldn't understand what the fuck I'm talking about, not least because I don't understand parts of it. Grok helped me a little too much in the end. The point is that the space this field lives on carries light cones of its own, and that the quantum potential, the odd de Broglie-Bohm force I have been leaning on all evening, is exactly the tilt of those cones. If that is right, two particles are not correlated across a distance. The cones themselves refuse to come apart. You will not follow the mathematics in it, because like I said I'm not certain that I do either. It may well be wrong. I mention it because this is what an objection

feels like from the inside when it is working properly: not a defeat, but somewhere to start.

40

Better Office Space, Then the Inversion

The second objection is the deep one, and it is fatal, and I want you to see that I see it. Grant me everything. Grant that the universal wave function is real, causal, nonlocal, undivided, that it factorises into us, that its division is the birth of time, grant the whole edifice. I still have not explained the one thing I set out to explain. *Why is any of it accompanied by experience?* Why does the field guiding a particle *feel like* anything from the inside, rather than being magnificent, intricate, unconscious clockwork with no one home? Nothing in the equations answers that. The wave function's job, in the theory, is to steer particles. Steering particles is not obviously the same thing as *being aware*, and I have not built the bridge from one to the other. Nobody has.

So here is the honest verdict. This does not *solve* the hard problem. At best it relocates the problem: it gives it a grander, more beautiful, more physically precise office to sit in. It is the same problem Chalmers named at the start of tonight, still unsolved, now merely housed in the wave function of the universe instead of in a lump of neurons. Better office space. Same tenant. If you take one intellectually honest thing away from tonight, take that.

Though notice what is still lying on the table, because I put it there an hour ago and then walked straight past it. Physics tells you what matter does and never what it is. The one piece of intrinsic nature any of us has direct access to is our own experience. I have not built the bridge from steering to being aware and nobody has, but that is the direction the only available plank is pointing, and I would rather show you a plank than pretend I have a bridge.

The hard problem of course is not as hard as what philosophers call the "fucking hard problem", which is "Why in the name of all that's holy does anything exist at all?" That is really and truly and completely inexplicable and absolutely impossible to understand. Which makes arguing about intelligent design or whether there is a God or there was a divine act of creation or whether it was all just a coincidence kind of secondary..

And having conceded that, I want to take one more step, because there is something wrong with the question itself and I have only recently been able to say what.

The hard problem, as it is always posed, assumes you begin with unconscious material and have to add experience to it. That is the generator story from the beginning of the evening, and it is atomist to the bone: build the whole out of parts, then wonder how the parts learned to feel. On the picture I have given you, you do not begin with parts. You begin with one thing. The primitive is not *there is experience here*. The primitive is *there is a wall here*.

Turn the question over and it comes out inverted. Not: why is there something it is like to be you? But: why is there so *little* that it is like to be you? Why is your experience a trickle? Why, if you are a piece of a field that is everything, do you get one body, one viewpoint, one lifetime and a headache? And that question does have an answer. The answer is the wall, and the wall is the whole lecture.

Which lets me say what I think the real damage of the hard problem is. It is not that the problem is hard. It is that the problem is an artefact of insisting on one mode of attention: take the world apart, find the pieces, then discover that experience is not one of the pieces and never could have been. Put the whole first and the unanswerable question becomes a physics question with a partial answer and a large unpaid bill. I have not made the bill go away. I have made it itemisable.

Objection?

THE OBJECTION

You have changed the question.

I have. I concede that, and I would rather concede it here than have you work it out on the way home. I have not solved the hard problem. I have changed the question it is a question about. Call it sixty per cent progress and forty per cent conjuring trick, and I would far rather be told which is which than be believed.

41

What Survives

So let me summarize what happened. On the *credit* side: the field is real physics, not my invention: de Broglie and Bohm and Bell and Valentini and others did the work, and it is the one genuinely universal, genuinely causal field on offer. The individuation is real mathematics. The timelessness of the whole-universe equation is real. The birth of time from partition is a real, published mechanism. None of that is me making stuff up. The debit column is the honest one, and it is on the screen in full: read the three charges against me there. The single move that turns all this physics into the thing I'm trying to do, welding that field to *consciousness*, is the one I can't make you buy. Two speculative floors, one stacked on the other, and no scaffolding under either. This is exactly where the mathematics stops carrying you and the poetry has to take over, and the whole art is in being able to feel the precise point where you cross from one to the other, and telling your audience when you do.

And there is a fourth charge, which I put on the board myself an hour ago and have not repaired since. The shelter inside the microtubule protects a delicate thing from Adam's own body. I need it to protect Adam from the universe. Those are two different walls and I have only ever paid for one of them. It stands in the debit column, unamended, and it is the item I would most like somebody in this room to take away and beat me with.

And of those four, two are bookkeeping and two are the pair I named at the top of this act. The hard problem has been rehoused rather than solved, and the join in the chain is not paid for. Everything else on that side of the ledger is negotiable. Those two are not, and if you forget the rest of the column, keep those.

So that is the ledger. I am not asking you to sign it. I am asking you to notice that it exists, and that I wrote it out in front of you rather than after you had gone to bed.

One more thing and then I am nearly done. That voice that has been arguing with me all evening, in cold grey type on the right of every other slide, and winning several times: that voice is mine. Every one of those objections is something I said to myself at two o'clock in the morning while I

was building this. *Then why can Eve punch him* is mine. *Shielded from his own body is not the same as hidden from God* is mine. *You have changed the question* is mine, and it is the one that took me longest to admit.

And the argument only ever got anywhere because I kept saying them. That is what the second mode actually costs. It is not open-mindedness, which is cheap, and which everybody in the world claims to have. It is having to be the person who says *then why can Eve punch him*, at the exact moment you would much rather not have noticed.

42

The Valve, Revisited

Which lets me close the loop we opened at the beginning. James, Bergson, Huxley: the brain as a reducing valve, filtering down a consciousness already there. I asked: a valve on *what*? Now we can answer them. On the one undivided field. And the brain is not, on this picture, a lamp that makes the light, and not merely a filter that dims it: the brain is the *shape of the partition*. It is the particular wall, the specific factorisation, that seals one trickle of the universal field off from all the rest and calls it “me.” The valve is the wall. Huxley reached for the word “valve” because he did not have the word “factorisation.” He was describing the same thing without the mathematics.

And notice we have quietly answered the panpsychists' nightmare too: the combination problem, how the many become one. On this picture you never had to build the one out of many in the first place. The one was always there, single and undivided. The many are what you get when it *divides*. The hard direction, assembling a unified mind out of a billion separate glimmers, was the wrong direction all along.

43

Samantha

One more person, and then the three roads.

We return to Samantha! You know her as a bronze sculptor, you know she runs a second-mode gallery in Florence, and she is by far the most intelligent person in this room. She is attempting to derive the structure of the universe from first principles entirely in the second mode, whilst deliberately being entirely uncontaminated by the ideas of the scientific establishment.

Many years ago she told me that a good deal of what I was after was already in Blavatsky, in Alice Bailey and in Seth. I was not thrilled. Bailey in particular is so dense as to be very nearly unreadable by any normal person with a normal education, and I include myself in that. But the second lecture ended on precisely those three names, and it ended there because they turn out to be pointing at the One: the same object the buried tradition has been describing since Plotinus, under different names, by people who were mostly not reading each other.

So she is not an anecdote. She is the living witness that the tradition is still being walked, right now, in Florence and in Vallico Sotto, by somebody who came to it with no physics and no philosophy and arrived at the same place that people like me have spent decades driving towards with equations, and beyond, and then and only then did she start learning physics! If the second mode is a real way of knowing rather than a nice thing to say about poets, then that is what it

looks like from the outside.

She works with Alberto Ghizzi Panizza, the world's greatest macrophotographer (somewhat counterintuitively macrophotography means taking pictures of very small things). I'm just going to show you some pretty pictures. Initially you won't know what they are, but they're actually super-zoomed in shots of the metal surface of her bronze sculptures. And this is what happens when I animate them.. And this is what happens when you put them in the multisensory room in Keil Space.

44

Three Roads, Same Destination

Stand all the way back now and look where we are. Three completely separate roads have arrived at one place. The *physics*: my road, Bohm's road, a real universal field that divides into minds. The *philosophers*: the panpsychists and idealists and filter theorists, coming the other way, insisting mind is fundamental and the brain receives it. And *the theory* I have refused to name for four lectures now, the one about the two modes of attention, which, when we finally open it next time, turns out to make a claim about the deep nature of reality that lands on this same spot.

Three roads. Physics, philosophy, and a theory of attention. Late antiquity you have already seen woven through all of it. None of these people were talking to each other. Some of them were separated by two thousand years. That so many roads, walked by people with nothing in common, should end in the same clearing: that is either the most seductive coincidence in the history of ideas, or it is not a coincidence. I am not going to tell you which. I am going to make you sit with it until next time.

45

Next Time: The Theory Gets a Name

One last thing, and then the name. At the start I asked where you went when the count reached seven. Here is my answer, and it is the whole of tonight in three sentences. You did not go anywhere. For a while there was no *you* to go anywhere, because the wall that makes a you had come down. And what was on the other side was not nothing at all, it was everything, with nobody in it to notice.

So here is where we are. Across four lectures I have kept one thing back: the name of the connecting question, the theory of the two ways of paying attention, the thing I planted at the very end of the first evening and asked you to watch for. Some of you have surely guessed it by now; maybe some of you have looked it up and are being kind enough not to shout. Next time I finally say the name, and show you who I'm talking about, and the neuroscience underneath it (real damaged brains, real hemispheres, not hand-waving) and then the enormous claim he builds on top: that one of the two modes has been quietly running our civilisation, and getting reality *wrong*, for three and a half centuries.

And when I name him, every road we followed (Burton's life, the buried tradition, the buried physics, and tonight's field that divides itself into us to find out what it is) will turn out to have been pointing at the same thing the whole time. Come back for the last one. Bring the second

mode of attention. As always, you will need it!

END OF LECTURE 4

Notes and Sources

The technical detail behind the claims in the talk, with its sources.

On “separability”, and why it is not “orthogonality” (Slide 14).

The word used in the talk is *separability*, which is the correct one; both the slide and the talk say so. This note is for anyone who wants the distinction from orthogonality drawn sharply. If the joint state factorises, Ψ = ψ_Adam ⊗ ψ_remainder, then the remainder carries zero information correlated with which configuration Adam is actually in (that is the real content of “God cannot read Adam's mind.” Orthogonality proper is a relation between two vectors in the *same* Hilbert space (two states Adam could be in), and distinct states are automatically orthogonal in any quantum system, entangled or not), so it is not what does the sealing work. The two are worth keeping apart: the honest word is separability.

On the preferred factorisation, and what the conditional wave function does about it (Slide 14).

The standard complaint is that nothing in the formalism picks out the “Adam” factorisation: the Hilbert space of the universe admits indefinitely many tensor-product decompositions and the bare wave function does not privilege one. In a theory with actual particle positions the complaint is weaker than it looks. Write the universal wave function as Ψ(x, y), with x the configuration of a candidate subsystem and y the configuration of everything else, and substitute the ACTUAL value Y(t) of the environment’s configuration: ψ(x, t) = Ψ(x, Y(t), t). That object, the conditional wave function, is the effective state of the subsystem and it obeys the subsystem’s own Schrödinger evolution whenever the coupling is negligible. Its content is fixed by where the particles in fact are, not by a choice of basis. This does NOT deliver a principled account of why a person rather than a hemisphere or a person-plus-chair is the relevant subsystem, so the objection survives; it survives as a question about which decomposition is a SUBJECT rather than as a claim that no decomposition is real.

On miracles as coupling terms, and the gravity leak (Slide 30).

If H = H_Adam ⊗ I + I ⊗ H_remainder with no cross-term, a product state stays a product state forever: total, self-sustaining separation. To “unpick” it, God switches on an interaction term H_int coupling the two sectors; formally this is the same kind of object as any ordinary physical interaction (a photon on the retina, gravity on the foot). Hence: divine intervention is not ontologically distinct from physics in this model. And because gravity couples every degree of freedom to every other with a strength that is never exactly zero, strict separability is physically unrealisable: the most you get is extremely weak residual coupling. Result: not tzimtzum (God absent, intervening from outside) but immanence (God present in all things, faintly, always). Spinoza fits the mathematics better than the Kabbalah does, once you take the Hamiltonian seriously.

On the microtubule evidence and the Gran Sasso bound (Slides 23, 26 and 28).

The claims made in the talk, each with its source, because this is the slide a technical reader will stop at. (i) Microtubules as a functional target of the inhalational anaesthetics, room-temperature quantum effects in microtubules, and the reading of the 2022 Dublin MRI result as a macroscopic entangled state correlated with conscious state and short-term memory: Wiest, *Neuroscience of Consciousness* 2025, doi 10.1093/nc/niaf011, reviewing Kerskens & Perez Lopez (2022). (ii) Coherence of order 10 nanoseconds in ISOLATED microtubule preparations, four orders of magnitude beyond older estimates; tryptophan superradiance across large microtubule networks; isoflurane and etomidate shortening both transfer distance and coherence time: same review and references therein. (iii) THE QUALIFICATION, which is spoken in the talk and repeated here because it governs all of (i) and (ii): every one of these measurements is on laboratory preparations, not on living brain tissue, and applicability to an intact functioning brain is UNCONFIRMED. (iv) The parameter-free Diosi-Penrose model is ruled out by the underground germanium search for collapse-induced X-ray emission at Gran Sasso: Donadi et al., *Nature Physics* 17, 74 (2021), strengthened by the Majorana Demonstrator (2022). Coloured-noise variants survive, and Penrose maintains that his own version, without Diosi's stochastic field, need not radiate. (v) The asymmetry is the point: the shelter is being confirmed in preparations while the engine is being constrained under a mountain.

On the join in the chain (Slide 24).

Stated in the talk and left unrepaired, deliberately. Orch-OR's shelter is an argument that a hydrophobic pocket can protect coherence from the thermal and aqueous noise of the CELL. The thesis requires that a sector of Adam be effectively decoupled from the REST OF THE UNIVERSE, which is a different and much stronger separability condition, and one that gravity in particular is known to obstruct (see the gravity-leak note above). Biological shielding from local noise does not entail cosmological shielding from the field. This is an extra postulate laid on top of the first, it is load-bearing, and it is unpaid. It is objection 8 in the tally below.

On whether the shelter and the wall are really two things (Slide 24, and the standing objection to it).

The spoken concession stands: the microtubule shelter protects a delicate structure from Adam's own body, and the wall that makes Adam a private subject is separability plus quantum equilibrium plus unscreenable gravity. Two walls, one paid for. On whether they can be brought together, the honest answer is not yet, but here is the shape a repair would have to take, and here is why the obvious version of it fails. The obvious version says the shelter builds the wall. It does not, and it cannot: in de Broglie-Bohm it is DECOHERENCE that enforces effective factorisation and makes a conditional wave function autonomous, and the shelter exists precisely to hold decoherence off. So the shelter runs against the grain of the wall rather than with it, and any stitch that ignores this is selling you something. The version that may survive runs the other way. Effective factorisation is cheap and universal: everything decoheres into effective factors, which is exactly why the preferred-factorisation objection bites, since nothing in the mathematics singles out you rather than your left hand. What is not cheap is a factor that remains INTERNALLY coherent, one joint quantum state rather than a heap of classically correlated parts. On that reading the shelter does not raise the wall; it decides what kind of thing is standing behind it, a single subject rather than a population. That would answer the preferred-factorisation question

biologically where the mathematics cannot: viable subjects are sectors that hold coherence AND maintain their own boundary, which is a description of a cell. It does not pay the join, because it still says nothing about screening Adam from the universal field. It converts one unexplained postulate into one unexplained postulate plus a research programme, which is an improvement in candour rather than in physics. Do not offer it from the platform as a repair.

On quantum non-equilibrium, and how far it may honestly be pushed (Slides 32 and 33).

The Born rule is not an axiom of this theory; it characterises a state of statistical equilibrium reached by relaxation (Valentini's subquantum H-theorem, *Phys. Lett. A* 156 (1991) 5 and 158 (1991) 1). Out of equilibrium the theory permits sub-quantum measurement, violation of the uncertainty relations, and signal nonlocality. THREE CONSTRAINTS ON WHAT MAY BE SAID, all spoken in the talk and repeated here because the written version travels further than the spoken one. (1) Nothing here identifies mystical or anomalous experience with non-equilibrium physics. The theory has a slot; the slot is almost certainly empty and will remain so, because relaxation is fast and thorough and finished in the very early universe. (2) The theory therefore PREDICTS the null results: no controlled demonstration of mind-reading should exist, and none does. That is a point in the theory's favour and it is also a firm prediction of ordinariness. (3) The place to look for residual non-equilibrium is cosmological, not neurological: primordial non-equilibrium sourcing CMB anomalies (large-scale power deficit, hemispherical asymmetry) after Colin & Valentini, and anomalous spectral signatures in relic particles that decoupled early after Underwood & Valentini. Relaxation timescales: Towler, Russell & Valentini, *Proc. Roy. Soc. A* 468, 990 (2012).

On the empty branches, and Deutsch's jibe (Slide 29).

Deutsch's complaint (*BJPS* 47, 1996) is that pilot-wave theories are parallel-universes theories in chronic denial. The standard replies are that the empty branches carry no particles, hence no observers and no records, and that a nomological reading of Ψ (Duerr, Goldstein, Zanghi) removes the ontological weight altogether. The second reply is closed to this lecture, which has reified Ψ as the field. The lecture therefore takes the first and owns the consequence out loud: unentered branches remain real structure in the one field. Not denial: restraint. Note the rhyme with *Ennead* IV.8.8, which is the reason the beat is placed where it is.

On timelessness: the right kind and the wrong kind (Slides 35-36).

The old "massless like a photon, therefore outside time" analogy fails: a photon's timelessness is a Lorentz-invariant fact about null geodesics, whereas the wave function's "instantaneity" in dBB is frame-relative, resting on a preferred foliation. Those are different kinds of timelessness and the photon one does not transfer. The *defensible* timelessness is the Wheeler-DeWitt result: for a closed universe, $H\Psi = 0$, no external time parameter. Page-Wootters then recovers apparent time relationally: pick a clock subsystem, condition on it, and the remainder evolves relative to it. So partition is literally the origin of the appearance of time. (Rovelli's thermal-time hypothesis is a different mechanism to the same end.)

The twin-paradox arithmetic, cut from the talk (Slide 35).

The worked numbers are left out of the talk for pace; they are correct and are kept here in case a physicist presses. Two twins with deliberately matched acceleration profiles: both burn identically, but one turns his engines off and coasts for ten years of base time at four fifths of the speed of light before an identical return leg. At v = 0.8c the Lorentz factor is 5/3, so his clock runs at three fifths of ours: twenty years of base time cost him twelve, and he comes home eight years younger than his brother. The point of matching the burns is to strip out the usual bad explanation. The difference is not caused by acceleration; acceleration only lets the paths diverge and meet again. Proper time is the length of a world-line, and the longer you coast at speed the SHORTER your own path through the four-dimensional geometry and the less of your life it uses up. In the textbook version, where one twin is inertial throughout, this is the same fact stated the other way about: the inertial path is the one of greatest proper time, which is why the stay-at-home ages most. Both statements are the same geometry; only the baseline differs. And the geometry remains a description rather than a mechanism, which is the whole reason the digression is in the lecture at all.

On zero entropy, and why one cut yields three things (Slide 36).

If the universe is in a pure state $\rho = |\Psi\rangle\langle\Psi|$ then $S(\rho) = -\mathrm{Tr}(\rho \ln \rho) = 0$ exactly. That is zero von Neumann entropy, which means zero mixedness and maximal knowledge of the state; it is emphatically NOT an absence of structure, since a pure state can encode arbitrarily rich correlations. Information here is the ignorance measure, so the whole contains no information in that sense alone. All the information anywhere is entanglement entropy of a subsystem, $S(\rho_A)$ with $\rho_A = \mathrm{Tr}_B|\Psi\rangle\langle\Psi|$, and it exists only relative to a partition into A and B. Page-Wootters recovers apparent time by the same operation with the partition taken as clock and remainder. So one cut, two well-known theorems, three products: time, information, and contrast. The Hegel remark in the talk is not decoration: *Science of Logic* (1812) argues that pure Being without determination is indistinguishable from Nothing, which is the same claim reached from logic alone.

The eight objections, honestly tallied.

1. Configuration space: weakened by the multi-field rescue (fields on 3-space), but survives as a dynamics problem: behaviour at a point still depends on the whole configuration. **2. Combination problem**: partially dissolved: you divide the one rather than assemble the many. **3. Preferred factorisation**: PARTIALLY ANSWERED: nothing in the bare formalism privileges the “Adam” slicing, but in this theory the actual particle configuration of the environment selects a subsystem’s conditional wave function, so the carving is a fact about the world rather than a convention. What remains unanswered is why THIS subsystem is a subject. Serious; no longer fatal. **4. Hard problem relocated**: untouched, still fully stands: guiding particles is not yet experiencing. **5. Stacked unfalsifiables**: two metaphysical layers (dBB-realism, then the consciousness identification); heavier, not lighter, with each refinement. **6. Foliation**: poisons the photon-style “outside time” move (retired in favour of Wheeler-DeWitt). NEO-LORENTZIAN REPLY: a preferred foliation is an embarrassment only if relativity is exempt from interpretation. It is not. Bell, “How to teach special relativity” (1976), and Harvey Brown, *Physical Relativity* (2005), both argue that Lorentz invariance is a dynamical symmetry of the matter equations rather

than a primitive fact about spacetime; on that reading an undetectable preferred frame is a cost of the same order as any other interpretive commitment, and the usual asymmetry (we allow interpretations of quantum mechanics and forbid them for relativity) is habit, not argument. **7. Gravity-universality**: exact separation impossible; reframed above as immanence. **8. The join in the chain**: the microtubule shelter, if it works, protects coherence from ADAM'S OWN metabolic noise. The thesis needs a wall between Adam and THE REST OF THE UNIVERSE. Those are two claims and nothing forces the structure that does the first to do the second. It is an extra postulate riding on the first, it is unpaid, and it is stated in the talk (slide 24) and again in the ledger (slide 41). In the talk the two that are still genuinely fatal to calling this science are 4 and 8; 3 is now serious rather than fatal.

Sources worth having in your pocket.

de Broglie-Bohm / quantum force: your own 2009 Cambridge lecture and Towler, Russell & Valentini, *Proc. Roy. Soc. A* **468**, 990 (2012). Undescended soul: Plotinus, *Ennead* IV.8.8. Bull of Phalaris: *Ennead* I.4.13 (the sage under torture; the suffering part is not the contemplating part). Timelessness: Wheeler-DeWitt; Page & Wootters (1983). Information as "a difference that makes a difference": Bateson. Hard problem / panpsychism: Chalmers; Strawson. Filter theory: James (1898), Bergson, Huxley (1954). Orch-OR and the decoherence dispute: Penrose-Hameroff; Tegmark vs Hagan-Hameroff-Tuszynski. Microtubule evidence (Slide 22): Wiest, *Neuroscience of Consciousness* 2025, doi 10.1093/nc/niaf011 (review); Kerskens & Perez Lopez, *Journal of Physics Communications* 6, 105001 (2022) (the MRI result); Tegmark, *Phys. Rev. E* 61, 4194 (2000) versus Hagan, Hameroff & Tuszynski, *Phys. Rev. E* 65, 061901 (2002). The Gran Sasso bound (Slide 28): Donadi et al., *Nature Physics* 17, 74 (2021); Majorana Demonstrator, 2022. Non-equilibrium (Slides 32-33): Valentini, *Phys. Lett. A* 156 (1991) 5 and 158 (1991) 1 (the subquantum H-theorem); Towler, Russell & Valentini, *Proc. Roy. Soc. A* 468, 990 (2012) (relaxation timescales); Colin & Valentini on primordial non-equilibrium and CMB anomalies; Underwood & Valentini on relic particles. Conditional wave function (Slide 14): Duerr, Goldstein & Zanghi (1992). Empty branches (Slide 29): Deutsch, *BJPS* 47 (1996). Entropy of a pure state and the one cut (Slide 36): von Neumann; Page & Wootters (1983). Hegel, *Science of Logic* (1812), Book One, Being / Nothing / Becoming. Ego dissolution (Slide 34): Carhart-Harris et al. on psilocybin and default-mode network activity.