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Dimentia: Footnotes of Time

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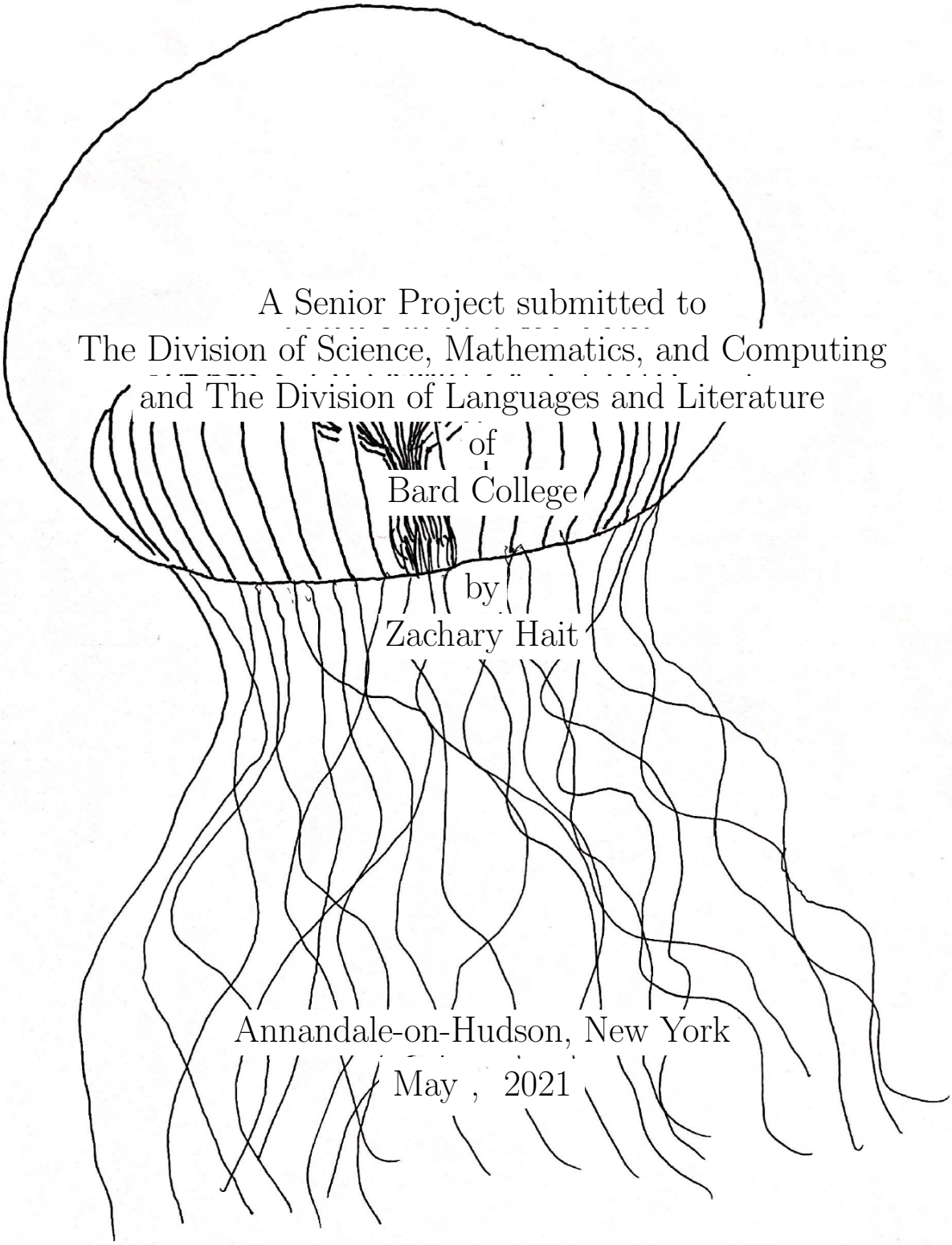

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by
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Abstract

Time from the physicist's perspective is not inclusive of our lived experience of time; time from the philosopher's perspective is not mathematically engaged, in fact Henri Bergson asserted explicitly that time could not be mathematically engaged whatsoever. What follows is a mathematical engagement of time that is inclusive of our lived experiences, requiring the tools of storytelling.

For Ann Callaghan

[1]There is no inside. Only outsides.

[2] "The actual cannot be reduced to mere matter of fact in divorce from the potential." (Whitehead 227)

"Virtual problems are the ground of all things; an adequate conception of actuality must involve virtuality; the topological structure of a virtual problem acts upon its actual solutions just as those solutions act back upon that topological structure." (Paetsch 298)

[3]A story never begins at the beginning, a story always begins in the middle.

"[The rhizome] has neither beginning nor end, but always a middle *(milieu)* from which it grows and which it overspills." (Deleuze, ATP 21)

"A haecceity has neither beginning nor end, origin nor destination; it is always in the middle. It is not made of points, only of lines. It is a rhizome." (Deleuze, ATP 263)

"Why is this so difficult? [. . .] It's not easy to see things in the middle, rather than looking down on them from above or up at them from below" (Deleuze, ATP 23)

[4]The ground was shifting beneath her feet stably in place of currents sweeping gyres inside her head. Stillness agitated. Jordan waved her arms, looking, searching for balance. Equilibrium never produced anything. Leaning on one heel, then swaying to her toes. Swiveling, a half-step forward, catching herself. No one else had ever been there to catch her; she didn't need her then she didn't need her now. Her vision had doubled, tripled, spiraling divergently, overlapping: eyes shut. Fluctuation, impetus, feet pushed back again, overcompensation. Humming, looking, searching for balance: a calming, soft, repetitive rhythm to hold her movement in sync. Labyrinth, Grouper. Eddies to tides. 85 beats per minute. Chaos to dancing. The distinction was never so clear. Jordan collapsed.

[5]

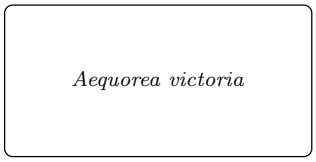
> It is hard to resist the (very philosophical) temptation to denigrate something apparent to consciousness but resistant to every means of expression. Yet it is precisely duration's *resistance* to discourse that (like Lautman's "mathematical reality") prevents it from being dismissed as a subjective illusion or a discursive residue. Even if it is present *for us* only in immediate experience, it is incommensurate both to the discourses that emerge from this experience and to the discourses that might condition this experience. How could we hallucinate it, if we can neither imagine it nor cognize it? How could it arise from discourse, if it's incommensurate with every discourse? Precisely because time does not allow itself "to be seen, but only to be lived" it remains alien to us—in this attesting eloquently to its reality, even its autonomy (Bergson 2001: 191). (Paetsch 205-206)

Duration is Bergson's construction of time. Our project involves an engagement of time that follows Bergson, but it also is engaging the domain of mathematical physics. As a balancing act between what will be best for a wide audience while emphasizing that what we are engaging here is not some offshoot of time but rather time itself, our terminology of choice will be time. However, in much of the literature we will encounter both duration and time, sometimes interchangeable in their meaning, and sometimes not (with duration referring to Bergson's construction specifically and time referring to spatialized time specifically).

It is through recognizing, accepting, and embracing the fact that time does not allow itself to be seen but only to be lived that the methodology chosen for our physics, the examples constructed, the experiment conducted, is by means of lived experiences through the tools available for communicating such lived experiences: storytelling. The physics is the storytelling, the storytelling is the physics. No analogies. "There is no 'like' here, we are not saying 'like an electron,' 'like an interaction,' etc. The plane of consistency is the abolition of all metaphor" (Deleuze, ATP 69).

[6]What makes a character real? When she feels real. When she has memories that contextualize her thoughts and feelings, experiences that inform her decisions, opinions formed through having lived and connected, habits developed from repetition. In a phrase: her past is present for her. If all that was said was "Alice sent x to Bob" it is overwhelmingly apparent that neither Alice nor Bob are real people, even if they could be. They are mathematical constructs meant to stand in for anyone amongst everyone. But what it means to be *someone* is in stark contrast to being *anyone amongst everyone*: Alice is Alice and no other. Experience is emphatically local. Reading a narrative through Alice's eyes, if she were to feel real, would not read like a narrative through Bob's eyes, if he were to feel real.

[7]



[8]Stability dissipated, speech cut short, accumulation of a rising fog, Jordan's head heavy, hand to the bridge of her nose. Swiveling, a half-step forward, her mother Victoria caught her arm, holding her in place.

"Woah, Jordan are you feeling okay? Why don't you sit down?"

Her mother guided her gently to the ground. Eyes shut, expending effort to blow the fog away; senses dragged elsewhere, music inside her head as a grounding mechanism, a way to dislodge her from the nausea of dancing, searching for chaotic clarity in the blur of busyness, Helix, Kelly Moran; the dirt beach beneath was warm. The two of them left at dawn but she could feel the sun shining on her face.

[9]

> With Kant, Deleuze insists: we can begin only with *our* experience. But we must beware of the temptation to hypostasize its current form. This form is as local as it is unique. [. . .] The medial, occasional domain possesses nonetheless a unique transcendental structure. If we can trace the latter's genesis, there is hope that we can capture the genetic mechanism for *all* transcendental fields. Then we can set aside "our" experience. (Paetsch 18)

The methodology, the process, of conducting a lived experience experiment through the tools of storytelling is meant as an engaged example, both as a form of an intuition check before the reader tests it against her own lived experience, as well as a communication vehicle. But any particular lived experience is a local and unique one, how time works in one particular lived experience. We will always have the end goal in mind of passing from one particular lived experience that is possessed by time over to time itself.

[10] "C'mon Jordan, get up, it's dangerous lying around out here."

Jordan didn't know how long she had been out for. Blinking, trying to wipe away the blur as best she could. Wrists grabbed.

"Up you go, you've got this. You alright? Gotta get you walking, get you somewhere else, yeah?"

The voice was clearer, her coworker Krzys. She's on the job. Construction. Or maybe landscaping. The task was always changing, never well-defined. Jordan planted her feet, feeling herself come into more control. "Thanks, Krzys," she said, patting him on the back.

"This is the fourth time this week. Everything okay with you? Are you dehydrated? Not sleeping well?" They were walking away from a dirt lot back towards the road where their cars were. They had arrived at dawn but she could feel the sun shining on her back. This may have been the fourth time Krzys noticed, but Jordan's been sick for as long as she can remember, fainting included, what she had always assumed was her body briefly shutting down for emergency repairs. She learned not to rely on her body.

And neither could she rely on people. People always let others down. Why would someone want to have to rely on someone else? "Yeah, you know, a bit under the weather."

Krzys walked her all the way to her car. Sedan: convenient, easy, invisible. A facade of reliability.

He opened her driver's side door for her. "Maybe go home and sleep for a bit? We can handle today without you. I'll cover for you. No sweat."

Never really here. As intended.

[11]

> Duration is a condition for life, not the converse. Lived experience is inseparable from duration, but duration is not reducible to lived experience: organisms are durative *modes*. Something lives if its past is virtually present for it—present not as an inert sack trailing behind it but as a force overflowing its vaporous presence. Defining life in terms of durative force suggests that duration has a being independent of life. The profligacy of life—its endlessly ramifying evolutionary lines, its fathomless individuals—expresses only its *inability* to actually exhaust virtual duration: the latter is always in excess of the former. Life could no more contain all modes of durative being than one species could resolve every aspect of the problem of Life. (Paetsch 215-216)

This independence that time has from lived experience, time as something that infects and possesses us rather than as something whose reality is contingent on us, thus makes our endeavor a cosmological engagement. We are exploring the universe, not the mind.

[12]Jordan had her knees to her chest, her mother beside her, having joined her on the ground, holding her hand, her veins jutting out, both of them looking out at the water. A few boats in the distance. Hikers came and went behind where they sat. Even when she was with her mom, surrounded by people living their lives, she felt alone.

"I was feeling woozy myself on our way over. It's still weird coming here. Visiting a past life."

She squeezed Victoria's hand, unsure if more of an attempt to comfort or a desperate effort at feeling present, visible to her mother, to someone, anyone, as if she belonged here. "I barely remember the day we first came here."

"You were just a baby, so small, so fragile."

Jordan looked at her mother. She seemed lost in a memory, her eyes glassier than the water. "I meant with just the two of us. I can't remember further back."

13

> Despite ourselves, we remain tethered to a radically alien durative domain. It is not "our" duration at all: we do not possess it, we are possessed by it. Does duration ground only lived experience? If life was a condition for duration, instead of duration a condition for life, duration would be essentially inexistent: by every measure—cosmological, geological—life is vanishingly rare. Is duration only "in" us? It is difficult to maintain that duration exists only *for* living things. Duration differs in kind from extension. How did an "intensive domain" (pure duration) that differs in kind from the "extensive domain" (space, filtered by the supple diagrams of praxis) get "in" us at all? Do we really have the power of generating a domain that differs in kind from the extensive world? Is duration then "in" nature? If it is in nature, we confront another problem: we encounter duration only in immediate experience. There can be no *mediate* experience of real duration: mediating mechanisms only distort durative structure. So if nature is possessed of time, how to grasp it? Can we "generalize" our experience of duration? But the means of generalization only falsify it. It seems that the only way out is through. Deleuze's wager: *beyond the turn, once it becomes impersonal*, "our" duration expresses the structure of whatever duration infects nature. "How do we pass from this inner time to the time of things" (Bergson 1965: 45)? If lived experience is the first clue, durative continuity is the true key. The structure of durative continuity is a structural invariant of all durative processes. Effacing the differences amongst the *elements* of a durative flow does not annul all of its structure. There is still the structure of its continuity: if we retain "of it only the continuation of what precedes into what follows and the uninterrupted transition, multiplicity without divisibility and succession without separation, [we] rediscover basic time" (Bergson 1965: 44). This kind of continuity is a structural invariant of duration, one "*inherent in* and *temporally co-extensive with* its dynamic content" (Capek 1971: 170). It is a "concrete universal" of duration, something "inseparable from and inherent in all" durative processes (Capek 1971: 173). Deleuze's next wager: this continuity secretes a logic adequate to nature. (Paetsch 214-215)

This kind of temporal continuity was what Bergson asserted was unable to be grappled with mathematically. Contra Bergson, we follow Deleuze and the logic of sense that he develops in order to be able to engage time mathematically on time's terms.

[14]Her bed still had Kaede's box resting at the foot. Jordan lay down on the other side, ignoring it, intent on heeding Krzys's instructions, but only because she agreed and not because he had said to.

Jordan eyed the box, feeling taunted, caught in a staring match. She needed a distraction. She grabbed the pack of cigarettes she left beside the hair-trigger, now-batteryless, smoke alarm. Jordan's body has been in disrepair for as long as she could remember, there was no use trying to protect it from tobacco–a drag offered one of the only sources of relief available. She lit up and inhaled, searching for the calm clarity in the blur of slowing down, closing her eyes, Hoyt-Schermerhorn, Vicky Chow, Christopher Cerrone. Serenity was conceived when Jordan could get lost in a plodding hum, something just barely alive but all-consuming, piercing every corner, inescapable. Being entirely enveloped by the drone erased anything else Jordan was thinking, feeling. Jordan squinted her eyes open, the box was still staring.

"Fine."

The box didn't have a top, the boundary of what belonged inside and what belonged outside not clear. Jordan skimmed through from above. A few shirts she had left behind. The red one Kaede had actually stolen. Borrowed, now, she guessed. Along the bottom edge she noticed a few pens. Kaede was giving back pens? Jordan grabbed the handful of them and turned towards her desk. She already had pens. She threw them back into the box. Jordan didn't have a junk drawer. If it was junk, what was the point in trying to save it? It was just more bogging her down. It had to be trashed. Kaede didn't feel the same way.

[15]

> Physical processes cannot be reduced to actual processes; we need something other than actuality to conceive adequately of nature. *"But why the virtual? Why not the possible?"* "The possible" is a false notion. It falsifies temporal processes—and all physical processes take time. Reasoning with "the possible" is reasoning with mutually external elements. Filling the future with possibilities—all of which resemble the present, all of which are mutually external—falsifies it. Durative elements reciprocally interpenetrate one another, and the flow of time does not respect the regime of resemblance: it is absolutely heterogeneous. (Paetsch, 7, Footnote 14)

An adequate mathematical-physical engagement of time is necessarily an engagement of the virtual. Einstein's relativity theory is a profound development for time in the domain of the actual and spatial, but it does not involve the domain of the virtual and temporal.

[16]

> For Bergson, duration becomes the metaphysical correlate of modern science. He, of course, wrote a book, *Duration and Simultaneity*, in which he considered Einstein's Relativity. This book led to so much misunderstanding because it was thought that Bergson was seeking to refute or correct Einstein, while in fact he wanted, by means of the new feature of duration, to give the theory of Relativity the metaphysics it lacked. (Deleuze, Bergsonism 116)

It is here that we intend to arm ourselves with a metaphysics adequate to engaging the virtual, from which we seek to construct a mathematical-physical engagement of time, one that respects time temporally rather than spatially. What is it that we mean when we say the virtual?

[17] "I'm going to say hello."

Her mother retreated her hand, offering a smile, still staring straight out at the water. "Don't go out too far. You've never been one to get sea legs. I was feeling woozy myself on our way over."

Jordan walked down to the water before sliding her flip-flops off. She waded in a few inches deep. Blue, clear, still. No matter how far in Jordan descended, she could see straight through to her feet, as if nothing was between, no one was between.

No matter how many times Jordan came here, she never felt his presence. She danced her fingertips along the surface of the water. It didn't feel welcoming, inviting, rather it felt like the water was displacing her, pushing her fingers away. It was important to try. "Sometimes it feels like I never knew who you were."

[18]

> What is the nature of this one and simple Virtual? How is it that, as early as *Time and Free Will*, then in *Matter and Memory*, Bergson's philosophy should have attributed such importance to the idea of virtuality at the very moment when it was challenging the category of possibility? It is because the "virtual" can be distinguished from the "possible" from at least two points of view. From a certain point of view, in fact, the possible is the opposite of the real, it is opposed to the real; but, in quite a different opposition, the virtual is opposed to the actual. We must take this terminology seriously: The possible has no reality (although it may have an actuality); conversely, the virtual is not actual, but as such possesses a reality. Here again Proust's formula best defines the states of virtuality: "real without being actual, ideal without being abstract." (Deleuze, Bergsonism 96)

Actuality is related to what is present. For example, Jordan in this moment has an actualization, her body is physically wading in the Puget Sound, physically standing in her bedroom looming over a box of unwanted possessions, the ways that she is right now. Who Jordan was in the past is still relevant to this present-Jordan, the Jordan who is *right now* is very much impacted by the in-the-past loss of her father, by the in-the-past breakup with Kaede. But these past-Jordans aren't manifested here as being identical to present-Jordan, they are *different* Jordans. Who Jordan was on the last day that she saw her father, that she saw Kaede, is different than the Jordan who is standing here now, knee-deep in the water, eyeball-deep in a box of memories. However, these past-Jordans inform, contextualize, constrain who these present-Jordans are, will be, will become. The Jordan who traveled to the ocean with her mother, the Jordan who took yet another day off from work has her decisions, her thoughts, her emotions overfilled, affected, by the past. Thus past-Jordan is real, as past-Jordan is present in such a way as to contextualize, inform, constrain the space that the system, present-Jordan, is in but it is present-Jordan that is actual. Past-Jordan is thus aligned on the side of the virtual. The virtual is related to what is past. An adequate mathematical-physical engagement of time is necessarily an engagement of the past.

[19]Even Jordan's room was smothering her too much, the cigarette, the drone in her head, unable to pacify the lingering suffocation; she escaped to her keyboard. Set the metronome. Begin. A mistake so soon? She didn't bother stopping the metronome. Refocus. From the top. Begin. Dissonance overwhelmed her ears, banging the keys out of frustration. Same mistake every time. It was difficult to unstuck herself, to get past even a single thing in her path. Grief had a way of shackling her when what Jordan wanted to do was play off, soar over into the next piece. Her nose was running. Again. Jordan ran to the bathroom and clogged her nostrils with toilet paper. Being able to continue playing, attempting to push forward, was important. She needed her hands.

Loss of a hand: her cell phone rang: Krzys. "Hey, sorry about you getting cut loose today. I wanted you to know that I did everything I could to keep you on the project."

Jordan held the metronome arm in place, waiting to release it, waiting to hear a better reason for the interruption.

"Maybe you'd want to grab a drink and talk about it?"

"No."

"Are you sure? I'm buying."

"Is that supposed to be a joke?"

"No, but, I'm just," fumbling with his words. "I figured since we're no longer co-workers."

Jordan stopped the metronome. Escalation. "Krzys, I'm not in the mood right now."

"Right, yeah, of course, sorry. What about dinner though? Not a date, just, you gotta eat and I know that whenever I have a bad day I like to escape into other things."

Jordan pulled the rolled-up pieces of toilet paper out of her nostrils, the mucus continuing to drip like a heavy reverb long after a chord was struck; she caught the trailing line with another wad of toilet paper, cutting off the reverberations with a dampening pedal, jamming a fresh clog back up her nose. "I'm sick, Krzys. Can't you hear how congested I am?"

He laughed. "You're always congested, I thought this was your normal voice."

"I don't want to make you sick."

"Let me make that decision. I don't care if you get me sick, I want to see you."

"Are you not listening to me? I don't want to see you, regardless if you want to see me. I'm sick. I feel like shit. I mean, fuck."

Jordan hung up. She shivered at the thought of being on another date so soon. Relationships were so dependent on one another. No part of them was stable. Do people actually feel comfortable living in that sort of environment? Knowing that at any moment life could come crashing down, and it could have nothing to do with anything in their control? Kaede had asked too much of her. Kaede was controlling too much of her. And here Krzys was actively pursuing the same thing. Something came up into her throat, either the bug or the thought of a date.

The metal trash can in her room was overflowing with tissues. To think Krzys wanted to add more instability to her life when her body can't even keep itself together. She needed to move to a different thought, a different location: the kitchen. Something easy, today's been hard. Bread. Jelly. Peanut butter.

[20]

> On the other hand, or from another point of view, the possible is that which is "realized" (or is not realized). Now the process of realization is subject to two essential rules, one of resemblance and another of limitation. For the real is supposed to be in the image of the possible that it realizes. (It simply has existence or reality added to it, which is translated by saying that, from the point of view of the concept, there is no difference between the possible and the real.) And, every possible is not realized, realization involves a limitation by which some possibles are supposed to be repulsed or thwarted, while others "pass" into the real. (Deleuze, Bergsonism 96-97)

The possible is said to have no reality as its very construction is a delimited set of mutually exclusive paths, one of which is to be realized. The mutually exclusive, mutually external paths, paired with a realization that assumes and utilizes a logic involving both the principle of excluded middle (*at least* one is true) and the principle of noncontradiction (*at most* one is true) is already to frame time in terms of space. Additionally, the possible paths do not dynamically act back upon the real, their realization assumes a homogeneously topological time. Whereas the virtual dynamically informs, contextualizes, constrains the actual, as the actual dynamically does back to the virtual. Each passing moment, her frustrating phone call with Krzys, her one-sided conversation with a now absent father, adds to and changes the whole of Jordan's virtual, of Jordan's past; this accumulating and morphing whole past informs who Jordan is and what Jordan will do, her present colored by the countless previous not-quite-as-subtle-as-he-would-have-hoped attempts Krzys had made to go out on a date, her present colored by the previous anniversaries of her father's death, anniversaries when her mother was more lucid, making this moment feel particularly alone, this moment feel particularly unnerving, that Jordan's mother is only around the corner from being her own anniversary, these presents, these actuals, will in turn add to and change the whole of Jordan's virtual, of Jordan's past, which as a new whole will inform, contextualize, constrain the new present, the new actual, which will in turn add to and change the whole of Jordan's virtual, of Jordan's past. . . . The topology of the virtual, and thus the topology of time, is not homogeneous. The space inhabited is different from every previous one due to the novel constraints (past, virtual) on each novel space (present, actual).

[21]

> The virtual, on the other hand, does not have to be realized, but rather actualized; and the rules of actualization are not those of resemblance and limitation, but those of difference or divergence and of creation. When certain biologists invoke a notion of organic virtuality or potentiality and nonetheless maintain that this potentiality is actualized by simple limitation of its global capacity, they clearly fall into a confusion of the virtual and the possible. For, in order to be actualized, the virtual cannot proceed by elimination or limitation, but must create its own lines of actualization in positive acts. The reason for this is simple: While the real is in the image and likeness of the possible that it realizes, the actual, on the other hand does not resemble the virtuality that it embodies. It is difference that is primary in the process of actualization — the difference between the virtual from which we begin and the actuals at which we arrive, and also the difference between the complementary lines according to which actualization takes place. In short, the characteristic of virtuality is to exist in such a way that it is actualized by being differentiated and is forced to differentiate itself, to create its lines of differentiation in order to be actualized. (Deleuze, Bergsonism 97)

The present is the way the past differentiates itself, actualizes itself. The elements of the virtual, of the past, that act as the impetus of the creation of the present are not mutually external, it is not the case that a single set-theoretic path (a possible) will be realized in accordance with the principles of excluded middle (*at least* one is true) and noncontradiction (*at most* one is true); the topology of the present, of the actual, is constituted (but not fully determined) by the past, the virtual. This new topology, this new space of the present, of the actual, is totally different from all that came before in the past: the present moment will always only happen once. The present moment could not happen again through time travel back to the same moment, nor through a realigning of all the atoms in the universe to the same identical positions, because in each of these cases time will have passed, and with time passing comes with it an accumulation of the past, of the virtual, that contextualizes, informs, constrains the present. "'Being virtual' means 'having an efficacious topology'" (Paetsch, 177 Footnote 261). In each of these scenarios, the past, the virtual, the topology, the space that the present, the actual, is situated within will be different for each present, despite the presents in question, the actuals, being identical. Thus these two moments are *not* identical.

[22]Even the highways felt empty. “Can you grab me a tissue out of my bag? My nose is running.”

Her mom grabbed her bag down at her feet, pulling out a pack of tissues. “Are you sure you need one, your nose looks fine.”

“Yes, mom, I can feel when my nose is running.”

“I know, I know, but you always think you’re sick and you never are. Haven’t been since you were just a girl.”

The gas light switched on. “This truck seriously eats right through gas. Gonna have to go to a gas station before we get back.”

“If we’re stopping anyway can we go to the grocery? I’m out of cat food.”

“No, mom, you don’t have a cat.”

“Of course I do. She’s black, her pupils spill out into her irises, she’s–” Victoria paused.

“Yerka?” Jordan finished her thought for her.

“Yes, Yerka, my cat Yerka, I need to stop at the grocery, I’m out of cat food.”

“Yerka’s been dead for a long while now, mom.”

Victoria slouched, staring out the passenger side window.

Jordan knew that her mother was aware enough to know her awares were fading. She needed to move to a different thought, a different location: the dredging. “Did I tell you that my next project is that beach?”

Her mom was staring out the passenger side window. “What do you mean?”

“Digging up the earth, taking the soil, moving it somewhere else. Not sure what for, that part’s beyond my pay grade.” Jordan chuckled.

Victoria turned and looked at her, what felt like the first time all day really seeing her. “Why would you do that?”

“It’s my job. Someone wants to build their own beach somewhere else or something, I don’t know.”

“Well tell them that you won’t do it,” her voice finding life, catching an edge.

Blinker. Merge. “He’s been dead for a long while too,” Jordan said as softly as she could.

Back out the window. “I can’t believe you would do this to me. Do this to him.”

It wasn’t her favorite thing to do but she needed the money. Her supposedly free decisions always feeling suffocated, smothered, constrained by the necessity to take care of herself, of her mother. Jordan scratched her neck, then readjusted her grip on the steering wheel. At least she’d be spending some more time with him.

Another shot; different thought, different location. “Are you coming to the bar tonight? I can pick you up on my way over.”

Silence. Separation. Scratching.

23

> Why does Bergson challenge the notion of the possible in favor of that of the virtual? It is precisely because — by virtue of these preceding characteristics — the possible is a false notion, the source of false problems. The real is supposed to resemble it. That is to say, we give ourselves a real that is readymade, preformed, pre-existent to itself, and that will pass into existence according to an order of successive limitations. Everything is already *completely given*: all of the real in the image, in the pseudo-actuality of the possible. Then the sleight of hand becomes obvious: If the real is said to resemble the possible, is this not in fact because the real was expected to come about by its own means, to "project backward" a fictitious image of it, and to claim that it was possible at any time, before it happened? In fact, it is not the real that resembles the possible, it is the possible that resembles the real, because it has been abstracted from the real once made, arbitrarily extracted from the real like a sterile double. Hence, we no longer understand anything either of the mechanism of difference or of the mechanism of creation. (Deleuze, Bergsonism 97-98)

The sleight of hand is from overcoding the real production of time, creation, as discovery of what was always there, a possibility amongst a set of mutually external delimited possibilities to be realized. But as we saw, possibilities and their realization do not dynamically act back upon the real, they are projections from the perspective of a present, of a certain space, a certain topology, and the changing, morphing, unending becoming nature of the space, topology, virtual, past, that the actual, present, is embedded within, is differentiated from, thus becomes muted, assumed homogeneous, unchanging. "The possible is always the enemy of creation, since it's always the projection of sedimented formations" (Paetsch 13, Footnote 20). Because the virtual, the space, the topology, is not changing, Deleuze notes that "everything is already *completely given*", as it is the actual where we can find, for example, our current spatial physical laws. So if we fix the virtual, the space, the topology, then we would have a shot at describing a deterministic picture, "everything is already *completely given*". This is one sense of what it means when Bergson and Deleuze refer to the spatialization of time: denying the real production of time, creation, as discovery of what was always there and a supplanting of the dynamic heterogeneous relationship between virtual and actual with the static homogeneous relationship between possible and real.

[24] "You're allergic to peanuts. Why did you eat a PB&J?" The doctor put his clipboard down at his side.

Jordan tried her best not to itch. "I wasn't allergic to peanuts yesterday."

"Well, now you know. These hives should fade away in a few hours. If they are still present by tomorrow, give us a call and we'll have you come in again. Avoid eating anything with peanuts in them, okay? It's a common allergy so you should be able to glance at food labels and see if you're in the clear. Taking some Benadryl will help calm down what you are experiencing right now if you need it."

Jordan headed back towards the exit, trying to move swiftly and quietly.

"Remember to give us a call once you locate your insurance card, okay?"

Losing her job couldn't have been timed any worse. "Absolutely. I'm sure it's in my junk drawer with everything else!"

[25]

> But this leads to the question of how the Simple or the One, "the original identity," has the power to be differentiated. [. . .] We know that the *virtual as virtual has a reality*; this reality, extended to the whole universe, consists in all the coexisting degrees of expansion *(détente)* and contraction. A gigantic memory, a universal cone in which everything coexists with itself, except for the differences of level. On each of these levels there are some "outstanding points," which are like remarkable points peculiar to it. All these levels or degrees and all these points are themselves virtual. They belong to a single Time; they coexist in a Unity; they are enclosed in a Simplicity; they form the potential parts of a Whole that is itself virtual. They are *the reality of this virtual*. This was the sense of the theory of virtual multiplicities that inspired Bergsonism from the start. (Deleuze, Bergsonism 100)

The past is real and is being accumulated throughout the entirety of the universe, from which we all live through, experience, are contextualized by, informed by, constrained by this same accumulation, the entire past, the virtual. We must be clear, this one unified time is not a return back to the absolute time of Newton. Both Newton's time and Einstein's time are times of the actual. Neither involve the virtual in their engagements. This one unified time is virtual and both grounds and impels the time of the actual, like Einstein's time. We can feel this through the loose lines we drew of allying the virtual with the past and the actual with the present: the actual-times of Newton and Einstein are concerned with efficient causality exclusively, the role of cause and effect is only concerned with direct local interaction in the immediate moment, like a particle or a force pushing on the object in question. By affirming the virtual, we are affirming that history meaningfully effects and affects the present, meaningfully effects and affects causality, in a way that isn't restricted to efficient causality.

26

> When the virtuality is actualized, is differentiated, is "developed," when it actualizes and develops its parts, it does so according to lines that are divergent, but each of which corresponds to a particular degree in the virtual totality. There is here no longer any coexisting whole; there are merely lines of actualization, *some successive, others simultaneous*, but each representing an actualization of the whole in one direction and not combining with other lines or other directions. Nevertheless, each of these lines corresponds to one of these degrees that all coexist in the virtual; it actualizes its level, while separating it from the others; it embodies its prominent points, while being unaware of everything that happens on other levels. (Deleuze, Bergsonism 100-101)

Lifting helpful verbiage from Paetsch, the levels of the virtual and the corresponding lines of the actual are akin to "modes of being" of time. A human is one such temporal mode, as would be anything else in time. Even more particular, within humanity's temporal mode, Jordan's level is different from Victoria's, different from Krzys's. They are all each local actuals of this global virtual, which is to say that each of their pasts accumulate as part of the whole past of the universe: the way Jordan feels about never being able to eat peanuts again impacting her subsequent decisions, thoughts, feelings, the way Jordan feels about her mother no longer being able to attend her performances impacting her subsequent decisions, thoughts, feelings, the way Krzys feels about asking a girl out directly and still getting rejected impacting his subsequent decisions, thoughts, feelings, the way Victoria feels about realizing she must have asked about her cat Yerka numerous times but can't remember doing so impacting her subsequent decisions, thoughts, feelings; all of these experiences are particular and emphatically local, yet they are together, coexisting, insofar as their pasts coexist in the one unified virtual, all of the past, the whole past. This unification is made clear because all of these emphatically local, totally different local experiences are nevertheless *the same* insofar as the "structural invariants" that persist across each of them. The *way* time works is the same, even if every expression of a "mode of being" in time is completely different from every other. On the side of the actual, where each are particular local experiences, they have their own line, level, by which their past accumulates and informs, constrains, their present. Crucially, these lines are divergences, which is to say that Jordan's past is not Krzys's past, is not Victoria's past, and they have no way of meeting, there is no way for Jordan to ever call to mind a memory of Krzys's or Victoria's, intentional nor accidental, despite all of their pasts being part of the one unified virtual, the entire past. Nevertheless, time has a singular unified structure independent from any particular local subjective instance on the side of the actual because of this unity of the virtual.

[27] "Excuse me, miss?"

Jordan held out the last note she was playing. Playing local bars was a nice way to make a few extra bucks while holding her day job with the dredging. In truth, Jordan also wanted to get out of her apartment. She never felt at home there. Sure, her things were there, but sometimes they felt like other people's things. Over the years, the same issues bubbled up in more difficult places, not feeling at home even around her mother. Jordan thought that this was just what life after losing a parent was like. It will never be the same as before, that Jordan is gone now. But being behind a piano, playing, balancing, juggling the contrapuntal melodies, the polyphonies, the syncopations, an overloading of physical, intellectual, emotional stimulations, Jordan could manage to lose herself and this sense of not-belonging that somehow belonged to her. "Do you have a request for me?"

"Actually, I was hoping to buy you a drink."

"I'm sorry, I don't drink anything except my water and I already have some."

"Fine. In that case, Bach's Fugue #17."

Fugues were Jordan's favorite pieces to play. No longer was the right hand bound to melody and the left hand bound to harmony, rhythm, what felt like a too common occurrence, a capturing and taming of the feelings she so desperately craved out of being behind the piano. Both hands took on all roles now, as they together formed something completely new. Her nose was running. This was not the sort of piece she could just use one hand to deal with her nose while the other carries through, both parts were too important to the whole, they contextualized, informed, constrained each other, they *were* each other. Jordan tilted her head back a bit, trying to remain inconspicuous in her unnatural movements. She hit the fermata. Tempo change. The prelude was concluding; the fugue was starting. This was her chance. She quickly reached down into her bag and grabbed a pack of tissues and decided blowing her nose would call too much attention when in the middle of the piece. She quietly wiped away, but didn't feel anything. Jordan opened up the tissue and saw nothing inside. Her hands quickly moved to her upper lip and her nose was indeed dry.

"Hey, what gives? That was just the prelude." The man who made the request earlier was walking back over, annoyed.

Jordan looked back at the piano and thought about all of the other performers who have played on it. How many of them blew their noses and then went right back to playing, because there wasn't time to throw it out and wash their hands? Jordan had felt sick for as long as she can remember; how can other people be so careless with their health? She grabbed some disinfectant wipes from her bag and cleaned each individual key, baffled at why she hadn't started the evening by doing this.

28

> We must think of it as follows: When duration is divided into matter and life, then life into plant and animal, different levels of contraction, which only coexist insofar as they remain virtual, are actualized. And when the animal instinct is itself divided into various instincts, or when a particular instinct is itself divided according to species, levels are again separated, or are actually cut out in the region of the animal or of the genus. And however strictly the lines of actualization correspond to the levels or the virtual degrees of expansion *(détente)* or contraction, it should not be thought that the lines of actualization confine themselves to tracing these levels or degrees, to reproducing them by simple resemblance. For what coexisted in the virtual ceases to coexist in the actual and is distributed in lines or parts that cannot be summed up, each one retaining the whole, except from a certain perspective, from a certain point of view. These lines of differentiation are therefore truly creative: They only actualize by inventing, they create in these conditions the physical, vital or psychical representative of the ontological level that they embody. (Deleuze 101)

The past coexists but the present is differentiated. As we saw, the actual does not trace the virtual by resemblance, this is only a feature of the possible and the real, and this feature erases the dynamic relationship between the two sides. The virtual grounds and impels (but does not fully determine) the actual. The virtual is in unending becoming, the past growing, accumulating, and looming over the actual. The virtual cannot be summed up because the virtual is continuous whereas the actual is discrete. This temporal continuity is different from what we are typically used to in mathematics; each part retains the whole, each part is interpenetrating every other part. If each part has the whole, then summing up higher than just one part will already not work, we'd have more than the whole. What each part has, despite each retaining the whole, is a certain perspective, a certain point of view on the whole.

[29]When Jordan got home, she stuck more toilet paper up her nose and applied some Benadryl.

She grabbed the jar of peanut butter that was still on the counter. Trying to rationalize in her head, she did nothing wrong. Jordan didn't feel like she ate too much peanut butter, nor too little peanut butter. Often with food it only took the slightest push for her stomach to go downhill; she always bought high quality stuff from those organic markets.

She sat down on the couch and took her shoes off for the first time all day. She needed to get new shoes, the ones she had been wearing were far too constricting.

[30]Pausing for a moment, what is it that we are doing here? No doubt we are becoming more familiar with the virtual and the actual, as we have argued that we must involve the virtual in order to construct a complete mathematical-physical engagement of time that is not spatialized. But notice, through developing tools and understandings of the domain of the temporal rather than the spatial, we are concerning ourselves with *how a subject is produced*. Who is Jordan? Who is Kaede? Who is Victoria? Who is Krzys? A spatial, set-theoretic construction doesn't care who or what we are talking about, nor how this who or what came to be. It is the mathematical analog of only concerned ourselves with the actual, erasing the the virtual. But each of these processes are of vital importance to causality, and each is the result of a process *in time*. To erase these processes from the model, leaving only the final point that has been arrived at, is akin to erasing the virtual from our understanding of the actual, and towards a growing tradition in the natural sciences to assert that reality is timeless. It is a proclamation that history does not matter outside of the efficiently causal. Part of taking time seriously, taking the virtual seriously, is affirming that we are not surrounded by static objects, but rather we must account for how an object has come to be, through a process in time, through the dynamic relationship between the virtual and actual. This understanding also shows that no one and no thing are ever a finished product. Every one and every thing are in a constant state of unending becoming, undergoing a process of the formation of who or what they are *in time*. To speak of objects as ontologically distinct and static, through which only external relationships are made, is another sense of what we mean when we speak of time being spatialized.

[31]

> [T]he classical, conventional conception of the relationship between [a] *'physical object' as ontological extant*, and [b] *'history of facts' as epistemic construct* by which physical objects are characterized, must be reversed if quantum mechanics is to be coherently understood as an ontologically significant theory. That is, the classical conception of a history as essentially contextual and therefore primarily epistemic—a particular story expressing particular knowledge of fundamental physical objects—must be reconceived, such that physical objects are not merely *understood by* their fundamental histories, but rather *understood as* fundamental histories of quantum events. (Epperson xvi)

Epperson and Zafiris have developed a quantum mechanics formalism from the process-theoretic perspective of Whitehead that resonates with much of what we are discussing. In particular, for us, they develop tools that allow us to engage the real, which involves both the actual and virtual, that is inclusive of the temporal process that is constitutive of what we are engaging, as opposed to only engaging the actual. The switch that they outline here is an understanding that subjects, objects, are the *products of processes*, and not distinct, static, Platonic essences that exist first that are *then* put into relationships.

[32]Jordan finished the fugue and grabbed another tissue. Blank. Empty. Her stomach felt like it was taking up more space in her body than it was allowed to. She got up from the piano and made her way through the red ambience to the bathroom.

"Jordan?" a woman's voice said.

She turned. "Hi."

"Hey."

The girl wasn't initiating any further conversation. What was the polite way to handle this sort of interaction? How did she know her name? There were notices on posters advertising her playing tonight, she was sure that was all it was. Although, it's still weird to have someone address you by name without there having been proper introduction. No one ever leaves the register at a market by saying "Thanks, Andy," because they read his name tag without him supplying his name. Perhaps this was yet another sign that being at a piano club was Jordan's truest sense of home. She is known without an introduction.

"Look, I need to use the bathroom. I'll be back on the piano in a few minutes, okay?"

"Okay."

Jordan dropped her bag by the sink and instinctively took out the tissues, expecting to use them. She looked at herself in the mirror; her nose was fine. Maybe a bit red from the amount of tissues she was using. Her throat felt itchy. She put the tissues back and grabbed her water bottle. It was one of those reusable water bottles that had a mega filter built in, if she filled the thing with pure sludge it would still come out as normal water. The cool sensation of the liquid didn't calm anything down. Jordan opened her mouth as wide as she could and tried to inspect herself in the mirror. Did her throat look red? Throats are usually red in color. It looked like there might be one spot that was atypically colored. That must have been it. Jordan took another swig from her water bottle, trying to swish it around, targeting that part of her throat, gargling. Still scratchy. Still distressing. She coughed, not because her body was physically reacting to anything, but because Jordan needed to try anything to get this spot wiped clean. She forcefully coughed some more, trying to make different sounds to hit different areas.

33

> Kant's table of categories is a "sedentary distribution"; it fixes the domain of possible experience. If we attack Kant's *assumptions* about necessity, we reject his *use* of possibility. "Possible experience"—a ridiculous notion! Of course, Kant had his reasons to invoke it: if the conditions of experience were universal and invariant, they would indeed delimit an experiential domain. Since we reject the conditional, to insist instead that conditions are local and variable, we reject the antecedent: there is no finally delimited domain of possible experience. *But what if we let the contours of this domain fluctuate? Would this satisfy you?* No: the notion of "possible experience" is a monstrous pairing, a false notion, one obscenely inadequate to real experience. "Possibility" is not a correlate of necessity; it is a parasite upon reality (the interesting relation is that between necessity and reality). Critique should be allergic to as derivative a notion as "possibility". For "the possible" is not even a projection of reality; it is a projection of a *consensus* about reality—nothing more than an image of historical biases and metaphysical prejudices. Transcendental philosophy cannot be dazzled by anything involving "the possible", whether "possible experience" or the "fitness landscape of all possible species". (Paetsch 72-73)

Kant's project set out to determine the limits of experience, and in so doing determined the limits of "possible experience." Thus, in much the same way that the possible does not dynamically interact with the real, the table of categories that Kant constructed was a fixed, static, rigid set of delimited classifications that were said to exhaust all of experience, that were not in an unending morphogenesis of reciprocal dynamic interaction with experience. Following Paetsch in his following of Deleuze, we reject the endeavor of determining all "possible experience" from the outset. Rather, the range of experience is more dynamic and indeterminate than what could be claimed to be determinately exhaustive at a particular moment in time to a fixed set of categories. Experience is emphatically local. Instead, we turn to the dynamic relationship between the virtual and the actual, and we conclude that the conditions (the virtual, the levels) are as local and variable as the conditioned (the actual, the lines). Due to the conditions and the conditioned being entwined in a reciprocally determining dynamic process in time, including the emphatically local nature of each actual, "there is no finally delimited domain of possible experience," as the range of real experience will be contingent on the virtual context constraining the actual, and the virtual and actual are always changing, and the actual (with its level of virtuality) is always local, and this process is unending.

[34]

> For his use of the possible, Deleuze convicts Kant of being insufficiently critical. To resist "the possible" is not to reduce either experience to actual experience or physical reality to actual reality. Resisting "the possible" is a part of Deleuze's robustly anti-reductive approach. He objects to possibility because it is an inert projection, one that resembles actuality. In its place, we affirm a genetic virtuality, one irreducible to actuality even though it interacts ceaselessly with it. (Paetsch 73-74)

An affirmation of the virtual is an affirmation of time and the processes of becoming that lie within time. To (impossibly) reduce the real to the actual or to only engage the actual is to deny the reality of time and the value and meaning of history, a process in time, that is constitutive of all things. Thus an affirmation of both the virtual and the actual is an engagement of the real. "Genetic" is referring to a process of internal relation as opposed to external relation. Earlier we assessed that the times of Newton or Einstein were times that only engaged the actual, not the virtual, and here we conclude that an engagement of time of this kind would lead to erasing the productive and creative forces of time and history, thus pushing towards a picture of the universe that is timeless. We also mentioned that the times of Newton and Einstein were concerned with an engagement of causality that was restricted to the efficiently causal. This aligns with external relation, or what Whitehead calls "coordinate division". We are seeking to account for and to be inclusive of internal relation, as a mechanism of creation, a process of becoming in time that is constitutive of objects, or what Whitehead calls "genetic division".

[35] "I see you are still pursuing throat singing as your next instrument?" the woman from before laughed to herself.

Jordan got herself under control. "There was something stuck in my throat. It took a bit of maneuvering is all." She wiped her mouth, then ran the sink to clean herself up.

"So how have things been with you?"

This girl was practically shaking. Jordan flicked her hands in the sink and tried to place her. Maybe this was a déjà vu thing. "What do you mean?"

"Have things been going well for you? I see you're still playing piano, so that's good." The girl's lip looked like it was being bitten from the inside.

"I'm sorry, I don't know who you are. I hope you have a great rest of your night though." Jordan walked past her and out the door, ready to have her fingertips dance the awkward interaction away. Her stomach grew another few inches within her, pressing on all of her insides, and the pain became unbearable. She about-faced and sped right back through into the bathroom, past the girl who was still standing there, and into one of the stalls.

"If you want to pretend like you don't know me, that's fine with me."

Jordan sat on the toilet, skirt around her ankles. Nothing was coming out but it burned as if she had diarrhea. "Could you wet some toilet paper for me?"

A few moments later, a hand appeared from under the stall door with the damp toilet paper. Jordan pressed it against herself gently.

"Diarrhea again?"

"What are you talking about?"

"Come on, Jordan."

"I don't know who you are." She let go of the toilet paper. "Could you get me another, please?"

Her hand reappeared once more. "Here."

Jordan kept pushing but nothing was coming. She stifled a groan, the burning was getting worse. The cooling of the toilet paper was only helping so much. Jordan picked her skirt back up and walked to the sink.

"Are you feeling any better?"

Jordan ignored her, finished washing her hands, and marched straight back into the stall. Knees. She was going to get whatever was inside of her out of her, one way or another. No one, not even her body, was going to be this much in control of her. Her mother was right, she couldn't remember the last time she was really sick, despite always feeling sick. The feelings had to stop. Jordan shoved her index finger down her throat. Gag. She coughed the finger back up.

"Do you want me to get you some water from the bar?"

Jordan coughed up some saliva and spit into the toilet bowl. "I don't drink water from anywhere but my water bottle."

Determined, Jordan took both her index and middle finger and jammed them most of the way back. A flinch away from her uvula. Eyes watering. Head fogging. She plunged the last bit, holding her fingers there, her stomach contracting. The scratchy part of her throat from earlier spasmed and Jordan violently coughed her hand out, saliva and mucus with it.

"Here, I took the water bottle out of your bag." Her hand reappeared underneath the stall.

There was no room for talking. Nothing was going down before things came up. Two fingers again. Her tongue swelled up and down. Her throat opened at the base. Jordan let out a war cry as she tried to force up everything inside her. Success. Vomit. She laid her head down on the spit covered toilet seat. She jumped up, quickly remembering how dirty a public toilet seat probably was, pushed through the stall door, dousing her face off in the sink.

Jordan stuck her tongue out trying to get everything off of her.

The girl laughed. "I guess this answers my how you've been question pretty well, huh?"

Jordan dried her face with paper towels. Her head was pounding, the room was spinning. She looked back in the mirror and held the back of her hand up to her forehead. It didn't feel especially warm. "I think I need to go home. I don't know what's wrong with me right now."

"Let me drive you."

"No." Jordan picked up her bag and strode past her, but the girl grabbed her by the arm.

"Yes. You are in no shape to be driving yourself home right now. I hate seeing you like this. Please," she tugged a bit on Jordan's arm, demanding her eye contact. "Just let me help you."

36

> Even though it is premature to characterize "real experience", we can say this: if Kant's devotion to a "sedentary distribution" of categories was sustained by uncritical assumptions, it is not too much to expect that the conditions of real experience will follow a "nomadic distribution" resisting every attempt at fixity and universality. We encounter only mutable sets migrating along variable trajectories. A genetic perspective pursues an "immanent principle of auto-unification through a *nomadic distribution*, radically distinct from fixed and sedentary distributions as conditions of the syntheses of consciousness" (Deleuze 1990: 102). Without forgoing any of the force of necessity, Deleuze renounces every pretension to invariant universality. Transcendental fields will secrete conditions that are only ever local and variable. Here's a précis of the genetic viewpoint: The transcendental field, after interfacing with a virtual problem, solicits the solutions that generate local conditions. Rather than submit something to the categories for processing, select occasions generate conditions along with conditioned. And though they bifurcate, these two aspects of a genital occasion—conditions and conditioned—continue to act upon each other, spurring irremediable mutation and further divergence. Real experience just is this tensed, mutable, reciprocally determining relational field that opens perpetually between conditions and conditioned. It can be no more "harmoniously resolved" than an energetic system definitively closed. (Paetsch 74)

Paetsch follows the development of Deleuze's logic of sense, equivalently logic of expression, which is constructed to be a logic for problems, where problems are understood to be on the side of the virtual. This is in contrast to what Deleuze refers to as our logics for solutions, which we familiarly know as our formal logics. This brings about an important conclusion. Bergson spent his life developing a theory of time in its full generality, one not subjugated to the domain of the spatial, which is to say (using some puzzle pieces of what we've learned thus far) an engagement that includes both the virtual and the actual and that doesn't seek to erase the creativity of time by fixing either condition or conditioned to a static domain, and throughout his oeuvre Bergson maintained that this was an engagement of time that was completely impossible via logic and mathematics. But here we see Deleuze developing a new logic, a logic of sense, a logic for problems not solutions, a logic of the virtual, and thus Deleuze constructs a logic adequate for time. Paetsch affords us a peek behind the curtain regarding how this will intuitively function in our endeavor of engaging the mathematical-physical construction of time: the field of real experience interfaces with a virtual problem (a past), which solicits the solutions (presents) that generate local conditions (the unending becoming of the virtual, the past), which progress, become, ad infinitum.

37

> If problems are continuous [...], if logic is grounded in problems, if time is itself problematic, Deleuze will have a means of overcoming Bergson's prohibition upon using mathematics to investigate time. (Paetsch 38-39)

We know that our construction of time must involve both the virtual and the actual. Bergson claimed that a mathematical-physical engagement of the virtual was not possible, but Deleuze's development of a logic of sense pushes back against this claim. In the same way we have said that the virtual grounds and impels the actual, we say that the past grounds and impels the present, and that the logic of problems grounds and impels logics of solutions (formal logics). In effect, this means that logics of solutions (the only logics available to Bergson) are not adequate for time, for the virtual. What is it about logics of solutions that make them incompatible with time?

[38] Jordan stumbled a bit. She didn't have the will to fight. "Okay."

The girl shifted her hand from Jordan's arm to her hand, interlacing her fingers, and led the way out to her car.

"Make a left out of here, then a right at the first light."

"A left? Are you sure?"

Jordan reclined her seat back far enough to feel relaxed, but not far enough for any more potential vomit to be flopping around inside of her. She gave the girl her address to punch into a GPS so she could close her eyes and ride in silence, focusing on calming down through the blur of some chaos, leviathan, mouse on the keys.

"We're here."

Jordan opened her eyes. She still felt like her body was imploding, but she felt together enough to hopefully be able to walk around. By the time Jordan sat up, the woman had already walked around to her passenger side door and opened it for her.

"Here, let me help."

"I'm fine. I can get out myself. Thanks, though." Jordan's arms buckled as she pushed herself up, but she managed to stand up. She stretched her arms upwards, then let them collapse back on top of her head. "So, you know my name is Jordan. What's your name?"

The girl looked right at Jordan.

"Kaede."

Hemiola. Arrhythmia. Organs jumping inside of her.

Kaede hugged Jordan. "I hope you start feeling better. I really do."

Jordan was still getting accustomed to the new heartbeat. "Why don't I give you my number, in case I ever need help again?"

Kaede smiled, looking away, wiping her face. "Sure, I'd love that."

"But you are to never bring tonight up again." Jordan wiped her own face of some running eyeliner she missed in the bathroom. "This is so embarrassing!"

"As you said, never happened. I'm capable of playing along."

Jordan closed the door behind her, leaning against it. The door felt much more stable than Kaede did. She couldn't believe she just gave her number out; she thought about vomiting some more. Her stomach felt empty, it would probably help to force herself to eat a little something before crashing. Jordan opened the cupboard and grabbed her favorite snack. Peanuts.

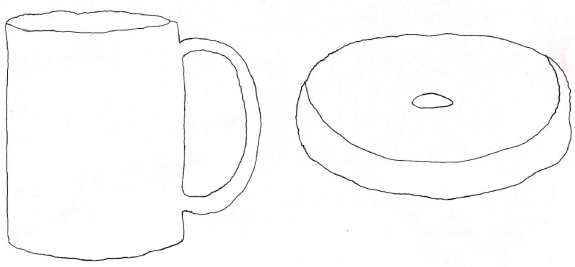
39

> Bergson has undermined the very notion of an "enduring identity": such a notion verges on outright contradiction, as duration pre-empts every form of identity. But this does not mean that durative flux lacks consistency, structure, or organization! It lacks *metrical* structure, *quantitative* order, and *logical* consistency. It is not hard to perceive that the consistency of durative flux is a very peculiar sort of consistency. How to conceive of it? Not as the logical consistency of an axiomatic system. That kind of consistency is unthinkable without the forms of identity: minimally, the elements of such systems must be self-identical. Further, certain logical elements (such as axioms) are exempt from change. This violates a central tenet of Bergson's philosophy: nothing not in flux. The ubiquity of fluctuation does not preclude the possibility of discerning certain *invariants* amidst this flux. Crucially invariants are not transcendent but immanent. Further, they persist amidst total flux: we need not fix any substrate beneath them. They will be indispensable for conceiving of the consistency of a continuous multiplicity without reference to any identity. (Paetsch 293)

Logics of solutions operate with the static logical consistency of an axiomatic system, they employ a form of identity, the elements are self-identical. Symbolically encoded: $x = x$. Notice that this mathematical construction is not temporal but rather spatial. In time, we have affirmed that objects are products of temporal processes, not always already constituted beings from which only external, epistemic interactions happen. Our first clue of the spatial nature of $x = x$ is that there is no engagement of the virtual, no inclusion of the processes that have produced what x is, and having bracketed out the productive nature of time brackets out time itself with it. But even more clearly, we saw that once we understood objects temporally, affirming processes as being productive of objects, that this process of unending becoming does not stop. Thus as time marches on, x becomes something different, such that $x = x$ is not true through time.

Axioms are exempt from change. We saw this obstacle when discussing the virtual and actual with the possible and real. The possible is not in a reciprocally determining dynamic relationship with the real, it consists of a delimited set projected backward in the image of the real. Similarly, axioms are set in stone, not in a reciprocally determining dynamic relationship with what they condition. The conclusion Paetsch follows Deleuze in reaching is of the mathematical concept of a *topological invariant*. We are still gathering our tools, orienting our intuition, motivating our construction, and so we do not yet descend into the granularity of this concept. A topological invariant is a property of a topological space such that if a space A were to morph or change into some other space B in a way that still preserved the structure of space A, any property that persists despite all of the changing, morphing, mutating, is a topological invariant. What makes this kind of topological property important and distinct from a universal property is this being inclusive of change.

As a brief example, we turn to the infamous topology joke that states that from the perspective of a topologist, a coffee mug and a donut are the same thing.



The topological invariant that persists between these two objects is that each only contains one hole (the handle of the coffee mug and the middle of the donut respectively). Yet these two objects look quite different from each other, they seem to have distinct identities from one another, yet within topology we can enact a process of deformation of one into the other, always with the topological invariant persisting despite the changing identity.

Thus we are looking for a logic, a mathematics, that will not utilize a form of identity, $x = x$, and we are looking to engage topological invariants of time, that allow for change, the unending becoming in time, rather than engaging universal properties of time.

40

> Bergson presents a reason for the inability of the intellect to think life, motion, continuity, or becoming: the logic of the intellect is a logic of solids—of inert, self-identical, stable figures and discrete operations upon them. To think virtual problems themselves will require us to abandon these intellectual crutches. Problems are fundamentally durative. Durative processes demand a different approach. Intellectual activity is preeminently analysis: *"the intellect is characterized by the unlimited power of decomposing according to any law and of recomposing into any system"* (Bergson). Analysis is inadequate to the durative processes of nature. To approach problems by means of analysis, to reduce everything to inert bodies, to proceed only by discrete operations upon mutually-external solids in inert ambient space—this is what Deleuze means by posing problems in terms of *space* rather than in terms of *time*: problems involving durative processes must be cast in terms of time. It is no wonder that becoming has been flogged so often by a too-intellectual philosophy: "the intellect represents *becoming* as a series of *states*, each of which is homogeneous with itself and consequently does not change. Is our attention called to the internal change of one of these states? At once we decompose it into another series of states which, reunited, will be supposed to make up this internal modification. Each of these new states must be invariable, or else their internal change, if we are forced to notice it, must be resolved again into a fresh series of invariable states, and so on to infinity. Here again, thinking consists in reconstituting, and, naturally, it is with *given* elements, and consequently with stable elements, that we reconstitute. So that, though we may do out best to imitate the mobility of becoming by an addition that is ever going on, becoming itself slips through our fingers just when we think we are holding it tight" (Bergson). It is no wonder that *"the intellect is characterized by a natural inability to comprehend life"* (Bergson). Indeed, "our intellect begins by mechanizing life and is then astonished that this mechanism subdivides indefinitely without the simple ever appearing—it is astonished by a miracle of which it alone is the author! The infinite only induces vertigo when we conceptualize it" (Jankélélvitch). (Paetsch 162, Footnote 237)

One problem of reductionism is what Whitehead termed the Fallacy of Misplaced Concreteness. Reductionism posits that an object can be understood by decomposing it down to its simple parts and then recombining the simple parts. The "misplaced concreteness" comes with the assertion of what counts as a simple part; the methodology of reductionism breaks down when there is something that we want to understand that *can't* be broken down further. Thus something that is unable to be engaged or unable to be understood by employing this method of decomposing into static, homogenous parts and then recomposed feels like the *least* simple piece. The trick happens when the "concreteness" of a simple part is said to be justified out of an *apparent givenness* — but what is apparent is contextual, contingent, local, dependent on who and what we are talking about, and we have now seen that objects are produced (unendingly so) in a process, and thus an appeal to a givenness is another sense of bracketing away the meaningful and impactful process that is productive of what we are talking about.

Thus throughout our history we have taken to breaking down a temporal process into static, self-identical, mutually external states, strung together in a homogeneous space, erasing the virtual and the productive nature of time: creativity.

[41]Restrained, incapacitated, Jordan's heartbeat pulsed, throbbed, as if her blood was trying to push through her skin, an overloading of physical, intellectual, emotional stimulations, she hadn't had any peanut butter, heeding the doctor's instructions, but only because she agreed and not because he said not to. She didn't have to place her fingers anywhere else on her body to feel it, pumping in her temples. Her ears. Her wrists. She rubbed her wrists together, trying to wipe away the intense feeling of the beating. Her skin was losing its sense as the boundary of her body. If not peanut butter, then what? Jordan got rid of Kaede, why would this still be happening? It should be over. It needed to be over.

Her insides expanded again. She ran to the bathroom and vomited into the sink, not having enough time to shoot for the toilet. Her vision had doubled, tripled, spiraling divergently, overlapping: eyes shut. Jordan grabbed a wash cloth and wiped her face before putting her hand on the wall to trace her way back to the bathroom door. She stumbled, but finally made it to the light switch and flicked it off. The blurring subsided a bit.

150 beats per minute. This was a standard playing tempo. This was way too high for a heart rate, but the bpm was undeniable. Jordan touched her fingertips to the sides of her head and quickly withdrew them at the feeling of how much it felt like her head was pushing outwards. She needed to verify such an insane claim. She stumbled to her keyboard and sat down. Mamiffer. Meteoric Iron. Her heart never wavered. Crawling out of her skin. Scratching her arms, her veins flaring. Discomfort. Fear. Jordan threw the keyboard off its stand, crashing it into the wall. A low resonant hum from something inside it persisted.

It's because she's still somehow here, right? That's got to be it. Kaede might have been removed, but she is still here in some other way. Memories of her were littered everywhere. If those objects that held a fading connection were removed, then the purge would be complete. Jordan grabbed her metal trash can and walked about the apartment, starting with the box she left followed by piling in practically all of her belongings. A blanket they shared on the couch. A loaned CD. Jordan clutched her stomach and winced before running back to the bathroom and slamming herself down.

The diarrhea burned. She prayed that her body would stick to one direction out of her at time. The shower curtain was taunting her, a witness to the showers they shared. Without moving from where she sat, she grabbed the curtain and yanked hard. The rod it was attached to came tumbling down, hitting Jordan in the side of the head.

Jordan rubbed her head to calm the pain, her heartbeat creeping her out too much. Breathing quickly. The diarrhea seemed like it might have subsided for now. Flush. She grabbed the toilet paper roll. Only a few squares left. She took them all, folded them, and squatted up a little so she could reach the sink. Jordan dampened the toilet paper and pressed it up against her. She dropped it in the toilet and prepared to get back up, rolling up the shower curtain in anticipation, but immediately sat back down. Her body wasn't finished burning her from the inside out. Jordan grabbed the empty toilet paper roll and squeezed it, trying hard to subside some of the pain.

"Kaede!" Jordan grabbed the roll with both hands, twisting it in different directions.

Held longer, "Kaede!" Jordan was yelling with all she had, forcing what was inside of her out. Stamping her feet. The toilet paper roll ripped in half.

Jordan got up and quickly used a bath towel to clean up as best she could before washing her hands for what felt like the four hundred and seventh time. Her hands looked raw, but they felt like everything was fine compared to the rest of her body. She marched over to the trash bucket and threw both the shower curtain and bath towel in.

Her throat, itchy on the inside, needing to come out. "Not again—are you kidding me?" She ran back to the bathroom, opened her mouth as wide as she could. A bright red mountain had formed near the back. Undeniable. She coughed, her body physically reacting to the new mass in her throat. She ran the sink and stuck her head underneath it, the smell of vomit unable to penetrate the hysteria tightening its grip, holding Jordan in place. The coughing prevented her from accomplishing much in the soothing department, keeping all liquids out of her no matter how quickly she tried to swallow. Swiveling, a half-step forward, caught by sickness, caught by grief, caught by trauma—Jordan didn't want to be caught, she wanted to run.

She staggered back over to the bedroom and fell onto the nightstand. Cigarettes. Jordan lit the whole pack together before throwing it into the metal trash can, tossing her lighter in too for good measure. The drone of the busted keyboard continued to buzz beneath, a steady, dissonant background, raising the noise floor, grounding and impelling, the echoes drowning out her ability to think straight. Smoke billowed, more coughing. That should be everything. Kaede should be totally removed. Wiped. Excised. Deleted. Why won't her body start feeling better? When there's a cause and an effect and that cause gets removed, the effect must get removed, right? When Jordan got rid of the peanut butter, her hives did calm down. She never got hives again after that.

Jordan collapsed on her couch, continuing to cough profusely. Her tonsils felt like they were going to be coughed out, one layer of flesh at a time. Maybe she can't even rely on herself. The dense black air accumulating, pushing lower than the ceiling, filling quickly. The fire roared inside of the bin sitting on the kitchen countertop. Oranges and reds flickering as they ate apart her memories, her life, her progress. The droning from her keyboard melding with the beating in her ear, the extension of what counted as her body blurring, her head felt hollow, the droning, the beating, bouncing around echoes of the noise as they layered upon themselves, amplifying each other, the next layer starting before the last one finished, contradicting and complementing themselves simultaneously. Please leave. Let this be over. Jordan dug her hand into her

pocket: her phone. She went to the phone application and saw Kaede in her most recent calls section. Jordan so desperately wanted to be in control, to be self-reliant, independent, but felt like she had lost all sturdiness, stability. Collapsing. Kaede wasn't the problem. She can't stand on her own two feet if her own two feet are the problem. Kaede cared for her when no one else would, went out of her way to make Jordan feel comfortable, safe. Things got too serious too quickly. Jordan wasn't used to that level of commitment, that level of care, appreciation, love from anyone.

It was time to reach out and ask for help. Jordan looked back towards the fire, devouring the kindling, breathing increasingly difficult. Jordan deleted Kaede from her contacts. She deleted her conversations with Kaede in all of her messaging applications. She deleted every picture that she had. The smoke had made it hard to see across the apartment at this point. Jordan dialed 9-1-1.

She coughed before speaking. "I need some help."

42

> The irreversibility of time exists only under such a condition. "Memory," says Bergson, "is not a faculty of putting away recollections in a drawer, or of inscribing them in a register. There is no register, no drawer; there is not even, properly speaking, a faculty, for a faculty works intermittently, when it will, or when it can, while the piling up of the past upon past goes on without relaxation. In reality, the past is preserved by itself, automatically. In its entirety, probably, it follows us at every instant; all that we have felt, thought, willed from earliest infancy is there, leaning over the present which is about to join it.... Doubtless we think with only a small part of our past, but it is with our entire past, including the original bent of our soul, that we desire, will, and act.... From this survival of the past it follows that consciousness cannot go through the same state twice.... Our personality, which is being built up each instant with its accumulated experience, changes without ceasing. By changing, it prevents any state, although superficially identical with another, from ever repeating itself in its very depth. That is why our duration is irreversible. We could not live over again a single moment, for we should have to begin by effacing the memory of all that which followed. Even could we erase this memory from our intellect, we could not from our will." (Capek 16)

It is not an uncommon occurrence for the brain to be compared to and treated as a computer, capable of storing files (memories) and calling those files (memories) up when needed. This analogy easily falls prey to the forms of identity Bergson warns about. On a computer, we can create and save a file, we can call this file x. That file has a fixed identity. It doesn't matter who opens it, when she opens it, how she opens it, if she puts the file on a USB stick and brings it to a different computer to open: it always is exactly itself. $x = x$.

This might seem to work at first glance when applied to the past: something happened once and then it goes into the past where that event stays the same for all eternity because we say the past can't be changed, and we call upon that fixed past when we remember something. This perspective is flawed. The past is nonphysical, but not fixed. There is only ever a physical access to the present.

The past isn't whatever we imagine it or decide it to be. There are unchangeable facts of the matter, like how Jordan and Kaede have broken up, this much is true. However, what this fact *means* to Jordan or Kaede in the present is not a set-in-stone, unchangeable, eternal, static, fact. It is precisely what this fact *means* to Jordan and Kaede that informs, contextualizes, constrains their decisions, thoughts, feelings. The moment just after the breakup, Jordan understood all of the set-in-stone facts to indicate that Kaede was overbearing, smothering, unable to be her own person and suffocating Jordan from being the only kind of person she's known herself to be. This understanding of the facts persists through Jordan burning down her own apartment in her most desperate attempt to escape Kaede's lingering smothering. Yet as Jordan endures a serious bout of illness, she remembers all of those same set-in-stone facts not filled with negativity but filled with positivity, that Kaede was the kind of person to go above and beyond in her help, sticking through these gross and scary sickness waves, ensuring safety and comfort during moments of heightened instability, never asking for anything in return. "The facts" haven't changed whatsoever, but the way in which these facts manifest themselves in the present, the way that they *mean what they mean* to Jordan, the way that they contribute to causality, the way in which they inform, contextualize, constrain Jordan's decisions, thoughts, feelings do not stay the same. They are in an unending process of becoming.

Despite our physical reality only having access to the present, the past is nevertheless present in other ways, informing, mutating, constraining, influencing. The key understanding here is that the past *is* indeed present, but not in a physical way. What does this mean? Recall how both the virtual and the actual are real. The past is real, grounding and impelling the present. The past informs, contextualizes, constrains, influences the present while still not being this differentiated present. A concrete objective fact we say can't be disputed, like the event of Jordan and Kaede breaking up. But the way in which this objective fact is perceived, felt, understood, the way in which this objective fact informs, constrains, influences the present is not an objective fact, it is a relationship in process, unending becoming, its identity is constantly changing, mutating, and thus is more accurately captured as lacking any fixed identity. The becoming of a past moment has no end, it never reaches a static, self-identical being. This is unlike the file on a computer, which is always in a static, self-identical being, never in a becoming. The way in which memory has a meaningful impact on the present is dependent on the who, the when, the how. The actual is emphatically local. A file on a computer is always itself, $x = x$, but a memory belonging to the past, outside of efficient causality yet still meaningful in a less restricted sense of causality, never remains itself, it is always changing, $x \neq x$, informing, constraining, influencing the present in a different way dependent on what x means at present in its unending becoming.

[43]Flashing lights. Sirens that got drowned out; the sound of the broken keyboard's tone still echoed inside of her head. She wanted it out, but there was no escape to anywhere else. The echoes no longer piling on in amplification, but imbricating in depth. Stretto, a theme introduced by the first movement of drone, picked up and played by its echo before the first concludes. Two voices at once. Together they build the line, a hum getting further and further away.

The single tone persisted.

"Pronounce her."

44

> Considerably later, in an initial passage of *Creative Evolution*, Bergson also pointed out the connection between *persistence* and *novelty* in psychological duration: "Let us take the most stable of internal states, the visual perception of a motionless external object. The object may remain the same, I may look at it from the same side, at the same angle, in the same light; nevertheless the vision I have now of it differs from that which I have just had, even if only because the one is an instant older than the other. My memory is there, which conveys something of the past into the present. My mental state, as its advances on the road of time, is continuously swelling with the duration it accumulates: it goes on increasing-rolling upon itself, as the snowball on the snow." (Capek 22-23)

This is one example of an intuitive way to orient ourselves process-theoretically, of including the virtual and the productive nature of time, creativity. Classically, we might describe this same system by saying we are ourselves, $x = x$, and the object in question doesn't change, doesn't move, is viewed at in an identical manner and thus this object would be encoded as $y = y$. There is no productive nature of time here, the entirety of the productive, creative processes has been bracketed away. However, we can run this experiment ourselves, and we immediately understand that the successive moments are in fact different. The first moment is contextualized, informed, by a past that has not spent any time thinking about this static object. A moment later *is* contextualized, informed by a past that *has* been thinking about this object. This is a simple example of the mechanism of unending becoming, process, creation, time.

45

> A logic need have neither an axiom of identity nor even a law of excluded middle to be a logic that enlists the forms of identity. It is enough for it to handle "elements" that are self-identical and not radically metamorphic. Whether in propositional logic or in set theory, the elements are only ever themselves, even when they enter into relations with other elements. In the context of a proof, these relations explicate the impact structure of these elements. We await a logic that dispenses not only with laws that prioritize the forms of identity but with any presentation that fixes atomic individuals. The logic of expression—equivalent, the dynamics of virtual problems—is just such a logic. By identifying problems with continuous multiplicities, Deleuze was able to develop covertly a logic of duration: the dynamics of problems is a dynamics of lived experience or of any durative whole. (Paetsch 293, Footnote 452)

Deleuze develops this logic of sense, and thus our logic of time, but neither the mathematical formalism nor the physical application of this mathematical formalism. This is what we set out to do. We must learn, develop, enlist the tools necessary for this process-theoretic, temporal engagement. Namely: the virtual is not representable but only expressible (lack of any fixed identity, $x \neq x$, different expressions of the internal structure, topological invariant, that persists); the virtual differs in kind from what it conditions (times of the actual do not have the temporal continuity of a time of the virtual); the virtual is a temporal continuity that is heterogeneous, not homogeneous (the virtual of each novel moment is completely different having been affected by a novel actual); each change of the virtual changes the whole of the virtual (each element of the virtual retains the whole within it, thus a change to any one part immediately changes the entirety of the virtual) (Paetsch 118).

[46]Jordan's phone buzzed. Without looking at the screen she stared at the ceiling of her bedroom. Eventually she pushed aside the comforter and got out of bed. Obstacle course, piles of dirty clothes, Jordan made her way to the bathroom. Staring in the mirror at herself, she went through her new routine. Two fingers on her wrist. Nothing.

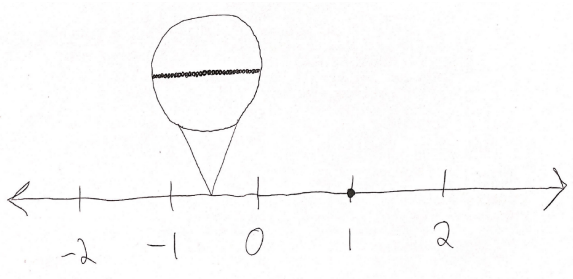
There was no questioning, this much was sure, she was absolutely dead. No one can be alive if they don't have a heartbeat. Jordan moved herself to the couch and sat there. The wall was blank, but she stared at it anyway.

Her phone vibrated again. It was all the way in her room, she felt no motivation to check it. Dead people don't use phones. Jordan placed two fingers at the top of her neck. Nothing.

Knocking. "Open up the door. It's Kaede."

47

> Bergson informs Deleuze's critique of projection. Besides decrying the projection of time onto space, Bergson provides an explanation for its prevalence: it is much easier to print ourselves in homogeneous space, where any "division" is local (in that it does not implicate a whole that it acts upon) and stable (in that it will not be contaminated by successive states). "We introduce [space] unwittingly into our feeling of pure succession; we set our states of consciousness side by side in such a way as to perceive them simultaneously, no longer in one another, but alongside one another; in a word we *project* time into space, we express duration in terms of extensity, and succession thus takes the form of a continuous line or a chain, the parts of which touch without penetrating one another" (Bergson 2001: 101, emphasis mine). Continuity is not here the enemy. It is just that the structure of geometrical continuity is antithetical to that of a durative continuity. (Paetsch 69, Footnote 101)



The real line is a mathematical construction composed of extensionless points. These points are extensionless by means of the reductionism methodology discussed earlier: the decomposition of something static to simpler parts. These simpler parts, the extensionless points, are arrived at through an infinity of divisions on this line. These extensionless points each have a rigid boundary and are only ever in external relationship with any other extensionless point. Each extensionless point has an identical internal structure (specifically, a shared *lack* of internal structure other than having a static identity) that ensures this real line is homogeneous with respect to internal structure. The internal structure is what we mean by internal relationships, genetic processes, unending becoming in time, not a static being separate from time.

As we have been arguing, in motivation of our mathematical-physical engagement, this erases the virtual, the productive nature of time, creativity, the internal relational genetic process of becoming that an object is always undergoing, $x \neq x$.

The consequence of having these extensionless points as our models of states external to one another, the meaningful way in which the virtual is erased from our engagement, is that we have no sense of how x is *in* y, not simply *next to* y; no sense of how the events of Jordan falling off the grid and not answering any of Kaede's texts or calls is *informing from within* the decision to march over to Jordan's apartment to find out if she's doing okay, and not that these are simply isolated, external events, where Jordan's lack of answering Kaede has no bearing whatsoever on Kaede's decision to show up on her doorstep, to rather be entirely reduced to a chain of efficiently causal particles and forces. The virtual, the past, informs, constrains, the present, and thus from our process-theoretic perspective, the full understanding of y, of Kaede's action of showing up at Jordan's apartment, inclusive of the process that produced y, that produced this decision of Kaede's, is one with an understanding of how x, the past of y, the virtual of y, Jordan's lack of answering any texts or calls, grounds and impels y, grounds and impels the causal action of Kaede's showing up. The moment y does not exist as a Platonic essence in isolation of all things, Kaede's decision to show up at Jordan's cannot be fully understood in complete isolation, cannot be reduced down to just particles and forces, the moment y is the (ongoing) result of a process, and thus y is situated in a contextual space, its virtual, its past, Jordan's lack of answering, a space that is productive of y, a space that grounds and impels y, a virtual x to the actual y.

Thus the continuity spoken of in relation to the real line, a string of extensionless points that are all external to one another, is not adequate to our engagement of time that includes the virtual, where each element is *in* every other and not simply *next to* others. A different continuity must be engaged.

[48]Jordan placed her hands on her ears. Why did she have to experience all of this if she were dead?

"Open up, Jordan. I know you're in there."

This was going to get annoying quickly. Jordan begrudgingly went to the door and opened it, letting in more light than she had seen in weeks.

"Look at all of this mail! Are you popular now or what?" Kaede's arms were overflowing with Jordan's mail as she walked inside.

"Your place is a wreck! What happened here?"

Jordan headed back to the couch and sat down. This was pointless. This must be some sort of hell.

"Have you eaten anything today?" Kaede asked.

Jordan kept staring at the wall. Kaede hurried over to the other side of the couch and sat with one of her legs beneath her. "Hey, Jordan. What's going on? You haven't answered a single call, text, and now you're acting really weird."

"I'm dead."

[49]

> Both Weyl and Poincaré pointed out that the term "mathematical continuity" is misleading since in the continuum of real numbers the elements are as external with respect to each other as natural numbers. This again was in agreement with Bergson who correctly recognized that the so called "mathematical continuity" is nothing but "discontinuity infinitely repeated", i.e. infinite divisibility. (Capek 52)

Typical mathematical continuity deceives us. It is still discontinuity: extensionless points are only themselves, $x = x$, and are external to all others. What we want is a temporal continuity, equipped not with extensionless points that are external to one another, but with the ability to engage process-theoretic, internal, genetic relationships. The past inside of the present is what distinguishes mathematical continuity from temporal continuity. The terminology "mathematical continuity" is a misnomer, an artifact from Bergson's assertion that time cannot be engaged mathematically. We follow Deleuze in repudiating this diagnosis. We intend to engage this temporal continuity mathematically, thus neither continuity is more or less mathematical than the other. In the interest of clarity as we refer to each of these, we refer to the "discontinuity infinitely repeated" external, coordinate continuity as spatial continuity, and the "past inside the present" internal, genetic continuity as temporal continuity.

In what follows is an engagement with the history of this temporal continuity. This began with Poincaré and Russell engaging with a perceptual continuity; there is a stronger focus on subjective perception than temporal structure here. As such, this is not yet the fully-formed temporal continuity which we seek to engage, but we will trace this history to better orient ourselves. After all, *history matters*.

50

> [Perceptual continuity's] most paradoxical feature is that *the relation of equality does not seem to be transitive in it*; while its two contiguous terms are indistinguishable from each other, the non-contiguous are: $A = B$, $B = C$, $A \neq C$ (Capek 64)

We flag from the outset, so that neither confusion with what preceded nor an incorrect intuition ossifies, that we've already discussed how temporal continuity does not employ any form of identity. This means that we don't even have $A = B$ or $B = C$, as we know B is novelly informed, constrained, grounded, impelled by the virtual inclusive of A, and the same is said for C but by another novel virtual inclusive of B. We employ language like "inclusive of A, B" to help build intuition, but we know that the virtual is a unity and cannot be subdivided like the real line, all of the "elements" are mutually interpenetrating one another, they are not mutually external to one another, they are not separable in the spatial sense we are used to. We continue to trace the history of the perceptual continuity, as we believe following how the intransitivity is dealt with is important to our orientation, motivation, and understanding.

> There seems to be an obvious way out of both Poincaré's and Russell's paradox [regarding the intransitivity of the perceptual continuity] and this way was already indicated before. All we have to assume is that qualitative continuum, whether its terms are simultaneous or successive, is merely 'apparent' or 'illusory', and that the alleged logical difficulty stems from its 'haziness'. In other words, this difficulty disappears when we focus our attention on the underlying physico-mathematical continuum which is allegedly 'the only real'. Illustrated by a concrete example: when we gradually increase weight, pressing on our hand, from 10 to 12 grams, the only thing we must consider is the continuous range of magnitudes through which the physical stimulus passes; within this continuum each term is sharply distinguished from any other and the logical absurdity of the non-transitive equality can then never arise. The whole difficulty is removed, if the scheme above $A = B$, $B = C$, $A \neq C$, is replaced by the following one: 'A is *indistinguishable* from B, B is *indistinguishable* from C, but C is *distinguishable* from A'. In other words, the paradox arises merely out of the limited capacity of consciousness to differentiate the minutely different stimuli. The same is true of the intuited temporal continuum: the underlying *mathematical* continuum is *the only real* and in it the transitivity of simultaneity is fully preserved. The apparent intransitivity of 'temporal togetherness' or 'psychological simultaneity' is due to the haziness of our temporal experience, more specifically, to the fact that our psychological present is merely 'specious', without definite boundaries. The only true present is the mathematical, instantaneous, 'knife-edge' present in the physico-mathematical continuum of events. (Capek 65)

One of the moves used to explain our experience of time from a position that the universe is timeless is to assert that our experience of time is a deficiency of consciousness. Running through the same formula Capek gives, much of our scientific tradition can be shown to follow a faith in strict determinism, that the entirety of the past and future are *completely given*, that the only thing missing is *our knowledge* of the relevant information to conclude the future, that it is us with our pesky consciousness that are deficient and not the universe that is indeterminate. Once we develop more computing power we might be able to crunch the numbers in our more complicated systems to accurately predict the future of these systems, because it's already available knowledge that has simply not been obtained yet. It is this series of moves that denies our empirical experience, a pillar that science is built upon, of time in dogmatic faith towards determinism. This argument brackets away an incredible amount of our empirical experience, calling it all a deficiency, an illusion of consciousness, said unrigorously and then never to be engaged again because illusions would not be the kind of thing a well-respecting physicist would involve herself with. We oppose this view.

[51] "What do you mean? Someone threaten you down at the bar or something?"

"No. I am dead. Right now."

"I don't understand."

Jordan grabbed one of Kaede's hands and pressed it into her wrist.

"I don't get it, what are you trying to tell me?"

"There's no pulse."

"Of course there's a pulse."

Jordan darted her eyes towards Kaede. She was lying. She grabbed Kaede's same hand and placed it on her neck.

"I still feel a pulse."

She moved Kaede's hand to her chest, on top of her heart.

"Yep. You are most certainly alive."

Jordan threw Kaede's hand away. "You're lying."

"No I'm not."

Jordan held back, not really feeling the will to fight.

Kaede jumped off the couch. "You stink. When was the last time you took a shower?"

"Dead people don't shower."

"Shut the fuck up. You know all about what dead people do and don't do now?"

"Why would they shower? They're dead."

"Right, so what difference does it make if you did take a shower?"

"There's just no point. It's a waste of time."

"Oh, I forgot how well you were using your time instead. Staring at the wall doing nothing seems like a great use of your time instead of caring for your body. Come on." Kaede tried to place her hands under Jordan's arms, but Jordan wasn't being cooperative.

"I see no use in showering."

"Yeah, well, I am here with you, right? Regardless of whether or not you are dead, I'm here in the same room as you."

"Okay. So?"

"You smell. Bad. For my sake, I would like you to smell better while I'm sharing space with you."

"What if a shower doesn't help? What if what you are smelling is actually just my body decomposing because I'm dead?"

Kaede rolled her eyes and tried putting her hands back under Jordan's arms. Jordan stumbled a bit. She didn't have the will to fight.

52

> In the first place, nobody claims that the intransitivity of equality exists on the level of physical stimuli. Neither does anybody deny that two stimuli whose difference is imperceptible are physically different, though indistinguishable psychologically. But it is clearly meaningless to call two sensations *qua* sensations 'different, though indistinguishable'. For the sensations resulting from two minutely different stimuli are *qualitatively the same*; to affirm their difference despite their imperceivability, does not make sense. A difference which is neither sensed or felt, simply does not exist *psychologically*; if we continue to say that two indistinguishable sensations are 'really' different, we are not speaking of sensations qua sensations, but of their *external stimuli*. In other words, we are unconsciously slipping from the language of perceptual data to that of physical stimuli. The paradox of the intuited continuum cannot be dismissed when we insist that it does not exist on the physical level; it continues to exist on the psychological level whose paradoxical structure it reveals. And this level can be called 'appearance' only with respect to the physical stimuli, but not with respect to itself; for as William James stated unanswerably: "A material fact may indeed be different from what we feel it to be, but what sense is there in saying that a feeling, which has not other nature than to be felt, is not as it *is* felt?" (Capek 65-66)

We encounter another sense of what we mean when we refer to the spatialization of time: the slippage from the language of perceptual data to that of physical stimuli. Time is engaged through lived experience; we erase the virtual when we ignore how history grounds and impels the present, how history constitutes (but does not fully determine) the present. The real line is of spatial continuity, whereas time operates by means of a different temporal continuity. We affirm our experience of time and seek to engage this temporal continuity as opposed to denying the reality of our experience and placing the spatial continuity on a pedestal as "the only real." Both spatial and temporal continuities are real.

If we follow this perceptual, sensational continuity that Poincaré, Russell, and Capek are engaging, we see how even though on the spatial continuity, in spatialized time, the present is modeled as an extensionless point, through our lived experience we have a blurrier sense of the present, from which things are felt together yet successive nevertheless.

> In melody, successive tones are perceived in a single durational stretch, not as simultaneous, but as successive, but nevertheless still "at once," provided that we understand the words "at once" not in the sense of durationless instant, but in the sense of enduring present. (Capek 33)

Melody is another simple example that embodies our lived experience of temporal continuity. In one moment, a sound is playing, a particular vibratory disturbance in the air is being transmitted, but that singular tone is not what we refer to as the melody. The melody is the string of tones that happen in succession, that come together to form the singular unit of "melody" because of how *the past is inside the present*. If the previous tones were not coloring the experience of the present tone, what we feel as a melody would not exist. We would experience the singular tone being transmitted, and a moment later we would experience a different singular tone being transmitted, but the first tone wouldn't contextualize, inform, color the second tone into a unifying feeling of a melody.

[53]Reductionism, through Whitehead's fallacy of misplaced concreteness, eventually reaches a set of simple parts that it doesn't know how to understand or what to do with.

> [R]eduction to incoherence by the arbitrary definition of one principle as substantial and the other as epistemic abstraction [. . .] Parmenides might exclaim, "Diversity is illusory. There is only unity! There is no change, only permanence!" while at the same time Heraclitus exclaims, "The only permanence *is* change!" and Protagoras, attempting to silence them both, exclaims, "There is no objectively true statement!" The incoherence of this method is evinced not only by the paradoxical character of these exclamations; it is also evinced by the fact that unity cannot be defined without reference to diversity, nor diversity without reference to unity, and likewise for the concepts of permanence and change. This clearly belies the assertion of exclusive ontological primacy for either concept over its counterpart. (Epperson 22)

One side is taken as more fundamental, more *concrete*, from which the other is said to be derivative. We can feel the resonance between this formulation and the one between the possible and the real, where one (the real) is more fundamental from which the other (the possible) is derivative, in the image of the real.

Popular applications of reductionism include projects like the Standard Model of Particle Physics or Grand Unifying Theories of Everything (GUTs). These projects are making the same error Deleuze criticizes Kant of making: Kant looked to exhaustively give the range of "possible experience" indexed to a finite, static, self-identical, delimited, rigid set of categories. In opposition to this, Deleuze argues that the conditions are in a dynamical reciprocal determination relationship with the conditioned. The possible and the real are not in a dynamic relationship of this kind, but the virtual and the actual are. Similarly, the Standard Model of Particle Physics is looking to construct a finite, static, self-identical, delimited, rigid set of particles and forces from which the entirety of reality, past and future, can be reduced to or deduced from. Any such GUTs is looking to construct a finite, static, self-identical, rigid, ultimate equation from which the entirety of reality, past and future, can be reduced to or deduced from. This method of reduction to something static, self-identical, fixed, or going the other way around the method of deduction from something static, self-identical, fixed, is guilty of erasing the virtual, guilty of erasing the dynamic relationship between the actual and the virtual, guilty of erasing time, guilty of erasing the productive nature of time, creativity. Again, we come face to face with the dogmatic deterministic assertion that everything the universe is, was, will be, is already *completely given*, that the only problem is *our knowledge*.

If not reductionism, if not positing static, self-identical axioms from which we reach conclusions by way of deduction, what is it that we're doing? Having *mutually exclusive*, *externally related* principles (recall an extensionless point) from which we understand relationships between always already constituted entities with isolable identities as *bipolar* (objectivity and subjectivity, necessity and contingency, conceptual and physical, global and local, continuous and discrete, virtual and actual (Epperson 4)), erases time, the dynamism of time, the creativity of an unending becoming, through referring to any of these as static, self-identical, isolated terms with static, self-identical, rigid definitions. We're then left, through Whitehead's fallacy of misplaced concreteness, to bicker about the status of these so-called simple parts:

> [T]he method of reduction and assimilation rightly recognizes the need to bring into coherence mutually exclusive, incommensurable categorical principles; but it wrongly grasps for that coherence by arbitrarily restricting the speculative schematization of the experience of nature to certain preferred categories of thought, in exclusion of other categories that could just as reasonably be characterized as fundamental. By this method, nature is always *either* fundamentally physical *or* fundamentally conceptual; either fundamentally continuous or fundamentally quantum; either fundamentally finite or infinite; either fundamentally deterministic or indeterministic. When one considers the increasingly profuse inflations of physical cosmological models into metaphysical cosmologies, their stipulated significance is belied by the fact that one can casually assemble practically any combination of the above qualifications and find a correlate interpretation of quantum theory or string theory or some other physical cosmology that can accommodate it. (Epperson 13-14)

[54]Kaede dragged her to the bathroom. “Are you going to shower if I leave you in here alone?”

“If you leave me in here alone, I won’t need to shower anymore because I won’t be sharing space with you anymore.”

Kaede’s jaw dropped. “You can’t be serious! You didn’t die, you became a toddler again!”

Kaede turned the water on and stripped Jordan of the clothes she had been wearing for however many days it’s been.

“Come on, baby Jordan. In you go.” Kaede was holding Jordan’s hand, leading her into the shower. Kaede stayed outside of the curtain but grabbed the removable shower head.

The water felt warm. Did it only feel warm because her body was losing its body heat? With no blood pumping through the body, it makes sense for there to be a substantial drop in body temperature. The warmth felt good. She didn’t realize how much she took her body heat for granted. Kaede grabbed Jordan’s loofah, scrubbing her back. This would be really awkward if she was alive. Only one of them was naked, and she barely knew this girl.

“Tilt your head back so I can do your hair.”

There was a pain coming from inside of her, near her stomach. Her body must be breaking down. Maybe this shower will be a good thing; if she has to be part of a funeral viewing in a few hours, she’ll at least look her best.

“What’s this dot on your ankle?”

They both looked down at Jordan’s ankle. “It’s a birthmark.”

“How long have you had it?”

“Since birth?”

“I’ve never seen it before though.”

“You’ve never seen my ankles before.”

Kaede stared a bit longer.

“Quit staring at my feet, you’re creeping me out.” Jordan shifted her feet behind one another.

Kaede’s expression was rigid.

“How about you hand me a towel?”

“Is the dead girl feeling cold?” Kaede snapped out of whatever trance she was in, poking fun at Jordan.

“No, just wet.” Jordan grabbed the towel out of Kaede’s hands and dried herself before wrapping it around her chest. “Cold is a feeling, wet is a property. Dead people don’t have feelings.”

“Can you handle getting dressed without me?”

“Yes.”

“Do you even have clean clothes?”

“Somewhere.”

[55]If the qualifier *bipolar* aligns itself with reductionism, being able to decompose something down to two, determinate, fixed, eternal, always already constituted, rigidly defined simple parts that are in mutually external relations, we instead assert *mutually implicative*, *internally related* principles (recall the past inside the present, the virtual and the actual) from which we understand relationships as *dipolar* (objectivity and subjectivity, necessity and contingency, conceptual and physical, global and local, continuous and discrete (Epperson 4)). Thus we understand these so-called simple parts through the dynamic reciprocal determination relationship between each simple part as a process *in time* whose history matters, whose history constitutes (but does not fully determine) the simple parts in question, their identities are relational processes in time.

> By this method of 'dipolar' relation it is explicitly recognized that the conception of one principle necessarily requires reference to its counterpart principle. Thus each relatum constitutive of dipolar conceptual pairs is always contextualized by both the other relatum *and* the relation as a whole, such that neither the relata (the parts) nor the relation (the whole) can be adequately or meaningfully defined apart from their mutual reference. It is impossible, therefore, to conceptualize one principle in a dipolar pair in abstraction from its counterpart principle. Neither principle can be conceived as 'more fundamental than,' or 'wholly derivative of' the other. (Epperson 4)

This is a process-theoretic perspective where nothing is fixed, neither the conditions nor the conditioned, everything is in flux. *But*, we know that even though everything is undergoing unending becoming, this doesn't mean that we can't say anything about the structure involved. We refer back to the notion of a topological invariant, a property of a system that persists amongst constant change, in contrast to a universal property, a property of a system that is not open to change but rather asserts a lack of change, *"always the case. . . "*, an erasure of time, an erasure of creativity.

Thus we advocate against exclusive, (external) bipolar relationships in favor of being inclusive of (internal) dipolar relationships. An intuitive way of thinking each of these is that an external relationship is putting two objects (already constituted, $x = x$) into relation, whereas an internal relationship is the production of an object in process (the becoming of an object's constitution, $x \neq x$). This is felt through our affirmation of time, process, history, creativity. If an object is not a static, self-identical, timeless, rigidly-defined essence that exists first which is subsequently put into external relationship, but rather an object is a dynamic, in-time, unending becoming, in-process, constituted (but not fully determined) by its internal relationships, then we are putting a relational foot forward. What it means to be an object is to be in-process, in-relationship. If there is no internal relationship, no history, no time, then we are no longer speaking of an object in reality.

> Why is differentiation an "actualization"? Because it presupposes a unity, a virtual primordial totality that is dissociated according to the lines of differentiation, but that still shows its subsisting unity and totality in each line. Thus, when life is divided into plant and animal, when the animal is divided into instinct and intelligence, each side of the division, each ramification, carries the whole with it. From a certain perspective it is like an accompanying nebulosity, testifying to its undivided origin. And there is a halo of instinct in intelligence, a nebula of intelligence in instinct, a hint of the animate in plants, and of the vegetable in animals. Differentiation is always the actualization of a virtuality that persists across its actual divergent lines. (Deleuze 95)

Deleuze explicates how a dipolar relation is such a relation through each of the two "poles" being grounded in a common unity: the virtual. Two actualizations, two differentiations, two objects that have become into distinct identities, have the other inside of them, a dipolar relationship, one cannot be separated from the other or their relation, because of their common grounding in the virtual.

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> For Parmenides, the reduction of potentiality to actuality implied related reductions of other mutually exclusive principle-pairs, such as creativity vs. discovery. [. . .] The ground of any experience interpreted as creativity (instead of understood as discovery) is the epistemic restriction or contextualization of all experience within our necessarily finite observational structures. (Epperson 9)

Discovery is understood here as having everything already *completely given*, the only thing missing is *our knowledge*. Thus nothing is invented, nothing is created, originality does not exist; rather things are discovered, different configurations of the same finite building blocks are rearranged, and we claim remixing the already known set of delimited building blocks into novel combinations *for us* but not to *the universe* is what we mean by originality. Again, we feel how this erases time, the virtual, the dynamic relationship between the virtual and the actual, the productive nature of time, creativity, for the universe, not just bracketed to a deficiency of consciousness and of our miniscule knowledge.

> The ontology of the world is a matter of discovery for the traditional realist. The assumed one-to-one correspondence between scientific theories and reality is used to bolster the further assumption that scientific entities are unmarked by the discoverers: nature is taken to be revealed by, yet independent of, theoretical and experimental practices, that is, transparently given. (Barad 41)

Discovery vs *creativity* takes the form of *revealed by* vs *created by*. Notice, we are encountering another dogmatic assumption in this timeless, discovery, revealed-by, perspective: nature is independent of, separate from our practices, that nature can be engaged while abstracting away our practices, of our engagement. Recall that the abstracting away of practices is a rewording of abstracting away processes, histories, time. Nature only has a static, self-identical, fixed, transparent, *completely given* reality when we erase time. If nature is also in time, in process, in unending becoming, which is to say that nature is not *completely given*, then the *way* in which nature becomes, *how* nature moves through time, what the histories and processes that constitute (but do not fully determine) nature are integral to understanding nature as a nature in time, as a nature in dynamic relationship, as a nature not *completely given*, as a creative nature.

[57]Kaede strode into the kitchen. “Let’s make you something to eat.”

Jordan walked into her room, looking around at the mountains of clothes. Nothing she would choose to wear was going to matter. How does anyone make a decision about anything when none of their decisions matter?

“All of your food is expired,” Kaede called out from across the apartment. “Have you not been eating anything?”

Jordan came into the kitchen, still in her towel. “Can’t you just leave me alone? I don’t need to eat.”

“I am not leaving you alone for you to just kill yourself.”

“I’m already dead.”

“No. You aren’t. Not to me at least.”

Jordan sighed. She didn’t want to fight but she was sick of pretending like she was alive. It felt so draining. Dead people should behave like they’re dead, not pretend to be something they’re not.

“Do you need help picking out clothes? Let’s do this together.” Kaede grabbed Jordan’s hand and dragged her back into her room.

“Do you feel colder or hotter right now?”

“I don’t feel anything.”

“Perfect. Super helpful. Okay, I would say it’s about room temperature in here, maybe a teensy bit below that, and you clearly are spending a lot of time inside. How about some comfy clothes. Sweatpants? Sweatshirt?”

Jordan didn’t respond.

“Okay. Right on.” Kaede rummaged through the clothes on the floor. “Here.” Kaede sniffed the sweatshirt in her hands and gave a little nod of approval. “This should work.”

Kaede opened the drawers of Jordan’s dresser. “Do you really not have a single pair of clean underwear?”

Jordan shrugged her towel off and pulled the oversized sweater over her head.

“Hold on, I have extra clothes in my car. I’ll grab you some underwear.” Kaede walked out of the apartment and closed the door behind her.

This was her chance to get rid of her. Jordan could stop going through these exhausting motions that living people constantly go through. She flipped the deadbolt, locking Kaede out.

[58]

> Essence thus becomes the trajectory of stabilization [. . .]. In contrast, Haraway (1988) emphasizes instability: it is the instability of boundaries defining objects that is the focal point of her explicit challenge not only to conceptions of nature that claim to be outside of culture, but also to the separation of epistemology from ontology. (Barad 41)

Essentialism seems appealing because of the stability offered, $x = x$, thus we can do work with x. However, as we have been arguing, in motivation of our mathematical-physical engagement, this erases time in contradiction to our empirical experience. Thus, despite essentialism offering higher *precision* through stable, determinate, rigid, static, self-identical, fixed boundaries to who or what things are, it is the *instability* of who or what things are, due to being in process, in unending becoming, in time, that we find higher *accuracy* when it comes to engaging reality.

Our arguments that nature itself is in time, in process, in unending becoming, not *completely given*, extend to culture as it is typically referenced in opposition to nature. This is another mutually implicative pair. Nature and culture are not isolated, disconnected, fixed, rigid, static, self-identical, timeless objects but are rather always informing, contextualizing, constraining, mutating, dynamizing one another. And once more, epistemology and ontology are a mutually implicative pair. What it means to *know* something is not as clearly cut, disconnected, separated, distanced from what it means to *be* something. This is felt in Epperson and Zafiris's reversal that objects be understood not *by* their histories but *as* their histories.

[59]Where are we and where are we going? We must spend time meditating and sorting out this essentialism, a language inadequate for time, because we ultimately want to engage time. Essentialism is a default language within much of the Western natural sciences and analytic philosophy traditions,

> [M]ost forms of realism presuppose a metaphysics that takes for granted the existence of individual entities, each with its own roster of nonrelational properties. As such, realism is often saddled with essentialism. But realism need not subscribe to an individualist metaphysics or any other representationalist tenet (indeed, I would argue that any realist account worth its salt should not endorse such idealist or magical beliefs). Realness does not necessarily imply "thingness": what's real may not be an essence, an entity, or an independently existing object with inherent attributes. (Barad 55-56)

We have been arguing, in motivation of our mathematical-physical engagement, that essentialism is aligned with erasing processes, erasing temporal continuity, erasing becoming, allied with spatial continuity, allied with set theory, allied with the extensionless point.

Because we seek to engage time we must construct what a "moment" in time is. Through affirming the reality of time we are disparaging the understanding of time as a spatial dimension, which models a moment in time as a spatial extensionless point, with no distinction between past and future. In order to shed our essentialist tendencies to better orient ourselves and motivate our eventual construction of a moment in time, we must better understand why the dominant traditions do not work for our intended goal.

[60]The door handle jiggled.

"Hey, does your door lock itself when it closes? It's just me, I got you some clean underwear and I grabbed a pair of my own sweatpants too."

The door handle shook again.

"This isn't funny, Jordan. Let me in. I know you're there, I was just inside with you."

"Leave me alone!" Jordan yelled through the closed door.

"I'm not going to do that."

"Why? I barely know you. You shouldn't care."

There was a pause. "Just let me back in, Jordan. I don't want to cause a commotion for the neighbors begging you to put on underwear from out here."

"Why should I care what they think? I'm dead."

It didn't matter whether or not Kaede believed her, the truth was the truth.

"Yeah, well, whether or not you think you're alive, you're still here interacting with me, right? What do you think is worse, having to deal with me, or having to deal with the police? If you don't let me in, I'm going to call them and tell them you are a danger to yourself."

Why was this girl trying so hard? It was irritating. Jordan flipped the bolt and Kaede opened the door instantly, not allowing any room for reconsideration.

"Put these clothes on, okay?"

"Whatever."

As Jordan was putting them on, Kaede walked back to the kitchen. "So all of your perishables have perished. Where do you keep your snacks?" She opened one and found a large container of peanuts. "Why do you have peanuts here? Aren't you allergic to peanuts?"

"No. Why would you think that I'm allergic to peanuts?"

"I just thought you were for some reason. Never mind. I love peanuts. Do you want to eat some?"

It's like she wasn't even listening. "Dead people don't eat."

"If you don't eat some peanuts, I'm going to call the cops."

Jordan resentfully grabbed a handful of peanuts and put one in her mouth. "Are you always this manipulative?"

Kaede laughed. "Only when you're trying to kill yourself."

"I'm—"

"I know, you're already dead. I got it, Jordan."

They stood there, leaning against the kitchen counter, munching on some peanuts.

"I'm really not hungry. How many do I have to eat?"

"Finish what's in your hand."

Jordan's eyes went wide, realizing how much she grabbed. She needed this to be over. She shoved her hand over her mouth, tossing in all of the peanuts at once.

Kaede snorted. "Y'know, not many people would take that as the action of someone who isn't very hungry."

Kaede grabbed a glass and filled it with water from the sink. "I guess the silver lining of you being dead means even though the apartment is dirty, your glassware and plates and utensils are all nice and clean."

Jordan took the glass of water and chugged it, washing down all of the peanuts in the process.

"I'm proud of you for getting that down! What should we do next? Laundry?"

Jordan looked towards the ground. Drained. Kaede walked forward and wrapped her arms around Jordan, hugging her tightly.

"Just leave me alone, okay?"

"Okay."

The hug lingered for a few more beats.

Hemiola. Jordan pushed Kaede off of her and put her hand on her wrist. Nothing.

"I'll come by later. We can do laundry then."

Jordan put her hand on the side of her neck. Nothing.

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> The idea that beings exist as individuals with inherent attributes, anterior to their representation, is a metaphysical presupposition that underlies the belief in political, linguistic, and epistemological forms of representationalism. Or to put the point the other way around, representationalism is the belief in the ontological distinction between representations and that which they purport to represent; in particular, that which is represented is held to be independent of all practices of representing. That is, there are assumed to be two distinct and independent kinds of entities—representations and entities to be represented. The system of representation is sometimes explicitly theorized in terms of a tripartite arrangement. For example, in addition to knowledge (i.e., representations), on the one hand, and the known (i.e., that which is purportedly represented), on the other, the existence of a knower (i.e., someone who does the representing) is sometimes made explicit. When this happens, it becomes clear that representations are presumed to serve a mediating function between independently existing entities. This taken-for-granted ontological gap generates questions of the accuracy of representations. For example, does scientific knowledge accurately represent an independently existing reality? Does language accurately represent its referent? (Barad 46-47)

Representationalism is a taken-for-granted presupposition of much of our scientific pursuits. Decided ahead of time is the determinate being of a *completely given* nature, and what follows as the scientist's job is to *model* nature with a representation. The strength of the model is determined by means of the correspondence between the model and the determinate, already *completely given* nature. Thus the only thing "changing" are our models, *our knowledge*, all the while we both assume and take for granted the definition, the production of, the creativity of, the boundaries of, the becoming of who we are and of what nature is, both of which are relegated to a timeless, static, self-identical, fixed realm. As we have been arguing, in motivation of our mathematical-physical engagement, this framework has *already* erased time, erased the virtual, erased the dynamic reciprocal determination between the virtual and the actual, erased the real productivity of time, creativity. This framework has abstracted away, bracketed aside, the processes, the practices, which constitute (but do not fully determine) all things in time. In the example of Jordan and Kaede, it would be like saying there always already exists a determinate essence to who each Jordan or Kaede are in isolation from all other people, things, contexts; then when someone like Kaede interacts with Jordan, there is merely a knowledge creation process, of Kaede learning about the determinate, always already rigidly defined Jordan, of Jordan learning about the determinate, always already rigidly defined Kaede. In opposition to this, we understand *who Jordan even is* or *who Kaede even is* is the product of these interactive, dynamic, relational processes, practices.

> Rouse identifies representationalism as a Cartesian byproduct—a particularly inconspicuous consequence of the Cartesian division between "internal" and "external" that breaks along the line of the knowing subject. Rouse brings to light the asymmetrical faith in word over world that underlines the nature of Cartesian doubt:
>
> > I want to encourage doubt about [the] presumption that representations (that is, their meaning or content) are more accessible to us than the things they supposedly represent. If there is no magic language through which we can unerringly reach out directly to its referents, why should we think there is nevertheless a language that magically enables us to reach out directly to its sense or representational content? The presumption that we can know what we mean, or what our verbal performances say, more readily than we can know the objects those sayings are about is a Cartesian legacy, a linguistic variation on Descartes' insistence that we have a direct and privileged access to the contents of our thoughts which we lack towards the "external" world. (Rouse 1996, 209)
>
> In other words, the asymmetrical faith we place in our access to representations over things is a historically and culturally contingent belief that is part of Western philosophy's legacy and not a logical necessity; that is, it is simply a Cartesian habit of mind. (Barad 49)

The method of representationalism asserts that there is an "objective" reality that is separate from our interaction with it. The practice of developing mediating models between us and this "objective" reality is called into question by Rouse, arguing that if the world exists separate and distinct from us, why is it that we feel we have a more direct access to our mediating models? Should these mediating models not have their own mediating mechanisms, tested for validity based on correspondence? How are we to know, determinately, what each word means, what each symbol means? What Rouse is trying to highlight is that the representationalist is the one who places languages on a pedestal, the one that believes our words have determinate meanings that perfectly and transparently describe exactly their referent. As we have been arguing, in motivation of our mathematical-physical engagement, we oppose this.

> Representationalism takes the notion of separation as foundational. It separates the world into the ontologically disjunct domains of words and things, leaving itself with the dilemma of their linkage such that

> knowledge is possible. If words are untethered from the material world, how do representations gain a foothold? If we no longer believe that the world is teeming with inherent resemblances whose signatures are inscribed on the face of the world, things already emblazoned with signs, words lying in wait like so many pebbles of sand on a beach there to be discovered, but rather that the mind cannot see its way to objects that are now forever out of reach and all that is visible is the sticky problem of humanity's own captivity within language, then it becomes apparent that representationalism is a prisoner of the problematic metaphysics it postulates. Like the frustrated would-be runner in Zeno's paradox, representationalism never seems to get any closer to solving the problem it poses because it is caught in the impossibility of stepping outward from its metaphysical starting place. What is needed is a new starting place. (Barad 137)

Words and meanings themselves are in time, in unending becoming, in process, their history matters, the practices of their usage matters, their boundaries are not determinate. We don't go out on a word expedition only to discover a word with its definition like finding already formed pebbles of sand on a beach. Words and their definitions are *processes in time*. Calling attention to this fact is not meant to conclude that due to have no fixed, rigid boundaries that everything must be a jumbled mess where nothing can be adequately engaged because precision is lost. Recall that instability is more accurate than the precision of stability. Time has a structure that is inclusive of change, becoming, process, instability.

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> **First**, objects are known only relative to theories. A theory does not just explicate a pre-existing essence. [. . .] We must resist the temptation to posit static, self-identical essences. Theories do not just transpose the properties of pre-given essences from static eternity to dynamic present. They actualize virtualities—and this actualization is a radically novel genesis inflected uniquely in time. **Second**, identifying mathematical reality with static essences is, frankly, dogmatic. It is an *a priori* decision, one that indulges so many biases—such as those towards identity, immobility, sedentary distribution. [. . .] Consider again the ellipse: is it an algebraic equation? Conic section? A "locus of points such that the sum of their distances to the foci is constant" (Lautman)? Is it the essence containing all possible properties of the ellipse? If we plump for the latter, we have to commit to the essence being inexhaustible. Who could prove it was exhausted? Who could prove that no forthcoming theory would reveal anything new about it? Mathematical reality would exceed always a discursive intellect. But—and here is the problem with static essences—we cast also these "new revelations" as "not really new": they were contained already within the essence! Its inexhaustibility is not an "objective" feature of the essence, only a reflection of a "subjective" condition. But what grounds this dismissal of novel discoveries if not a *bias* against the possibility that concepts *evolve* in time? That they are indeterminate not just *for us* but *in themselves*; that they dissipate errantly a coiled force (which is a function of its aspect upon a problem) in time—Lautman refuses to conceive otherwise of mathematical concepts. *Okay, we forgo essences. How about reducing the ellipse to a "canonical" equation?* But that an ellipse is now an equation, now a geometrical figure introduces a certain undecidability. Is one specification "more fundamental" than the other? Who decides? Again, Lautman urges us to take seriously this undecidability: it is expressive of mathematical reality, not just of subjective ignorance. If an ellipse were essentially geometrical, algebraic equations would be derivative, almost inessential. Why prioritize geometry over algebra? For Lautman, such pseudo-problems are symptoms of a tendency to regard mathematical reality as static and complete in itself. The latter is never a trivial assumption. Besides being philosophically portentous, it countermands the very character of mathematics: its love of transformation, its startling surprises, the bizarre complicity of disparate theories. (Paetsch 146)

Going back as far as Plato, mathematical reality is often considered to be static, eternal, timeless, determinate; that there may not be any perfect triangles in physical reality, but we sure can have a perfect triangle in mathematical reality and start rattling off the static properties of this essence. What Lautman is highlighting here is that mathematical reality is likewise not eternal, timeless, static. There is no determinate, static, rigid, fixed definition for what an ellipse is: there are not only different ways of defining an ellipse (geometrically, algebraically, . . .) where crucially none of these have any fundamental priority over the others, but we cannot determinately say that our definitions capture everything about this essence of the ellipse. What we mean when we refer to an ellipse is thus in process, in unending becoming, always open, never exhausted, never reaching a determinate being of $x = x$. When new things are "discovered" about the ellipse, this essentialist, representationalist, erasure of time bias says "This property was in the ellipse all along, part of its eternal, static, globally-defined essence! It was only *our knowledge* that was lacking! Everything has always been *completely given*, we just have to get past our pesky subjectivity, this illusion of time, this emphatically local experience!"

[63] Jordan was working on the dredge again. Kaede convinced her that even the living dead needed to get by somehow. That was before she moved in with Jordan. Kaede practically forced her way into moving in with how often she came over, but getting by was easier with a partner, right? Still, Jordan increasingly needed the respect of not being treated like a living person the way Kaede kept asserting. At first the dredge represented a job, an activity aligned with the living, but over time became a reprieve, a solitary place where she could just feel dead.

Kaede let herself in with the key Jordan made her. No light spilled in behind her so it must have been night time.

"Do you know what I've been thinking about lately?"

"What?"

"Going to a club."

"Then go."

"I want you to come with me."

"Why?"

Kaede grabbed Jordan's hand and dragged her onto the couch. "Please?"

"It's pointless."

"I think it'd be a lot of fun. I used to have a lot of fun."

"You don't seem like the kind of girl who would enjoy going to clubs. I mean, I met you at at an uppity piano bar. Those two scenes don't usually overlap."

"I didn't enjoy going to clubs, but a friend of mine dragged me there and we had a lot of fun."

"Friend?"

"Yeah."

"Sort of how like we are friends?"

"Is that what we are, Jordan?" Kaede refused to avert her eyes. Jordan didn't feel good about being watched like this. Her thoughts don't matter. Questions prompt anxiety. She needed this to be over.

"Pick out some clothes for me. I've never been to a club before."

Kaede jumped up smiling, quickly hugging Jordan and then scurrying off to their bedroom to wade through the clean clothes for a suitable outfit.

[64] "Quantum physics undercuts reductionism as a worldview or universal explanatory framework." (Barad 24) Quantum mechanics is an arena where we can find clear examples to engage on our journey of learning and developing the tools about this dynamic creative nature in time, the tools necessary for our mathematical-physical engagement of time; an engagement that does not employ reductionism of the static, self-identical, fixed, in external relation (extensionless points), but rather an engagement that employs mutually implicative relationships of the dynamic, unending becoming, in internal relation (past inside the present). We want to be clear: despite turning to quantum mechanics, we are not turning to a separate "micro world," as Barad puts it, "To ask whether it is not suspect to apply arguments made specifically for microscopic entities to the macroscopic world is, in this case, to mistake the approach as analogical. The epistemological and ontological issues are not circumscribed by the size of Planck's constant" (Barad 70). Jumping in,

> Bohr's naturalist commitment to understanding both the nature of nature and the nature of science according to what our best scientific theories tell us led him to what he took to be the heart of the lesson of quantum physics: *we are a part of that nature that we seek to understand*. (Barad 67)

We are in a dynamic, reciprocally determining, in process, in time, unending becoming relationship with nature. The process of what nature *is* is tangled with us. The process of who *we are* is tangled in nature. If we are to take the conclusions of our affirmation of time seriously, then we must let go of the desire to construct models as a mediating construction between ourselves and a *completely given* nature. We must account for the process by which nature comes to be. We are a part of that process, thus we must account for our role in nature. Nature is not *completely given*, awaiting discovery, rather nature is created, in time, and involves, among so many other agencies, ourselves.

This can be felt from an angle of throwing aside bipolar dualisms whose poles are separated, always already fully constituted, rigidly-defined, in favor of dipolar mutually implicative relational poles.

> The realism-antirealism distinction is often drawn on the basis of questions about belief in a correspondence theory of truth, which is rooted in subject-object, culture-nature, word-world dualisms. The separation of epistemology from ontology is a reverberation of these dualisms. Bohr's philosophy clearly contests the Cartesian (inherent, fixed, unambiguous) subject-object distinction in a way that undermines the very foundations of classical epistemology and ontology. (Barad 125)

Discovery through, transparency of, separation of, individuality of, *completely given* except to knowledge passive gazing versus active, dynamic, in process, creation is specifically what we are engaging here. All of these puzzle pieces became front and center when quantum mechanics came on the scene.

> Representationalism and Newtonian physics have roots in the seventeenth century. The assumption that language is a transparent medium that transmits a homologous picture of reality to the knowing mind finds its parallel in a scientific theory that takes observation to be the benign facilitator of discovery, a transparent lens passively gazing at the world. Just as words provide descriptions or representations of a preexisting reality, observations reveal preexisting properties of an observation-independent reality. In the twentieth century, both the representational or mimetic status of language and the inconsequentiality of the observational process have been called into question. (Barad 97)

[65] "Do you want a drink?" Kaede shouted over the music.

Jordan responded with a glare.

"Fine. But if I know anything, I know the dead can dance."

The dance floor was hundreds of eyes. Everyone was in their own worlds but their eyes were transfixed onto her as they danced and talked with others. Unnerving. The thump of the bass was overwhelming but offered a hopeful escape from this affair. Jordan moved a few inches away from Kaede. She closed her eyes and let herself wander away.

Hands around her waist. Another body pressed up against her. Jordan opened her eyes and spun around. She was confident that her eyes must have been filled with death and decomposition, anyone should be able to pick out a dead woman compared to an alive woman. This guy didn't seem to care. He moved his hands upwards, groping her chest, not even raising his eyes for any check of approval. It almost seemed to calm the anxiety. Instead of a person she was an object. It felt true. Someone finally acknowledging the state of things as they were. Dead people aren't people. Jordan took his hand and walked him over to the bathrooms.

They still hadn't even exchanged pleasantries, much less names. He flipped her around facing a toilet in the stall and bent her over. Jordan's hands were against the wall just above the toilet. She made no sounds. She felt nothing. But that's how objects feel, right? Objects don't feel anything because they are objects.

"That's right. Right there. That good?"

He wasn't asking. Her answer was irrelevant. No lingering pause waiting for a response.

He picked up speed, grunted loudly, and pulled out during ejaculation.

"Thanks," he said, picking up his pants before walking straight out of the bathroom.

The ejaculate was uncomfortable. Jordan grabbed a wad of toilet paper and started cleaning herself up. Discomfort was one way to motivate dead people, but she didn't feel uncomfortable as he was using her, just the lingering fluid left to dry. Creeping closer to who she knew she really was.

She washed herself up and walked out of the bathroom. Eyes. The peace she managed to get behind in the bathroom stall only lasted so long.

A new guy walked up to her.

"I'm pretty sure I just saw a guy come out of this women's room. You alright?"

"Yeah, I didn't even notice."

Objects are never alright or not alright. The amount of people treating her like she was alive was infuriating. She wanted to be used again. Put back on the level she knows herself to be at.

"Listen, I'm sorry for the way our last conversation went. I really didn't mean to come off the way I did, making it seem like I cared more about going on a date with you than any of the shit going on in your life. I admit, it was selfish. But it's pretty cool seeing you come back here again. I've missed you."

First Kaede thinks she knows her. "I'm sorry, who are you?"

He laughed. "Wow, okay. That's how you want to play it. I'm Krzys. Nice to meet you." He extended his hand for a handshake.

"Say Krzys, are you still into me?" Whoever this Krzys guy was, he already admitted to being selfishly into Jordan. He dropped from the sky as exactly what she needed to soothe the anxiety of observation right now. Jordan looked around the room. Kaede was over by a giant speaker, standing still, solemnly looking right at Jordan, just like everyone else was.

He left his hand frozen in front of him. "Is this a trick question?"

Jordan locked eyes with Kaede. She grabbed Krzys's hand, spun around, and led him into the women's bathroom.

[66]Let's follow Barad through a famous example, the double-slit experiment.

> From the perspective of classical mechanics, the two-slit experiment evidences a stark distinction between particle and wave behaviors. When particles are aimed at the partition with the double slits, we find that most of the particles land on the detection screen directly opposite each of the two openings in the partition, with a smaller number scattered off to either side. The bimodal pattern [...] is a graphical representation of this result: it indicates the number of particles that are collected at each location along the screen and shows that the bulk of particles are found directly across from the slits. (Barad 101-102)
>
> Waves, on the other hand, exhibit a very different pattern. When waves impinge on a barrier with two openings, they spread out as they emerge from each of the slits. The emerging waves interfere with one another. When the interfering waves reach the screen, the greatest intensity will be at the centerline between the two openings. As one moves off to the sides, the resulting wave amplitude alternates from areas of constructive interference (high intensity, e.g., bright lines) to areas of destructive interference (low intensity, e.g., dark lines). This overall pattern exhibited by waves is called an interference or diffraction pattern. (Barad 102)
>
> [W]hat happens if we perform this experiment using electrons? The surprising–indeed, startling–result is that electrons, tiny particles of matter, produce a diffraction pattern! [...] Are the electrons somehow "interfering" with one another? We can in fact eliminate this possibility by sending each electron through one at a time. That is, we fire one electron at the double slits and wait until it hits the detection screen before sending the next one. [...] What do we see after sending the first particle through? We find a single mark on the detection screen indicating the position of the electron as it arrived at the screen. So far this seems to follow our classical-physics intuition that electrons are little particles. This happens for each and every electron run that is collected: each electron arrives at a well-defined location on the screen. But here's the rub: we collect the data for each event, and look at the overall pattern after a large number of electrons have gone through, and what do we observe? An interference pattern–the electrons manifest wave behavior! But how is this possible? unlike the case of water waves, which go through both slits at once, the electrons are sent through one at a time. Does an *individual* electron "interfere" with itself? Does a *single* electron somehow go through *both* slits at once? How can this be? Doesn't each electron go through one slit or the other? (Barad 102)
>
> Suppose we alter the apparatus in such a way that we can detect which slit an individual electron passes through on its way to the screen. [...] What do we find? Bohr argued that if we were to perform a two-slit experiment with a which-path device (which can be used to determine which slit each electron goes through on its way to the detecting screen), we would find that the interference pattern is destroyed. That is, if a measurement is made that identifies the electron as a particle, as is the case when we use a which-path detector, then the result will be a particle pattern, not the wave pattern that results when the original unmodified two-slit apparatus is used. But this result makes the situation even more confusing than ever–is the electron a particle or a wave? How can we get different results using different experimental apparatuses? (Barad 102-104)
>
> According to Bohr, either we can find out which slit an electron goes through by using the which-path apparatus, in which case the resulting pattern will be that which characterizes particles, *or* we can forego knowledge about which path the electron goes through (using the original unmodified two-slit apparatus) and obtain a wave pattern–we can't have it both ways at once. In some important ways, this all seems very sensible, but the implications are nothing short of revolutionary. Notice what the complementary nature of these results means: *the nature of the observed phenomenon changes with corresponding changes in the apparatus*. But this is contrary both to the ontology assumed by classical physics, wherein each entity (e.g., the electron) is either a wave or a particle, independent of experimental circumstances, and to the epistemological assumption that experiments reveal the preexisting determinate nature of the entity being measured. Bohr's conclusion, as we will see, is that classical physics, along with the classical epistemological and ontological assumptions on which it is based, is fundamentally flawed. (Barad 106)

What we refer to when we say "electron" is thus not a determinate, static, self-identical, rigidly-defined fundamental building block that the universe can be reduced down to, its nature is in process, dependent on context, what Whitehead terms "subjective"–it is a mistake to search for a "discovery" of the "true" and "objective" nature of the electron as if this were an always already determinate particle (or wave) always already with a finite set of delimited determinate properties such as charge and mass. An electron as particle is a *creation between* the electron in question and its specific context (e.g. measuring system with a which-path device), and electron as wave is a *creation between* the object in question and its specific context (e.g. measuring system without a which-path device). We place importance on how much work the

word “between” is pulling: to understand objects not as static essences discovered but as productions of relational processes created in time.

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> Classical epistemological and ontological assumptions, such as the ones found to underlie Newtonian physics, include the existence of individual objects with determinate properties that are independent of our experimental investigations of them. This accounts for the fact that the process of measurement is transparent and external to the discourse of Newtonian science. It is assumed that objects and observers occupy physically and conceptually separable positions. Objects are assumed to possess individually determinate attributes, and it is the job of the scientist to cleverly discern these inherent characteristics by obtaining the values of the corresponding observation-independent variables through some benignly invasive measurement procedure. The reproducibility of measured values under the methodology of controlled experimentation is used to support the objectivist claim that what has been obtained is a representation of intrinsic properties that characterize the objects of an observation-independent reality. The transparency of the measurement process in Newtonian physics is a root cause of its value to, and prestige within, the Enlightenment culture of objectivism. (Barad 106-107)

There is a clinging to a certain constructed notion of "objectivity" — measurement as something transparent, external, neutral, able to be abstracted away, not part of the constitutive process, not part of the creation, that "objectivity" owes its strength and truth to an underlying, separate, removed nature to be modeled from without. What gets dubbed "the measurement problem" is a pseudo-problem that falls out of this dogmatism.

> Bohr called into question two fundamental assumptions that support the notion of measurement transparency in Newtonian physics: (1) that the world is composed of individual objects with individually determinate boundaries and properties whose well-defined values can be represented by abstract universal concepts that have determinate meanings independent of the specifics of the experimental practice; and (2) that measurements involve continuous determinable interactions such that the values of the properties obtained can be properly assigned to the premeasurement properties of objects as separate from the agencies of observation. In other words, the assumptions entail a belief in representationalism (the independently determinate existence of words and things), the metaphysics of individualism (that the world is composed of individual entities with individually determinate boundaries and properties), and the intrinsic separability of knower and known (that measurements reveal the preexisting values of the properties of independently existing objects as separate from the measuring agencies). (Barad 107)

Bohr's opposition to the world being composed of already defined, static, determinate individuals resonates with our process-theoretic temporal engagement we are motivating. Where objects (eventually for us, moments) are *created* in a relational process, the boundary of said moment, the meaning of said moment being just as indeterminate as the "objective" eternal state of the electron in the double-slit experiment, the boundary, the meaning of our moments will be context dependent (Whiteheadian subjective), not *discovered* under the umbrella of essentialism. Bohr's opposition to the act of measurement being a (spatially) continuous interaction such that it can be abstracted out to leave a revealed, discovered, separate, "objective" reality resonates with our relational-theoretic temporal engagement.

[68]Jordan knew last night would prompt eyes, questions, anxiety. She ducked out of their apartment before Kaede was awake, headed for the dredge.

Jordan sifted the loose dirt through her fingers, falling, spreading over the water, but water was too generous a term for what she was standing in; only a few inches deep and Jordan couldn't see her feet. Of course, they were really there, barely under the sea's surface; Jordan could feel her feet. Feelings often spoke louder than visuals.

The noise of a still-dark, still-empty ocean, ruptured: "You know you're not supposed to be in the water."

69

> The hallmark of Newtonian physics is its strict determinism: given the "initial conditions" (i.e., the position and momentum of a particle at any one instant in time) and the full set of forces acting on a particle, the particle's entire trajectory (i.e., its entire past and future) is determined. Newton's equations (i.e., the laws of classical mechanics) are acclaimed for their ability to predict and retrodict the physical state of a system for all time. According to Newtonian mechanics, the initial conditions can be determined by any one of a number of different measurement procedures. (Barad 107)

Notice how we have already erased time (the process of creation of the object in question, the asymmetry of the virtual and the actual, the dynamic interaction between the virtual and the actual, the conditions and conditioned, that creates indeterminate-from-the-present novelty and not the realization of a predetermined possible in the image of the present) in the way we have constructed the problem, entirely from notions that we would argue lie in metaphysics, assumptions, biases, dogmatisms. If there are no already-constituted, fixed, rigidly-defined, determinate particles that have a list of similarly qualified delimited properties, Newton's algorithm breaks. If the past is different from the future, an asymmetrical relationship to the present, Newton's algorithm breaks. If the future of the universe cannot be precisely predicted (strict determinism), Newton's algorithm breaks. This engagement of physics, we argue, was constructed out of these uncritical metaphysics, assumptions, biases, dogmatisms, such to reflect these principles. When the math works out (as constructed) physicists say it *must* be correct because math doesn't lie. Notice, it is said that the math doesn't lie because math and physical models are revealing of "objective" reality, a matter of discovery, and thus we can't discover something that isn't there. But if we understand this engagement as a creation, a creation built in a context, in a history, we see how the math constructed to align with a deterministic worldview would work but not necessarily match reality. It is not enough for the math to work out, we must hold our mathematical engagements up to empirical experience, and not just the experiences that are most emblematic of embodying a deterministic machine. Newton's algorithm says "input determinate, deterministically output determinate"; this is a much easier algorithm both to understand and to use in practice than "input indeterminate, indeterministically output indeterminate," but we cannot be swayed by the temptation of the precision from stability against the accuracy from instability. We continue to affirm that our indeterminate, indeterministic understanding is not a jumbled mess that we can't say anything about, there is still structure, topological invariants, but we will indeed not have the precision of a determinate, deterministic system, in the same way as saying "the object has one whole" does not precisely identify between a coffee mug and a donut. We embrace this, physics is about accuracy, not precision.

> [I]t is often the case that any such disturbance is too small to notice. (For example, we don't notice the furniture being rearranged in the room when we turn a light on in a dark room, although this is strictly the case.) There are, however, situations in which the disturbance is noticeable (e.g., when the accuracy of the measurement is increased beyond a certain limit or when the object is sufficiently small). But Newtonian physics is not troubled by this scenario, either. When the disturbance is not negligible, Newtonian physics argues that the measurement-independent values of the object's position and momentum can be found nonetheless because the disturbance can always be determined and subtracted out. According to Niels Bohr, this account of the measurement process rests on false assumptions. Bohr's criticism of measurement transparency is based on two important points: the discontinuity and the indeterminacy of measurement interactions. (Barad 108)

The Newtonian algorithm's commitment to inherent separability and timeless, static, determinate objects rears its head with the way it sets itself up for the self-contained problem of its own construction, "the measurement problem." Measurements themselves are said to embody this inherent separability and timeless, static, determinate nature as well, thus in experiments where the measurement is productive of a noticeable disturbance, the Newtonian algorithm says that the measurement's separate and static, determinate nature can be deduced and subtracted to determine the separate and static, determinate nature of the system in question. We call attention to the language adopted by this bias, a "disturbance" being an external interaction between two already constituted objects, not an internal relationship productive of the objects.

> The lack of continuity places a lower bound on how small the disturbance caused by the measurement interaction can be (e.g., the light can be reduced in its intensity no further than one "photon"—one particle of light—or else no measurement takes place). In particular, it means that Newtonian physics will have to face the limits of its ability to ignore measurement interactions by presuming that they can always be reduced to the point where they are negligible. Hence, the only remaining possibility, if the goal is to determine the presumed measurement-independent properties of an object, is to determine the effects of the measurement interaction. (Barad 108-109)

This is the way in which measurement transparency breaks down according to Bohr's first point: discontinuity. What the Newtonian algorithm defines as a separate, determinate "measurement" can only be neglected, abstracted out, if the "disturbance" can be reduced all the way down to a limiting case of zero disturbance. However, due to discontinuity, this

reduction to zero can never happen, in the case of measuring with photons the furthest point that can we can reduce to is that of one photon. But a "disturbance" of one photon has contexts where this is a significant impact. Thus what we are engaging is no longer some "objective" reality that is separated from us, beneath, behind the measurement, rather we are creating, constructing an experiment such that a measurement refers to this interaction of all parties.

[70]Jordan jumped–was there no escaping her?–focusing on the liquid horizon, pretending she didn't hear wasn't going to poof her away, blood pressure heightening, spinning around to see Kaede walking down from across the dirt mounds. Privacy was lost. Her last space that could truly be referred to her as her own: gone. Jordan's heart was pumping loud, heard, felt in her ears. Kaede knew how to make a dead person experience hypertension. She debated making a run for it but the Earth gripped harder. She should have joined her hidden feet beneath the opaque glass when she had the chance.

"You know you're supposed to be asleep," Jordan countered, doing her best to keep cool. The fastest way out was keeping cool.

"I didn't want to leave things the way they ended last night."

Jordan turned away from her, toward the warmth of daybreak. "Are you coming in or am I safe in the water?"

"The water isn't safe. Do you do this every morning now? Is this the reason I never wake up next you?"

"It's only a few inches." Jordan bent down, peering above where her feet were, focusing her attention, trying to pierce through her reflection. "Whatever you have to say, can you make it quick, I need to get out there. Big day ahead of me."

The footsteps never continued. Kaede was staying put. "It's always a big day with you. I don't appreciate feeling like my feelings are inconveniencing you."

Jordan stared down at her warbly eyes, the boundary, cohesion of her eye constantly renegotiated as the small waves moved. She couldn't see Kaede but she felt where this was going. The muck crept further upwards, constricting her ankles. If she waited long enough her whole being would be trapped. Not fast enough. Or rather, it was happening much too quickly.

Kaede tried again. "What does this relationship mean to you?"

[71] Like the particle-wave complementarity contingent on apparatus, there is position-momentum complementarity, where position is determinate when measured with a fixed platform and momentum is determinate when measured with a movable platform.

> [A] measurement of the photon's momentum requires a *movable* platform. But this is excluded by the requirement for the measurement of the position (of the photon on the photographic plate, which marks the position of the particle in the room): position, as we saw, is necessarily defined by reference to a *fixed* platform. Hence it is not possible to determine the effect of the photon on the particle, since we would need to determine the photon's position and momentum simultaneously, which is physically impossible given that the measurements of position and momentum require mutually exclusive apparatuses for their respective determination. Therefore we arrive at Bohr's conclusion: *observation is only possible on the condition that the effect of the measurement is indeterminable*. Now, the fact that the measurement interaction is indeterminable is crucial because it means that we can't subtract the effect of the measurement and thereby deduce the properties that the particle (is presumed to have) had before the measurement. This does not mean that we can't measure position accurately; indeed, we can (we just use an apparatus with fixed parts). What it *does* mean is that we are *not* entitled to ascribe the value that we obtained for the position to some abstract notion of a measurement-independent object (i.e., the object as it presumably would have been before the measurement). (Barad 113-114)

We are creating systems that, through both their internal and external interactions, are productive of objects and properties. We are not creating transparent, passive models that are windows to a separated, independent nature. The difference we are motivating is one of a *science-from-within* as opposed to a science-from-without. If conducting a science-from-within, where we matter to the process of production, then we cannot be abstracted away. This is another sense in which we employ storytelling as our embodied example, as our vehicle for experiment, we are not proselytizing speculation from a removed position, the physics is not simply in coherent math, our engagement of time is one not through mediation but through lived experience. A moment in time will be relationally, process-theoretically engaged by means of science-from-within, experience is emphatically local, and thus the boundary, definition of a moment in time is not universal, global, determinate, well-defined, static, fixed.

> Bohr argues that the indeterminacy of the measurement interaction is of profound consequence: Since observations involve an indeterminable discontinuous interaction, *as a matter of principle, there is no unambiguous way to differentiate between the "object" and the "agencies of observation." No inherent/Cartesian subject-object distinction exists*. [. . .] The first case [measuring a particle's position with a photon] essentially describes the process of taking a picture of a particle with a flash camera. In that case, the light (photon) is part of the *agencies of observation*. In the latter case [measuring a particle's momentum with a photon], the light's (photon's) momentum is being measured, and hence it is part of the *object* in question. So the question of what constitutes the object of measurement is not fixed: as Bohr says, there is no inherently determinate Cartesian cut. *The boundary between the "object of observation" and the "agencies of observation" is indeterminate in the absence of a specific physical arrangement of the apparatus*. What constitutes the object of observation and what constitutes the agencies of observation are determinable only on the condition that the measurement apparatus is specified. *The apparatus enacts a cut delineating the object from the agencies of observation*. Clearly, then, as we have noted, *observations do not refer to properties of observation-independent objects (since they don't preexist as such)*. (Barad 114)

Boundaries are created, not inherent. We saw this in the example of an electron in the double-slit experiment. Whether or not the electron was a particle or a wave was not a determinate, static, essence as the ontology and epistemology of the Newtonian algorithm assumes, it is contextual (Whiteheadian subjective) and indeterminate unless in said context. We ground this back in our intention of time: we do not expect a moment to be a determinate, static, essence, an entity with a fixed inherent boundary from which we can say a moment is an extensionless point or a range of extensionless points on a decided-ahead-of-time "more real" number line. Rather we expect that what constitutes a moment is dynamic and dependent on the present interacting relationships between moments.

For example, when determining the identity of the moment related to "Jordan and Kaede meet at the piano bar", in the immediate aftermath of this moment Jordan would characterize the moment as being the highest degree of embarrassing; a girl she might end up being interested in spent their first evening together dealing with Jordan having the feeling of diarrhea and inducing her own vomiting. But now that more time has passed, the identity of this moment has changed. Jordan no longer feels embarrassed by that first encounter. For starters, Kaede has now helped her through similar situations, like when Kaede was first helping Jordan when Jordan started feeling dead, such that these kinds of interactions have become more normal between them. Additionally, related to Jordan feeling dead, Jordan has a high degree of carelessness and ambivalence towards almost everything in her life, especially herself. The moment once understood as embarrassing no longer holds this identity. The way in which this moment is felt is part of its identity because it is the way in which this moment is felt that

contributes to causality – the moment in question when it means one thing, when it has one such identity, is productive of certain decisions, thoughts, feelings, whereas the same moment at a later time means another thing, having a different identity, and is productive of different decisions, thoughts, feelings, despite the facts of the matter never changing (Jordan did feel like she was having diarrhea, Jordan did induce herself to vomit, Kaede did drive her home, all undisputed). The identity of the moment in question is thus in a process of unending becoming, surely to have its identity different than what we know of it from the perspective of this moment in relation to a future moment that has not yet occurred. Connecting this more explicitly back to our quantum mechanical example, we can understand the identity of a moment being contingent on the perspective, the point of view, of another moment, in the same way that the identity of an electron being contingent on the context it is in, or the identity of the object versus the agencies of observation being contingent on the context employed, where all of these things (moment, electron, object, agencies of observation) are indeterminate when outside of any context, of any productive relationships.

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> As we have seen, for Bohr the central issue concerning the nature of measurement is not one of disturbance but one of resolving an inherent indeterminacy. In other words, in Bohr's account, the key point is "quantum wholeness," or the lack of an inherent/Cartesian distinction between the "object" and the "agencies of observation." In the absence of a given apparatus there is no unambiguous way to differentiate between the object and the agencies of observation: an apparatus must be introduced to resolve the ambiguity, but then the apparatus must be understood as part of what is being described.
>
> > *Descriptively*, there is a *single* situation, no part of which can be abstracted out without running into conflict with other such descriptions (namely, those of complementary situation). The object cannot be ascribed an 'independent reality in the ordinary physical sense' (Hooker 1972, 156; italics in original).
>
> This is a central notion in Bohr's philosophy-physics, and he uses the term "phenomenon" to designate particular instances of wholeness: "While, within the scope of classical physics, the interaction between object and apparatus can be neglected or, if necessary, compensated for, in quantum physics this *interaction thus forms an inseparable part of the phenomenon*. Accordingly, *the unambiguous account of proper quantum phenomena must, in principle, include a description of all relevant features of the experimental arrangement*" (Bohr 1963c [1958 essay], 4; italics mine). (Barad 118-119)

We are dealing with the ontology of phenomena, not the epistemology regarding essences. This is an important shift because we are embracing how all of the universe, past and future, is not *completely given* with only *our knowledge* missing. There are novel creations, including those of which we have a role in creating. Again, we are accounting for the role of process and production, an affirmation of time, instead of assuming from the outset that everything is always already *completely given*, timeless, against our empirical experience. The identity of a moment is dynamic, unstable, we affirm time through a lack of identity, moments having identity in process, in unending becoming, $x \neq x$. It is thus helpful for us to understand a moment as a Bohrian phenomenon, but we must emphasize that we are not engaging quantum mechanics, we are engaging time, thus our "fundamental units" still repel every sense of identity, $x \neq x$. But a moment understood as a phenomenon is a step in the relational, process-theoretic orientation that is inclusive of novel creations (moments). In this formulation, the apparatus in question is the relationship between the present and the past, the actual and the virtual, that is productive of their subsequent ever-changing identities.

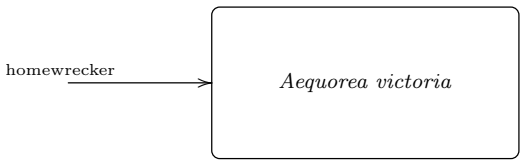
[73]Jordan had done her best to inch further away, now leaning against the gantry, the safety of a workday looming, threatening to go asea by sheer proximity. Jordan tried again. “It doesn’t feel like we’re getting anywhere and I need to get out of here, I can’t be late. Already lost this job once. Our conversation is running in circles. Can we please pause and pick back up tonight?”

Kaede was still on the dirt shore, opting to stay put, a safe distance away. “No.” The anger crept further upwards, constricting her voice. “I’m going to be thinking about this all day, it’s going to ruin any attempt at productivity, and then I’m going to wait at home for you to show up in the middle of the night just in time to argue about continuing this conversation before you decide you’re too tired, that everything is pointless, that you want to be left alone forever, you have to go to bed, that we’ll continue this later.” Kaede stopped and Jordan met her eyes. “We are continuing this now.”

There was no escape. No back door, no panic room, no muck to sink into. Breathing tighter. Claustrophobia. “It’s not my fault if you can’t handle being separated from me. Your work is your responsibility, mine is mine. Please let me go.”

“Sometimes I actually like spending time with my girlfriend. Fucking sue me. You realize if we don’t spend any time together then we,” Kaede violently motioned her hand back and forth between them, “aren’t a thing.”

74



75

> Part of Deleuze's program for "overturning Platonisms" is rejecting Bergson's residual Platonism! Orthodox Platonism would insist upon the strict unintelligibility of every flux. If Bergson accepts Plato's arguments that becoming is unintelligible, he insists that it is accessible to the non-intellectual faculty of intuition. Deleuze does not accede to the stark Platonic duality: if becoming is inaccessible to an intellect, it is inaccessible to an intellect *in the thrall of the dogmatic image of thought*. If we abandon the diktats of representational thought, we might discover a non-intellectual thought adequate to flux—one that only extends the insights of intuition. This non-intellectual thought is no more a negation of it than non-Euclidean geometry is a negation of Euclidean geometry. (Paetsch 221, Footnote 332)

We can start connecting some dots! These residual Platonisms are essences, Bergson arguing *with* Plato that if time has no sense of identity, $x \neq x$, then time cannot be engaged by the intellect, logic, or math, but only by means of his system of intuition. But it was on Plato's terms that the only possibilities were "fully able to be understood" essences and "totally unable to be understood" fluxes. We oppose this from the outset; time has a structure and can meaningfully be engaged without subjugating it to the realm of the spatial, which is to say time is not "fully able to be understood" insofar as we understand this phrasing to be referring to the precision of essentialism, but neither is time "totally unable to be understood" insofar as we understand this phrasing to be referring to Bergson's assertion that the intellect, logic, and math cannot engage time. The dogmatic image of thought is representationalism, the methodology employing essentialism, a presupposition of separated, determinate, static identities that asserts due to the already-erased time that external interactions (experiments, models) are themselves separable and determinate, able to provide a transparent look at "objective" (separated, determinate) reality. Thus we have been arguing, in motivation of our mathematical-physical engagement, and orienting ourselves into a move that Paetsch likens to an engagement of non-Euclidean geometry – we do not negate the validity or success of these spatial theories of time like Newton's and Einstein's, rather we seek to engage time not spatially but temporally, and this move requires us to abandon essentialism and representationalism.

Moments in our engagement will thus not be separated, determinate, static identities, rather the identity of a moment will be contingent on an internal relationship (Baradian apparatus), thus understood as an identity *in process*, from which we would say something akin to "moment x *from the perspective of* moment y". We thus affirm that x has no inherent, determinate, static identity of $x = x$ always and in complete isolation from all relations, from all contexts, rather x has an identity that is (for example) situated from the point of view of y. From a different moment, let's say z, we would thus have moment x *from the perspective of* moment z. We understand that moment x from the perspective of y is *different* from moment x from the perspective of z, thus we are on our way to better understanding on a conceptual level what we want to mathematically encode such that we can engage time while affirming a lack of identity, $x \neq x$. This resonates with our example of the moment of Jordan and Kaede first meeting at the piano bar, a moment which held an identity of embarrassment from one moment (we can say x from the perspective of y) and the identity of ambivalence from another moment (we can say x from the perspective of z).

76

> Maimon is important to Deleuze because he develops a logic of difference to support a genetic perspective. This perspective weds Spinozist immanence, Leibnizian differential dynamics, and Kantian critique—*fearsome!* The key to this perspective is that differential intensities enter into relations of reciprocal determination: "The differential elements unfold their ideal characteristic genetic potential whenever they enter into appropriate relationships of reciprocal syntheses" (Rölli 2016: 12). Maimon uses Leibniz's differential calculus to model the genesis of experience from differential intensities: differential intensities (dx, dy) generate intensities ($\frac{dy}{dx}$), intensities generate qualities (neighborhoods), and qualities compose objects (surfaces). Except at the final level (that of objects), real difference predominates. There are only differences in kind: no identities, no differences by degree. No need to speak of a "self', not even a local self: no global "identity" will unify these pulsating, infinitesimal, local neighborhoods. It is sheer perversity to subordinate bubbling infinitesimal neighborhoods to a placid global identity. Maimon's turbulent domain precludes global identification. Consider a differential element dx. Why does it repel identity? In itself, *it is unproductive*. It impels nothing—and what impels nothing has no properties that can identify it or that can be identified with it. Yet it is not nothing: it *becomes* productive when it enters into a reciprocally-determining relation with another differential element dy (Maimon 2010: 21). Thus, "in relation to x, dx is completely undetermined, as dy is to y, but they are perfectly determinable in relation to one another. For this reason, a principle of determinability corresponds to the undetermined as such" (Deleuze 1994: 172). Interactions amongst differential elements are local and generative. Determination is not negation, even if difference is ubiquitous. "Absolutizing" difference is refusing to couple "negation" and "becoming". Discarding "negation" is the price differential philosophy must pay to become genetic. One of Deleuze's key insights is that negation only affirms the forms of identity. (Paetsch 82-83)

We gloss another point of view of this relational determination of something indeterminate outside of any context in order to build intuition. A moment, like dx, is undetermined, which is to say lacks an identity. This is good! This allows for the dynamic aspect that we want. Intuitively, if we want to know what a moment is in general, from some fixed universal perspective, the answer can be no more specific than "it depends". A moment dx in a particular context, in a particular internal relationship, thus generates a sense of identity, the dynamic reciprocal determination of $\frac{dy}{dx}$. We can put this in the language of the virtual and the actual, where the virtual is dx and the actual is dy. The full depth of meaning we ascribe to an actual moment dy is through the way dy is informed, contextualized, constrained, in dynamic reciprocal determination with the virtual dx. Deleuze puts this in his own words,

> The differential dx affirms the triadic logic of expression: "The symbol dx appears as simultaneously undetermined, determinable and determination. Three principles which together form a sufficient reason correspond to these three aspects: a principle of determinability corresponds to the undetermined as such (dx, dy); a principle of reciprocal determination corresponds to the really determinable ($\frac{dy}{dx}$); a principle of complete determination corresponds to the effectively determined (values of $\frac{dy}{dx}$)" (Deleuze 1994: 171). (Paetsch 83, Footnote 124)

The moment related to the morning after Jordan and Kaede went to the club we affirm is indeterminate in itself. Like our discussions about the moment of Jordan and Kaede first meeting, the identity of this morning-after-the-club moment is in unending becoming through time and thus lacks a determinate identity, $x \neq x$, outside of a particular perspective in time. Choosing the perspective of the moment itself, as in, understanding the moment of morning-after-the-club from the perspective of morning-after-the-club, we see how this moment is still always already in a relational, process-theoretic, reciprocal determination. We turn to the virtual and the actual. The virtual, the past, informs, contextualizes, constrains Jordan in the present such that she knows Kaede treats her like a living person, which is something Jordan is looking to avoid. Thus Jordan expects this and sneaks out of their apartment before Kaede awakens. This moment came to be in this way through how the virtual, the past, informed, contextualized, constrained the actual, the present. This novel actual in turn acts upon the virtual, the past includes this now-gone moment and the whole identity of the virtual changes with this new piece added in to the mix because, by means of engaging time through a temporal continuity and not a spatial continuity, every part retains the whole within it, each element interpenetrating every other element, and thus any new element added to the mix changes the whole.

We depart from Deleuze with respect to using differentials as our mathematical encoding, but we have included the present discussion as a helpful heuristic.

[77]In order for structures to be built, they must have a ground. Jordan worked the levers up, down, swirling, dancing. The whole vehicle vibrated, hummed, punctuated by the abrupt arm movements that she was controlling. The first step was to make a cut. The insides were stuck, locked beneath a surface. It was their business to break barriers, exploiting the exposed. And here she was, their arm. Jordan jerked her arm, shifting the arm of the dredge. The smell of saline displaced the stagnant air of the control room as the water sprayed.

Land reclamation is haptic, not visual. Once a cut is made the loose sediment disperses, a noise of muck. Jordan couldn't see under the surface of the ocean. The dredge had become an extension of her own body. She scanned her arm's blades out in front of her. Jordan desired nothing more than to fade into the prestructured role of a dredge operator. Separated from all feelings. Machines aren't living, they aren't treated as living.

Thunk. The cabin shook. Jordan's arm found the next chunk of earth. Shifting more levers. The buzzing of the cutting, pulsing through the whole machinery, drowned out any footing of fixity. Kaede's previous presence had given what Jordan thought felt like a heartbeat, which she knew couldn't be right; she took it as another disrespectful slight, even if unintentional, of Kaede trying to convince her that she was alive. Jordan felt her not-heartbeat mimic the oscillating drone of the dredge. Entrainment. Returning to the stagnancy of the dead.

Her boss never went out on the dredge. This was grunt work, machine work. Hurt is easier to inflict when you don't have to see it. The feeling of the earth beneath her hiked up in resistance. Haptic, not visual. Levers. Pivot. Next line.

Jordan felt her mind mimic the oscillating drone of the dredge. Entrainment. Ripping up the floor through repetition. The conscious thoughts were embedding themselves as muscle-memory, movement of the body. Hurt is easier to inflict when you don't have to think about it. She loosened her grip on the lever, the dredge arm shifting from being her body to an object. Something she could touch. Something she could see. The trembling of the lever tickled. Was it scared too? Jordan took a step back, detaching herself from the machine more – who was she? Was her whole identity as simple as being the operator of this machine?

Jordan broke her fixating glare to look out towards the rest of the sea, briefly thinking of her father and the way he must have valued this place, remembered this place. She wanted to see blue again, maybe transparent enough to see the fish, the coral, the urchins, a family of different entities living together to construct their own home. Instead she saw the black wake of a corporation. And a rowboat inching its way to the arm. Jordan jumped back to the controls, twisted the key, turning it off.

78

> Making the ontological nature of this indeterminacy explicit entails a rejection of the *classical metaphysical assumption that there are determinate objects with determinate properties and corresponding determinate concepts with determinate meanings independent of the necessary conditions needed to resolve the inherent indeterminacies*. (Barad 127)

Learning from Bohrian phenomena and Baradian apparatuses, we understand that through affirming time, including the lack of identity of a moment in unending becoming, in process, we are affirming an indeterminate ontological nature, which conclusively puts us outside the realm of essentialism, representationalism, and the Newtonian algorithm.

79

> Since individually determinate entities do not exist, measurements do not entail an interaction between separate entities; rather, determinate entities emerge from the intra-action. I introduce the term "intra-action" in recognition of their ontological inseparability, in contrast to the usual "interaction," which relies on a metaphysics of individualism (in particular, the prior existence of separately determinate entities). A phenomenon is a specific intra-action of an "object" and the "measuring agencies"; the object and the measuring agencies emerge from, rather than precede, the intra-action that produces them. Crucially, then, we should understand phenomena not as objects-in-themselves, or as perceived objects (in the Kantian or phenomenological sense), but as specific intra-actions. (Barad 128)

It is helpful to adopt Barad's language of intra-action. It's use emphasizes for us that the moment x has no identity in isolation, it has no essence, but when put in internal relationship, as the moment undergoes its becoming, its process, in time, as understood through examples like "moment x from the perspective of moment y", these relationships are *productive* of what we understand as the moments x and y. The term "intra-action" stresses and keeps mutually implicative, internal relationships as productive of relata at the forefront of our intuition as opposed to falling back into old spatial, essentialist habits of understanding all relationships as external, all relata as constituted prior to relationships.

> The primary ontological unit is not independent objects with inherent boundaries and properties but rather phenomena. In my agential realist elaboration, phenomena do not merely mark the epistemological inseparability of observer and observed, or the results of measurements; rather, phenomena are the ontological inseparability/entanglement of intra-acting "agencies." That is, phenomena are ontologically primitive relations—relations without preexisting relata. The notion of intra-action (in contrast to the usual "interaction," which presumes the prior existence of independent entities or relata) represents a profound conceptual shift. It is through specific agential intra-actions that the boundaries and properties of the components of phenomena become determinate and that particular concepts (that is, particular material articulations of the world) become meaningful. [. . .] In other words, relata do not preexist relations; rather, relata-within-phenomena emerge through specific intra-actions. (Barad 139-140)

This is felt in our science-from-within as opposed to science-from-without, our embodied example and experiment of storytelling. We don't proceed by talking about moment x as if it were an extensionless point on a number line, rather in order to demonstrate and engage the structure of temporal continuity we walk in the shoes of a character's story in order to understand how a moment is in itself indeterminate, how the perspective from a particular moment determines the identity of the moment from one point of view, and how processes in time are productive of an unending becoming of a moment's identity as demonstrated through understanding a moment's identity from different perspectives.

> [T]heorizing and experimenting are not about *intervening* (from outside) but about *intra-acting* from within, and as part of, the phenomena produced. (Barad 56)

We are not constructing a model from a distance, abstracting ourselves out, we are understanding time *through* our lived experience.

What an actual moment dx *is* is grounded and impelled by its virtual, dy, all of its past moments. To not include dy in the productive process of dx is to ignore the constitutive role of the process. Different virtuals in a Bohrian phenomena relate to different phenomena, phenomena that produce different actuals. It is in this sense that we understand what we said earlier about a moment of the universe never being able to repeat itself, that neither time travel nor a divine ordering of all particles back to their same positions are able to reach the same Bohrian phenomena of a moment because time must pass in either of those hypotheticals, and time passing changes the virtual, and a different virtual involved in our Bohrian phenomena is productive of a *different* actual, which produces a different virtual, which produces different actual. . .

We intend to reach constructions about time that are separate from our experience, the topological invariants that persist across all "modes of being" of time, these topological properties are inclusive of change due to the emphatically local nature of each instantiation, they are inclusive of variable subjective experience, arrived at through subjective experience.

80

> It might be said that the epistemological framework that Bohr develops rejects both the transparency of language and the transparency of measurement; however, even more fundamentally, it rejects the presupposition that language and measurement perform mediating functions. Language does not represent states of affairs, and measurements do not represent measurement-independent states of being. (Barad 138)

Summing up, in our now grounded discussion in relation to time, our Baradian apparatuses are relationships between lacking-identity, individually unproductive moments, Deleuzian differentials dx, dy, such that a measurement is the productive, determinate, process, internal relationship of creation between the two relata. Thus the moment dx as an essence behind the relationship is not understood from the measurement context of $\frac{dy}{dx}$. $\frac{dy}{dx}$ is a Bohrian phenomena, there is no inherent Cartesian cut between them in reference to two eternal, rigidly-defined essences of dx and dy except in abstraction.

> Questioning the basis of the Newtonian tradition, Bohr refuses to take for granted the delineation of the "object" and the "agencies of observation" and makes the constitution of this "inside" boundary the centerpiece of his analysis. In particular, he emphasizes that the cut delineating the object from the agencies of observation is enacted rather than inherent. (Barad 142)

Our moments are mutually implicative, reciprocally determining, productive of each other. Using Deleuze's differential notation once more, what this means in practice is that the moment dx might have a certain identity, a certain boundary, from the perspective of dy (encoded as the measurement context $\frac{dy}{dx}$), however the moment dx might have a completely different identity, a completely different boundary, from the perspective of dz (encoded as the measurement context $\frac{dz}{dx}$). Thus we can say the identity of the moment dx is in process, in unending becoming. But we must again be clear: dx itself possesses no identity, the cut made between $\frac{dy}{dx}$ is in abstract because it is an ontologically whole Bohrian phenomena.

[81]Pushing open the window, Jordan looked down the ten or so feet to the surface of the water. Waves splashing against the hull finally had their voice now that the drilling and vacuuming procedure was paused. Another voice pierced the background noise.

"Permission to come aboard?"

The dredge itself wasn't that large. Sixty feet long, give or take, it didn't rise too high, the control cabin sat right atop the deck on the far end. It was safer than the smaller ones. This wasn't one of those war machines. Maybe that's where Jordan needed to be to reach her true mechanical self. The woman in the rowboat could easily pull herself up if she wanted to. Jordan opened the cabin door to walk towards her, yelling down, "Sure."

Jordan helped her onto the deck then watched her tie her boat to a metal beam. "What are you doing out here? Don't you know this is dangerous?"

The woman tucked the last of the rope around itself. She looked straight at Jordan. "I was going to ask you the same thing."

"I have the necessary training. I have the necessary permits. This isn't dangerous."

"Maybe not for you. There's an entire marine ecosystem that you are disrupting."

"I've got a permit from the state environmental conservation agency too."

"I don't care about your permits or what government bodies have approved. I care about what you are doing. Look at this water." She motioned her hands around herself.

"It's agitated sediment. It was always here. It will settle down."

"But do you understand what you are doing until then? That agitated sediment," her tone mocked Jordan's phrasing, "is adjusting the environment to be less oxygenated. Fish are either dying or leaving. Your vacuum is sucking up fish too young to swim against it, sucking up eggs before they hatch."

"Look, this isn't my decision. Take it up with my boss. I'm just doing what I'm told. I think you should leave."

She listened, untying her boat. "I didn't come out here to sabotage. I believe people know right from wrong. I came out here to make sure you understood what you are doing."

Being treated like a person was exhausting. Jordan waited a few minutes for the woman to escape the immediate area. No one should be here unless they wanted to get hurt. She twisted the key; the body pulsed to life. Peering out the window to make sure she was a safe distance away; the woman did not avert her gaze. Jordan had been here before. Driving people away. Anywhere but here. Here is where things get hurt. Here is where cuts are made. Here is where they'll lose oxygen; asphyxiating, drowning. Jordan gripped the levers and continued the process.

The light on the satellite phone blinked. Jordan shut her body off again, picking up the receiver. "This is Jordan."

82

> *Performative* approaches call into question representationalism's claim that there are representations, on the one hand, and ontologically separate entities awaiting representation, on the other, and focus inquiry on the practices or performances of representing, as well as the productive effects of those practices and the conditions for their efficacy. A performative understanding of scientific practices, for example, takes account of the fact that knowing does not come from standing at a distance and representing but rather from *a direct material engagement with the world*. (Barad 49)

The way we are engaging in the embodied example of storytelling, where we do not attempt to abstract ourselves away but rather embrace our role in processes, the way we are walking through the motivational process of how and why we are engaging time, constructing a mathematical-physical regime that can be empirically felt and tested in our own lived experiences, these are part of conducting a science-from-within where internal intra-acting relations are productive of their respective relata, a performative science.

> A *performative* understanding of discursive practices challenges the representationalist belief in the power of words to represent preexisting things. Unlike representationalism, which positions us above or outside the world we allegedly merely reflect on, a performative account insists on understanding thinking, observing, and theorizing as practices of engagement with, and as part of, the world in which we have our being. (Barad 133)

Recall, a story always begins in the middle, Deleuze's rhizome has neither beginning nor end but always a middle, we are engaging things from *within*, from the *middle*, this is what it means to be a part of the process.

83

> What often appears as separate entities (and separate sets of concerns) with sharp edges does not actually entail a relation of absolute exteriority at all. Like the diffraction patterns illuminating the indefinite nature of boundaries—displaying shadows in "light" regions and bright spots in "dark" regions—the relationship of the cultural and the natural is a relation of "exteriority within." This is not a static relationality but a doing—the enactment of boundaries. (Barad 135)

Barad is connecting to what we've discussed as mutually implicative, dipolar, genetic relationships. The layer we are adding now is that we are understanding these genetic, internal relationships not as static beings, eternal essences, already constituted objects, but as processes themselves, an active engagement rather than a passive gazing. To better understand this we turn to the example of what gender is, what gender means.

> Building on Foucault's critique of representationalism, Judith Butler's influential theory of gender performativity theorizes the gendered constitution of the subject. As Butler emphasizes, gender is not an attribute of individuals. Rather, gender is a doing, not in the sense that there is a pregendered person who performs its gender, but rather with the understanding that *gendering* "is, among other things, the differentiating relations by which. . . subjects come into being" and "the matrix through which all willing first becomes possible" (1993, 7). Gendering, Butler argues, is a temporal process that operates through the reiteration of norms. In other words, Butler is saying that gender is not an inherent feature of individuals, some core essence that is variously expressed through acts, gestures, and enactments, but an iterated doing through which subjects come into being. (Barad 57)

Gender isn't deduced from who a person is, who a person *is* is neither *completely given* nor fixed, rather gender is a doing, unending-becoming, a process in time, creative and productive of gender identity. Our engagement of time is similarly not a deduction from something *completely given* nor fixed. Like the example of gender, a moment has no prior determinate identity, but rather through processes in time, active doings, a moment and its relations are generative of an identity, an identity that does not remain fixed but continues to evolve in time; through which we seek to engage by means of the embodied example of storytelling, through having the reader walk in the shoes of particular lived experiences, through encouraging the reader to apply our engagement to their own lives, their own experiences.

[84] "It's almost evening. How's it coming out there?"

Jordan looked at her watch. Time flew by. "Pretty much done with the excavation."

"That's great, really great. Do you think you could stay out there a little longer? Just leave it running, maybe retread some of the area around you?"

"Why?"

"We made a deal with the Demersal Aquarium, they're in the process of building a jellyfish exhibit and I told them we could help them out."

"How would we be able to do that? What does running the machine do?"

"Jellyfish are quite invasive and they can thrive in all sorts of environments. If we keep the fish out, the jellyfish will come through to eat the plankton no one else is eating."

"Isn't that deliberately harming the environment?"

"Who's to say? The aquarium is going to be able to showcase some beautiful stuff. Maybe the exhibit does more than offset through inspiring environmental action. Jordan, this doesn't matter. None of this matters. Just do what you're told, okay?"

85

> As Butler notes, the "controversy over the meaning of *construction* appears to founder on the conventional philosophical polarity between free will and determinism" (8). She promptly rejects both options, indeed the very binary conception of causality, and insists that what is needed is a radical rethinking of the nature of identity. Butler proposes that we understand identity not as an essence but as a doing. In particular, she suggests that gender is not an attribute or essential property of subjects but "a kind of becoming or activity. . . an incessant and repeated action of some sort" (Butler 1990, 112). Butler cautions that this claim—that gender is performed—is *not* to be understood as a kind of theatrical performance conducted by a willful subject who would choose its gender. Such a misreading ironically reintroduces the liberal humanist subject onto the scene, thereby undercutting poststructuralism's antihumanism, which refuses the presumed givenness of the subject and seeks to attend to its production. Crucially, the performative "is not a singular act used by an already established subject, but one of the powerful and insidious ways in which subjects are called into social being from diffuse social quarters, inaugurated into sociality by a variety of diffuse and powerful interpellations" (Butler 1997a, 160). As Butler explains, "the 'I' neither precedes nor follows the process of this gendering, but emerges only within and as the matrix of gender relations themselves" (1993, 7). That is, gender performativity constitutes (but does not fully determine) the gendered subject. (Barad 62)

We again ground our unending becoming, our process-theoretic, temporal understanding in the concrete example of gender. Temporal processes are productive of objects, thus we cannot say that there exists always already an essence to a person, to Jordan, such that Jordan chooses, wills, acts the part of her gender. Rather who Jordan is, from the perspective of gender, is generated through the temporal process of the production of gender: becoming-woman is a process that involves both Jordan's non-theatrical performance of woman but also of the boundary creating intra-action that Jordan's performance draws with respect to the temporal process of what "woman" or "becoming-woman" come to mean.

We are driving towards a new construction of causality. Earlier we discussed that an engagement of time that does not include the virtual restricts its understanding of causality to the efficiently causal. For example, in physics, an object's movement is only understood through the ways it is being directly impacted, either by another object or by a force. Embracing the virtual, and with it the dynamic reciprocally determining relationship between the virtual and the actual, having no fixed stability in either the conditions or conditioned, has us embracing an indeterministic picture, where the future of a system cannot be fully given because the virtual itself, the ways in which the past inform, contextualize, constrain, is in process, in unending becoming, having no fixed identity, grounding and impelling the actual without fully determining it because the identity of the virtual and the way in which it is productive of an actual is picked out only when a Baradian apparatus, a new relational moment, a Deleuzian $\frac{dy}{dx}$, is picked out, that is, a relationship that changes, augments, the continued unending becoming of each the virtual and actual.

Butler is throwing out the binary between determinism and free will, as conceived as being between a strict determinism (everything is *completely given*) and strict freedom (no causal determination whatsoever). We agree with this move. Our indeterministic picture is not one of strict freedom, it is inclusive of the efficient causality that physics currently operates with.

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> As Bohr points out, the inseparability of the object from the apparatus "entails. . . the necessity of a final renunciation of the classical ideal of causality and a radical revision of our attitude towards the problem of physical reality" (Bohr 1963b [1949 essay], 59-60). While claiming that his analysis forces him to issue a final renunciation of the classical ideal of causality, that is, of strict determinism, Bohr does not presume that this entails overarching disorder, randomness, or an outright rejection of the cause-and-effect relationship. (Barad 129-130)

The virtual informs, contextualizes, constrains, the space, the topology of the system in question. We must reconceive causality. Our first step has been following Barad and Bohr into an indeterministic picture that is neither strictly deterministic nor strictly indeterministic. We retain efficient causality as understood by the Newtonian algorithm, but through Bohr we understand that quantum mechanics shows inescapable discontinuity and indeterminism with respect to novel Bohrian phenomena, that is, we understand that objects are not always already constituted but rather in process, in unending becoming, which is not strictly deterministic but rather constraining of the system. The ontological and epistemological lessons that we learned through the quantum mechanical examples is the metaphysics that we orient ourselves with when it comes to time; affirming time's reality meant affirming the real productivity of time, creation, which meant affirming creation over discovery, which meant renouncing essentialism.

> First of all, it is important to realize that this new sense of causality cannot be founded on a simple combination of classical options such as the following: there is, on the one hand, absolute freedom in our choice of apparatus, and, on the other, a strict deterministic causal relationship whereby objects simply "do their thing" once the apparatus has been chosen. This combination is neither as rich nor as subtle as what I believe Bohr had in mind, or should have had in mind, because each of these elements is premised on the contested inherent or Cartesian dualism. But neither is this to suggest that human beings determine the outcome or play an "interventionist role," stepping forward, tweaking a few dials, and stepping back to watch, since these kinds of claims are also conditioned by the same contested dualisms. Second, causality is too often conceptualized as a binary affair: either a situation of strict determinism applies (i.e., causal determination) or there is a state of freedom (i.e., no causal determination). However, there are more ways to think about causal relations than the usual choices between determinism and free will. Since traditional formulations of causality assume that independently determinate entities precede some causal interaction, we are clearly already on very new ground. Third, the fact that scientific results are reproducible requires (or at least seems to require) that intra-actions entail some kind of causal structure—that is, something being the cause, and something the effect—otherwise it would be impossible (or at least very difficult) to account for the reproducibility of experiments. Finally, it seems important to consider whether it even makes sense to attribute the notion of agency solely to human beings, since this particular conception already seems to be undone by the analyses we have been considering. Indeed, the issue is not merely who or even what gets to have agency or whether or not culture or nature determines a particular outcome, but also what the notion of intra-actions tells us about the nature of causality such that we will be able to account for how the distinctions between "nature" and "culture," "human" and "non-human," and "science" and "society" are produced, what that production entails, and how we are to understand the nature of agency. (Barad 130-131)

It is this direction of a reconceived causality, one inclusive of the genetic, internal relationships that characterize how the virtual informs, contextualizes, constrains the actual, such that we can meaningfully engage not just the actual but also the virtual, where we now direct our attention.

[87]Jordan had docked the dredge, standing on the dirt beach looking out at the water. The moon offered no further help, she still couldn't see beneath the surface. Reduced to an instrument of someone else's destruction. Hurting anyone, anything in her path. Jordan knew that she was dead but she still didn't want to actively hurt others. It was strange. She waded into the water. Knees. Waist.

"Mmph," Jordan's leg convulsed. Stung. A dull green glow surrounded her. Jellyfish were already here. Thriving in conditions where nothing else was supposed to. She tried to catch one in her hands, but their bodies were too fluid, unformed, morphing, always on the move. Free. Not held captive by a relationship, not held captive by a disease, not held captive by a corporation, not held captive by even any sense of a rigid body. Everything was in flux. A true freedom, one that couldn't be co-opted as someone else's arm of oblivion.

More stinging, all across her arms, even through her clothes over the rest of her body. Consumed by individual small jolts pain. Blurring together to form a background of static, white noise, a raised noise floor, a new normal. Not really here, not fully formed.

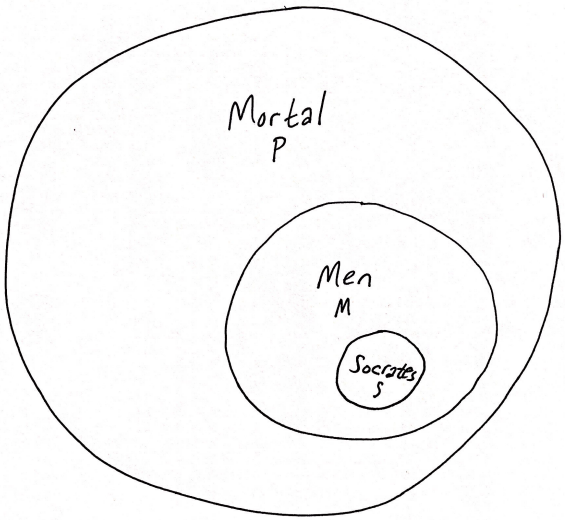
Jordan sunk herself into the darkness, submerging her whole body.

[88]The erasure of time entails an equivalence between temporal process and logical implication, no time has to pass in order to know the future because the real production of time, creativity, is erased, rather everything is already *completely given* for discovery, which requires no time at all. This can be felt in projects entirely built on methodologies of deduction and reduction, which as we discussed earlier posit a fixed, static class that allows for these methods to do work (fixed, static axioms from which to deduce or fixed, static simple-parts to which to reduce respectively, where no temporal process is necessary to reach conclusions via deduction or reduction, rather those conclusions are always already there and can be determined in no time via logical implication).

> The output is logically implied by the input and the program. [. . .] This logical determination requires no time, because no physical process is involved. [. . .] This is the sense in which time is removed from the description of physics within the Newtonian paradigm. It is unnecessary to actually run the computer to know what the output is, because the output can be deduced by a sequence of logical arguments. How the deduction is carried out is irrelevant; the computer is just a tool exploiting the laws of physics to model a logical implication through a causal process. [. . .] What the Newtonian paradigm does is replace causal processes—processes playing out over time—with logical implication, which is timeless. (Smolin 50- 51)

Thus projections that do work via deduction or reduction are already erasing time with how the problem is being set up. Against this, we affirm that temporal processes are indeed *processes in time* and we likewise affirm that time is productive of novel creation against the view that everything is already *completely given* except to *our knowledge* and only requires our discovery. This means that the virtual must be taken seriously as the virtual is what grounds and impels the actual in time. What this means in practice is that temporal processes and logical implication are *distinct*.

> However, by this very assertion, a determinist encounters a difficulty which, in my opinion, is insurmountable. It is known that any logical implication is *ex definitione* non-temporal. It is a commonplace in elementary courses of logic to distinguish logical implication, which is outside of time, from the psychological process of inference by which we deduce a conclusion from premises. Although, psychologically speaking, the conclusion is *preceded* by the premises, that is, preceded in the temporal sense, it nevertheless remains true that, logically speaking, there is no succession, no unrolling, in the temporal sense of the word. And let no one be deceived by the ambiguity of the word "flow"; *there is no logical flow in the temporal sense of the word.* If we say that the conclusion "flows" from the premises, we are using this word only in the metaphorical sense. A logical antecedent is not a temporal antecedent; a logical consequence has nothing in common with temporal succession. The premises are not, in the temporal sense, *before* the conclusion, and, in the same way, the conclusion does not *follow* the premises in time. It is more exact to say that the conclusion *preexists* in the premises or that it is *contained* in them logically. We *discover* it after the premises in the actual process of human thought, but we do not *create* it by that process itself. The simultaneity of the conclusion with the premises can be illustrated in a convincing way by analyzing a form of classical syllogism: All men are mortal; Socrates is a man; consequently, Socrates is mortal. Or, in symbols: All M are P; all S are M; consequently, all S are P. It is obvious that the expression "consequently" has no temporal meaning. One is easily persuaded of this if he draws the famous Euler's circles, which symbolize the classes, or the logical extensions in question. Not only is class M contained in class P at the *same time* that class S is contained in class M but it is easy to see that class S is contained at the same time in class P. In other terms, the conclusion and the premises are *simultaneous*. The very possibility of symbolizing logical relationships of inclusion by spatial diagrams whose parts are, by their very nature, *juxtaposed*, therefore *simultaneous*, is the reason for this. For there is not a trace of succession in the relationship of inclusion, that is, in the relationship of container and contents. Unquestionably, every conclusion *coexists* in the logical sense with its premises, although it is *thought* and *pronounced* after the premises. We must not confine our attention to one particular example of the traditional syllogism, for the pre-existence of the conclusion is postulated in every valid reasoning. That is why we say that we *discover* the truth, instead of saying that we *create* it. (Capek 152-153)



The form of the Euler circles demonstrating the logical implication of the Socrates example is thus separate, distinct from our engagement of time, where through affirming its reality we are affirming the real productivity of time, creativity, where temporal processes are *necessary* to reach outcomes due to the dynamic, reciprocally-determining relationship of the virtual and the actual and the indeterminacy of an actual moment that is informed, contextualized, constrained but not fully determined by the virtual. We intend to give an example, but must flag at the outset that our example is necessarily inadequate, a shifting from the virtual-actual to the possible-real. After Jordan docked the dredge she was mesmerized by impenetrable darkness, tantalized by the ability to ensure her deadness through a suicidal affair with the water, perhaps also wishing to be closer to her father during a time of profound discomfort throughout every corner of her life, the reasons are indefinite in number, what we care about is Jordan's decision to go into the water. If temporal processes were equivalent to logical implication, an erasure of time and the real productivity of time, creativity, then once we had Jordan docking the dredge we could say, by implication of the current situation, that she would absolutely go into the water and the story of her life would play out as described. This is not the case. Jordan could have melted into her desired indifference as a machine operator, Jordan could have gone home to a conversation with Kaede, Jordan could have ran away somewhere, Jordan could have tempted suicidal ideation in a myriad other ways, all of which would not seem like outlandish, preposterous paths for Jordan's storyline to traverse. Jordan's virtual informs, contextualizes, constrains her actual, we know it *wouldn't* have made any sense for Jordan to get off the boat all smiley, lovey-dovey, buying flowers for Kaede, and proposing an adventure to go on, it would come off as her history, the story we've read thus far that got us to this place, not mattering to the present moment. We called attention to our shifting to the possible-real because the examples we are giving are all possibles, given in the image of a specific virtual-actual, backwards projected now that time has already elapsed, and given by means of mutually external, mutually exclusive possibilities which efface the mechanism of creation from time.

> Just as in the classical syllogism the inclusion of class S in class P coexists with the two inclusions symbolizing the two premises, so in the solving of a mathematical equation, for example, the "unknown" quantity is *determined in advance* without any ambiguity; thus it is *unknown only to us*, and we discover it in the same way that Columbus discovered America. We say that the solution is simply *waiting for* our discovery, that it exists, so to speak, before our discovery, just as the American continent existed *before* the voyage of Columbus. In the same way, if the future is determined in all its details and without any ambiguity, have we not the right to conclude with Laplace that it is already present and that it is merely waiting to be unveiled to our limited consciousness? (Capek 153-154)

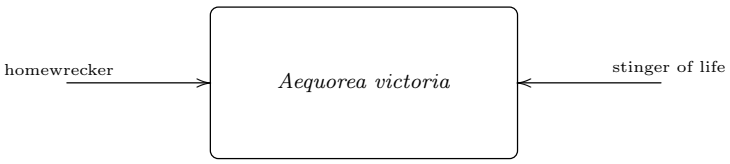
The possibilities are not known ahead of time because each actual moment is grounded and impelled by means of an ever-changing virtual, where the conditions do not resemble the conditioned. The next moment is created by this dynamic, reciprocally determining relationship, it is not discovered from the vantage of a homogeneous, static, fixed, eternal temporal space.

[89]The stinging made each part of her body twitch uncontrollably, independently, on its own reflexes, separating away the fully formed unit of Jordan's-body, pushing towards a formless mass of cells. Becoming-jellyfish.

Jordan was alive as long as she wasn't being held captive by her body, by her job, by love. She came back to the surface and took a deep breath of fully desired air. The jellyfish were going to be condemned to a life of captivity if she didn't do something.

Her arms were now numb, fashioned for the very occasion. Jordan swam to shore and grabbed her bag. Multiple trips between the ocean and the bed of her truck, dumping the jellyfish in, a portable pool of glowing green slime.

90



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> But, if we read carefully the works of those who defend the indetermination of the universe in the name of the reality of time, we see that their indeterminism is far from being absolute. The temporalistic philosophers, or, as they are called in English-speaking countries, the "process-philosophers," insist vigorously on the continuity of the past with the present, on the cohesion of the successive phases of becoming. Reread the passages of William James on the stream of consciousness or on the continuity of the perceptual flux; reread Bergson, especially that passage, so infrequently quoted, in *Matter and Memory*, where he affirms that creation is never *creatio ex nihilo* because each present moment is colored by its past; reread Whitehead when he speaks of "causal efficacy" in nature. What, then, is the difference which separates them from the classical determinists? There is only one: when they speak of connection, of continuity, of cohesion of cause and of effect, they affirm that this connection, this continuity, this cohesion, is *temporal* in the true sense of the word, and as such it cannot be the equivalent of static connection, of logical implication; consequently, that it must contain an element of *irreducible novelty*. (Capek 160)

Our reconception of an indeterministic causality comes from this affirmation of the distinctness between temporal process and logical implication. Because we affirm that time has a structure, that temporal continuity has topological invariants, when we speak of indeterminism of temporal processes we do not claim to be left with a jumbled mess from which nothing can be said or can be engaged. The virtual grounds and impels the actual, constitutes (but does not fully determine) the actual. Understanding the ways in which a system is constrained, informed, contextualized, is much more of an engagement than not being able to say anything at all about a system whatsoever, but it is admittedly less precise than the deterministic, essentialist methodologies. We affirm that this imprecision is in fact more accurate, better matching empirical experience via the affirmation of time, and is a causality inclusive of a wider array of events.

Making clear the distinction between logical implication and temporal causality makes clear the distinction between discovery and creation, which makes explicit the stakes involved: the existence of novelty and creativity. There is no sense of temporal succession in logical implication, and as a result, there is no sense of creation as the answer arrived at is not created as the result of a process in time but rather deduced via a logical implication, which is to say, an answer, an essence, an already determinate object with a fixed definitional boundary that was always already there from the start has been found, discovered by a previously deficient subject that has now attained the *completely given* information available. The subjugation of temporal causality to logical implication is a tradition we are rebuking. These are two separately meaningful, independently useful ideas.

[92] "When was the last time you went to an aquarium?" The kind of questions that Ann needed them to think about were a delicate balance: obscure enough for the brain to undergo a localization process, not a simple verbal regurgitation of a story they've told to others or themselves, something that could uncover details with focus, while not being too obscure so as to be impossible to answer or impossible to localize. Ann's patient seemed to be stuck in thought, perhaps this question was too restricting.

Ann attempted to widen the net. "Have you ever been to an aquarium before?"

"I don't know," Victoria said. "I mean, I'm sure I have everyone's been to an aquarium, right?"

The neuroimaging would be ineffective if Victoria wasn't actively working, swimming, localizing through her own memories, feelings, thoughts, senses. Ann needed to guide her.

"Tell me about your time there. Was it the one here in town?"

Intensity took over her face once more. Bow out. New approach.

"Why don't you tell me about a memory that you do remember instead?"

"My daughter and I got into a fight."

"Concrete details, Victoria, the more specific the better; what's your daughter's name?"

"Jordan."

Ann grabbed the counter, unable to hold herself in place, knotted tongue. She swallowed. "And what did you fight about?"

"My husband's been dead for as long as I can remember, which isn't saying much. We go to his favorite beach on the anniversary every year, we even spread his ashes there at some point. It's where we go to visit him. She works for a company that's going to destroy it, and she's going to be the one that does it."

Ann listened intently, flustered, looking for stability in the words presented to her. "I see."

"I haven't been remembering things lately. Jordan used to help me out but I haven't seen much of her since that fight. I need to be able to take care of myself."

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> For example, if p = 'Socrates is in Athens' and Q = 'Socrates is in Greece,' Socrates being in Greece does not determine his being in Athens, though it does condition the possibility of the latter. (Conversely, his being in Athens does determine his being in Greece—thus the asymmetry of internal relation via logical implication.) This is analogous to the case in quantum mechanics such that in the spin $\frac{1}{2}$ system,
>
> $$|\Psi >= \alpha|\psi \uparrow> |\phi \uparrow> |e \uparrow> +\beta|\psi \downarrow> |\phi \downarrow> |e \downarrow>$$
>
> $|\Psi >$ is a vector of unit length and thus representative of the actual (though indeterminate) state of the composite global system and its facts prior to the measurement outcome. $|\Psi >$, for example, thus represents the *implicate* in the statement $|\psi \uparrow> |\phi \uparrow> |e \uparrow> \implies |\Psi >$ (read, $|\psi \uparrow> |\phi \uparrow> |e \uparrow>$ *only if* $|\Psi >$). These facts subsumed by Ψ condition, but do not determine, the novel predicative outcome fact (in this case, either eigenstate $|\psi \uparrow> |\phi \uparrow> |e \uparrow>$ or $|\psi \downarrow> |\phi \downarrow> |e \downarrow>$) generated by measurement. This indeterminacy is reflected, for example, in the fact that each eigenstate (i.e., each *implicans* of the internal relation) is always evaluated as a probability, via the complex coefficients α and β, respectively $\alpha|\psi \uparrow> |\phi \uparrow> |e \uparrow>$ and $\beta|\psi \downarrow> |\phi \downarrow> |e \downarrow>$–with $|\alpha|^2 + |\beta|^2 = 1$. (Epperson 141)

In the example of Socrates, if we determine that Socrates is in Greece, we cannot say with any certainty that Socrates is in Athens, however, we *do* change the system we are exploring such that the probabilities for us to determine Socrates is in Athens *before* determining Socrates is in Greece is *different* than the probabilities for us to determine Socrates is in Athens *after* determining Socrates is in Greece. We can intuitively understand this by guessing that the chances Socrates is in Athens after knowing he is Greece is much more likely than if he were to be anywhere at all.

However, the example of Socrates uses ontology and epistemology of the Newtonian algorithm, that there are always already constituted objects, essences (here Socrates) that have fixed properties associated with them (here position). We've followed Barad through orienting ourselves on the problems these ontological and epistemological stances take in quantum mechanics so that we could better orient ourselves for engaging time which, similarly, we have motivated and argued does not operate within essentialism or representationalism. In the example of the quantum mechanical system given, we have constructed a particular system such that our particle in question can either read upon measurement 'spin up' or 'spin down'. $|\Psi >$ encodes the entire wave function complete with the probability distribution between these two possibilities, α and β are coefficients related to the weight of each probability for each of these possibilities, $|\psi > |\phi > |e >$ is the system, apparatus, environment respectively, all put together because, as we saw with Barad and Bohr, there is no inherent distinction between these in quantum mechanics. Thus we could imagine replacing this triple with a single encoding that stands for a 'Bohrian phenomenon' which we understand to be the inherently inseparable combination of these three components: system, apparatus, environment. We understand that our measurement outcomes are not the discoveries of properties that are eternal and static of always already constituted, well-defined objects, but are rather the creation of particular measurement outcomes that were previously indeterminate in reference to the whole Bohrian phenomenon which subsequently constitutes the relata involved, what was before an indeterminate probability density becomes a determinate measurement, and we can understand and ground this as a process in time as opposed to dealing with deduction via logical implication, the experiment *has to run* to get the real output.

The specifics of the situation, what our system is, what our apparatus is, and what our environment is, *condition* what probability states there are (spin up and spin down) and what each of their respective probabilities are (α and β), but these specifics do not *determine* if the system is spin up or spin down. This is the sense in which we seek to reconceive causality. The virtual informs, contextualizes, constrains the actual in the same way that our choice of system, apparatus, environment (Bohrian phenomenon) conditions (but does not fully determine) the possible states and their respective probabilities.

We make reference to our previous discussion regarding the causal chain of Jordan's life after docking the dredge. There are clearly "possibilities" that would not make any sense given the virtual that is grounding and impelling her actual, but the virtual does not fully determine what will happen next, temporal processes are not equivalent to logical implication, and thus we can understand Jordan's future in that moment as being similar to the quantum mechanical system above, where there are a number of possible options (spin up, spin down) that make sense given the virtual for that particular moment, each having an associated probability, and through which the only way to determine the outcome is by *running the experiment* of Jordan's life in that moment. We must flag again that we have entered the realm of the possible-real. If we were to stay in the realm of the virtual-actual, as is our intention, there would not be a delimited set of mutually external, mutually exclusive possibilities each with an associated probability such that the principle of excluded middle (*at least* one is true) and the principle of noncontradiction (*at most* one is true) hold; these are features of the actual in separation of the virtual.

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> Thus, quantum mechanics requires a different kind of probability conditionalization rule than its classical analog—namely, *one that depicts the evaluation of quantum observables as a fundamentally asymmetrical relational process*. To further clarify this point, consider that the conventional ontological implication of commutativity in classical mechanics is that the order of observation (i.e., the order of predication via measurement) is irrelevant because all observables are thought to possess well-defined values at all times, regardless of whether or not they are measured. But in quantum mechanics, this is not the case; asymmetrical probability conditionalization evinces that the act of observation is generative of novel facts, not merely revelatory of pre-existing facts. That is, outcome states yielded by quantum mechanical measurement are not merely *revealed subsequent to measurement,* but *rather generated consequent of measurement*, as evinced by the Heisenberg uncertainty relations as well as other equally fundamental principles of quantum theory. The outcome states generated by quantum mechanics, then, are properly understood as ontological events, not merely epistemic qualifications, and as such, their asymmetrical relational dependencies are likewise ontologically significant. For example, if a = 'opening a screen door' and b = 'walking through a screen door,' it is quite obvious why $(a \circ b) \neq (b \circ a)$. Each conjunction represents a possible physical state, but these states and their ingredient conditional probabilities are quite different (as anyone fortunate enough to witness this particular demonstration will verify). Thus the order of generation of predicative facts in quantum mechanics yields asymmetrical potential relational dependencies among these facts and among their measurement contexts. (Epperson, 45)

The asymmetry of the evaluation of quantum observables is due to this sense of internal relation that we are looking to engage. In the humorous example provided, where $(a \circ b)$ reads "a after b," the series of opening a screen door followed by walking through a screen door gives a different outcome than walking through a screen door followed by opening a screen door. To make the sense of internal relationship even clearer, we can isolate this down to just walking through a screen door (b) versus walking through a screen door after opening a screen door ($a \circ b$). Having the event a happen *conditions* the situation such that different states with new probabilities are available. Without a, then b is fundamentally different with respect to what states are available with what probability density. In the context of quantum mechanics, through our analysis with Barad, we understand a as a novel event, a Bohrian phenomena, what Whitehead calls an "actual occasion". Thus, the outcome at b is not discovered, "revealed subsequent to measurement," rather it is created, "generated consequent of measurement," an event whose actuality was conditioned by its asymmetrical internal relationships.

> Thus, when searching for Socrates ('measuring his position') the probability of discovering him in Athens is nonlocally, logically conditioned by his sighting in Crete. Classically, of course, this intuition is unremarkable since by that worldview, still regnant in our common sensibility, all physical observables are thought to possess precise values at all times. But quantum mechanically, as we have seen, measurement outcomes can only be understood as generated consequent of measurement, not merely revealed subsequent to measurement—an understanding that has been consistently confirmed empirically, against every attempted imposition of classical intuition upon quantum theory. The actualization of a potential measurement outcome, in other words, is always understood as a *novel* fact in quantum mechanics. (Epperson 74)

Finding Socrates in Athens with no prior information has a probability that is different than the probability of finding Socrates in Athens after finding him in Crete. But notice, as Epperson points out, we are already framing the problem in terms of the static: there is always already a determinate entity "Socrates" who always already has a determinate property "position", we are discovering, finding, revealing these always already determine things. Thus, this example does not force us to think outside of the bounds of a timeless essentialism as we must in order to affirm time. Quantum mechanics *does* force us to think outside these boundaries. A novel event, a Bohrian phenomenon, a Whiteheadian actual occasion is not something that is determinate ahead of time, we saw with Barad that Bohrian phenomena are creations, not discoveries. After the creation of an event, Bohrian phenomenon, Whiteheadian actual occasion, the topological space of subsequent events is altered (confer the opening of a screen door changing what it means to walk through a screen door). It is this changing of the space, the space that is productive of the possible states and their respective probabilities, that we refer to when we speak of a changing virtual that is informing, contextualizing, constraining an actual.

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> More broadly, then, the concept of 'evaluation of observables via quantum measurement' entail the totality of the process by which an initially indeterminate, uncontextualized actual state ψ, defined as an abstract integration of countless *potential* outcome states (where neither [principle of noncontradiction (PNC)] nor [principle of excluded middle (PEM)] hold) evolves, *by way of* its local Boolean contextualization in terms of some particular observable a, to become a reduced integration of *probable* outcome states a_1 or a_2, thus satisfying PNC and PEM, and terminating in the actualization α_1 or α_2 according to the probability valuations of a_1 and a_2 respectively. Thus in quantum mechanics probability presupposes actuality (as it does in classical mechanics) *and* actuality presupposes probability (which it does not in classical mechanics). Likewise, evaluation presupposes Boolean contextualization *and* Boolean contextualization presupposes evaluation. Evaluation and contextualization, in other words, as ontologically relational features of actuality and potentiality, are thus mutually implicative in quantum mechanics. Indeed, it is in light of this mutual implication that quantum indeterminacy can be more comprehensively understood—that is, beyond just the probabilistic character of quantum measurement; for while it is true that the evaluation of observables presupposes Boolean contextualization, it is never the case that the latter *determines* the former. Rather, evaluation is *conditioned* by Boolean contextualization, and this conditioning is indeterminate. (Epperson 50)

Our indeterminate, uncontextualized actual state ψ is the encoding of having an actual that is currently undetermined and uncontextualized. This ψ does not adhere to PNC or PEM because of its lack of contextualization: if ψ were referring to a system of an electron such that we want to measure a position, but we *don't* have the contextualization from the rest of the Bohrian phenomenon (no apparatus ϕ, no environment e), then we don't yet have a finite delimited set of possibilities with which we can ascribe determinate probabilities. Once we contextualize ψ (that is, specify ϕ, e) we obtain a set of possibilities each with an associated probability. The conclusion here is that evaluation and contextualization are another mutually implicative pair, such that neither side is a fixed, static, essence from which deduction from or reduction to can happen. Thus evaluation and contextualization are in their own dynamic reciprocally determining relationship as a process in time. This dynamism, this lack of a fixed ground, means that evaluation is conditioned by contextualization, but that evaluation is not determined by contextualization. As we saw in the earlier spin up, spin down example, the context of our $\psi\phi e$ does not determine spin up or spin down, rather it constrains the completely indeterminate Ψ into the informed, contextualized, constrained, conditioned understanding of having two possibilities (spin up, spin down) each with an associated probability.

It is this asymmetrical internal relationship that conditions but does not determine what we understand the relationship between the virtual and actual to be. The virtual conditions but does not determine the actual. The actual conditions but does not determine the virtual. The past is in the present by means of internal asymmetrical relational conditioning. This is distinct from an external relation of an efficiently causal picture, which has been up through now the full extent of the causal picture from the physicist's perspective. Our engagement of time thus requires a generalization of causality from how it is typically thought. We are engaging Epperson and Zafiris to understand this causal mechanism of internal relationship that the virtual and actual use, but we must again caution that within the virtual-actual there is not a distinct set of possibilities each with an associated probability such that realization abides by PNC and PEM. We are intent on learning about internal relationships while being aware of this wrinkle.

[96]None of the indicators showed up. Ann had introduced a stony coral fluorescent protein, Kaede, into Victoria's brain. The idea was to find the presence of certain cells, certain proteins she had been researching such that during memory recall if they appear, if they activated then the Kaede will be with them, following them, not letting them go out of sight, glowing red for Ann.

Jordan was never meant to be sick. That was the whole point.

The past was behind her, it needed to stay there. No indicators, no tags. The past doesn't attach itself to Ann, glowing red when present. It's *gone*.

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> An internal relation is one in which the objective properties of a relatum are modified *by* the relation. They are relations, in other words that are *constitutive* of a given relatum, rather than external to it. For example, a child's genetic history is understood to be *internally* related to that of his grandfather, since the grandfather's history is internally constitutive of the child's. Conversely, the grandfather's genetic history is *externally* related to that of the child, since it is objectively independent of any relationship with the latter. [. . .] In precisely the same way, in quantum mechanics, the outcome state of a measured system is internally related to its initial state, with its particular contextualization. Further, since relata are qualified as probabilities in quantum mechanics, probability conditionalization in composite quantum systems is another example of asymmetrical internal relation. While classical conditional probabilities are not the same as quantum conditional probabilities (it can be argued, however, that the latter are properly understood as a generalization of the former), they are sufficiently analogous to employ the simpler classical notation here: $\mathrm{P}(A|B)$—the probability of A given B—entails that A is internally related to B. When it is also true that B is externally related to A (i.e., A and B are not *mutually* internally related) this asymmetry is reflective of the non-commutativity of quantum observables, such that $\mathrm{P}(A|B) \neq \mathrm{P}(B|A)$. (Epperson 52)

Internal relations are the mechanism by which the virtual informs, contextualizes, constrains the actual. Ann's is haunted by her past, she thought she had sufficiently outran it but the past has resurfaced. These past events, whatever she did that she is haunted by, informs, contextualizes, constrains the present moment in her research lab with Victoria, stronger, the virtual and its internal relationship to the actual is *constitutive* of the present moment. The present moment is grounded and impelled by the Ann's past, the present moment is only happening this way, only means what it means, because of the ways that the virtual informs, contextualizes, constrains. We must be careful not to ascribe full determination of the present by the past or else we will slip back into the equivalence of temporal processes and logical implication, erasing time.

In the case of the virtual and the actual, they are each asymmetrically internally related to one another. In our previous discussion of the way in which the moment of Jordan and Kaede meeting at the piano bar informs, contextualizes, constrains the present for Jordan, we noticed that from the perspective of one particular moment y the identity of the moment of their meeting x was filled with embarassment, whereas from the perspective of another particular moment z the identity of the moment of their meeting x was filled with indifference. As time elapses, novel actuals become part of the virtual, which subsequently change the virtual in its entirety as a result of virtual being a temporal continuity: each part contains the whole within it, each element interpenetrating every other, where what distinguishes each part is its particular perspective on the whole. Thus the example of this moment of Jordan and Kaede meeting x is an example of the internal relation going from the actual to the virtual, as novel actuals subsequently changed the identity of the virtual, of the past, by means of our understanding of the morphing identity of the past moment x.

[98]Following Epperson and Zafiris through an example of entangled particles,

> Once a measurement outcome has been registered by one of the detectors—say A—the integration of potential outcome states at B is *revised* via its internal relation to the outcome at A, and this revision is manifest as a probability conditionalization (Epperson 61)

In the example of having two entangled particles, once one of the particles is measured at a detector given by A, this event (which is *not* the discovery or revealing of an always already determinate quantity but rather a novel creation) *conditions* the potential outcome states and their probabilities of the measurement of the entangled particle given by B. In this sense, B is in an internal relation with A.

> What these experiments reveal is that while there is, indeed, no measurable nonlocal, efficient causal influence between A and B, there *is* a measurable, nonlocal probability conditionalization between A and B that always takes the form of an asymmetrical internal relation. For example, if A registers first, the outcome at B is internally related to the outcome at A. This, again, is manifest as a probability conditionalization of the *potential* outcomes at B by the *actual* outcome at A. (Epperson 62)

No efficient causal process is happening in our example of entangled particles because the only way that the potential outcome states and their probabilities could be impacted via efficient causality after the measurement at A is if the particles or forces involved were superluminal, faster than the speed of light, since we can keep our entangled particles a distance away from each other and see these results at B faster than a light signal could reach B. The potential outcome states and their probabilities are already conditioned before any particle or force going the speed of light could causally affect our system. Thus our system is being causally effected in a way that is not restricted to the efficiently causal.

> From this perspective, in summary of the present example, the equivalence class of Boolean subalgebras representing the integration of potential outcomes at B is 'logically affected' (or better, ontologically revised) by the measurement outcome at A, thus exhibiting B's internal relationship to A, even when A and B are spacelike separated. This nonlocal revision entails no propagation of energy of any kind from A to B and is thus not properly understood as an efficient causal influence of the actualized outcome at B by that of A; rather, it is a logical conditioning (viz., a nonlocal probability conditionalization) of the contextualized *potential* outcomes at B via the internal relation of these outcomes to the *actualized* outcome at A. (Epperson 63)

We are here making clear the distinction between internal, genetic relation and external, coordinate relation. The internal, genetic relation functions through logical conditioning, once A has been measured, the probability distribution for measuring B has already changed. The external, coordinate relation functions through efficient causality, that is these causal relations must travel through spacetime, bound by the speed of light. But notice, these internal, genetic relations are allied to the process of what it means to become an object, as it is by means of internal relations that the dynamism between the virtual and actual is in place. These internal, genetic relations constitute (but do not fully determine) our outcomes. We can see this in our entangled particles: the measurement of A *does* meaningfully impact what the subsequent measurement of B will be, but measuring A does not *alone* tell us *determinately* what the measurement of B will be, everything is not *completely given* though we do have constraints.

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> It is crucial, however, to distinguish between 'logical antecedence' and 'temporal antecedence' here, for these are often casually assimilated. Temporal antecedence refers to an asymmetrical *metrical* relation of events—that is, a 'distance' relation of events as *objects* according to the parameter of time (or more accurately, spacetime).

We interject to make clear to the reader that when Epperson speaks of the temporal being metrical and involving a distance, he is referring to spatialized time, to spacetime, and not to the construction of durative time we are engaging presently.

> Logical antecedence, by contrast, refers to an asymmetrical logical supersession of events which are *themselves* internal relational structures—that is, an internal relation of relations, such as that implied by the notion of conditional probability or more broadly, propositional logic, operative quantum mechanically. For example, in a classical conditional probability $\mathrm{P}(B|A)$, 'the probability of B given A,' there is no requirement that A's logical conditioning of B be understood as a supersession of events A-B since classical conditional probabilities are purely epistemic; that is, as classically conceived, conditional probabilities presuppose that all observables have precise values at all times, such that any logical dependency of B upon A is reflective only of one's knowledge of A and B as already extant facts. The historical significance of the EPR argument and its modern experimental incarnations is the definitive demonstrations that this classical conception of conditional probabilities is entirely invalid in quantum mechanics, where measurement must be understood as generative of novel facts (measurement outcome events) and not merely revelatory of already extant facts. Thus in quantum mechanics, logical dependence depicted by a conditional probability like $\mathrm{P}(B|A)$ can only be understood as a Boolean logical conditioning of potential measurement outcomes at B by an actual measurement outcome A, such that $\mathrm{P}(B|A)$ depicts a supersession of ontological events and their asymmetrical logical relation. [. . .] In this way, the traditional conflation of temporal and logical antecedence, and more generally, the causal and logical orders—a conflation that has dominated the philosophy of nature since the Enlightenment—has been definitively invalidated by quantum mechanics. (Epperson 75-76)

Spacetime events, objects measured metrically a distance away from each other, has to do with efficient causality. Internal logical conditioning rather is the causal mechanism by which the past constrains, informs the present. A picture that only includes efficient causality via spacetime events misses the way in which the past constrains, informs the present through internal logical conditioning.

To connect back to what we are motivating as our engagement of time, we disagree with Epperson with respect to the temporal realm not containing the asymmetrical logical relation. It is only the realm of spatialized time where this is true. Our engagement of time is inclusive of both of these causal dynamics. One of the asymmetrical logical relations of time in our engagement is history, the past inside a present, a virtual informing an actual (the other being the actual back upon the virtual). Thus time is not limited to extant objects in strictly efficient causal external relations on a metrical distance grid; time is inclusive of the history that has an internal logical relation that constrains a system's output, of the history that is productive of what something is (in unending becoming), of who someone is (in unending becoming).

The novelty of an event A and the novel conditioning that it has on a potential event B is the takeaway we are looking to orient ourselves around. This is the mechanism through which an unending becoming, a dynamic reciprocally determining process, like that between the virtual and actual, is understood, with an actual changing the virtual, which changes what can be an actual, which once actualized changes the virtual, ad infinitum.

[100]Ann knew which beach Krzys belonged to. She drove up to a nearby cliffside, a lookout point. The water was indeed disturbed. Kaede absorbs green, emits red; here was blue absorption, emitting black. As if what had been ignored, asserted to be long dormant, grew in mass, eating everything around it, until it was too big to ignore. The railing was cold. A few cars sped by.

The parking lot was visible. Nearly empty, the black tumor having driven away those that couldn't deal with the past. It's been over twenty years since Ann was last here. With Krzys. And Krzys's truck was the lone occupant of the parking lot. Jordan was here.

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> The central concept by which [Epperson and Zafiris's] formalism can be understood within the context EPR is that whereas temporal antecedence in causal relations is formally expressed *metrically and set theoretically*, in [Epperson and Zafiris's] framework logical antecedence in causal relations is formally expressed *topologically and category theoretically* as an antecedence of internal relations. (Epperson 77)

If our engagement of time is to include the past in the present by means of an internal asymmetrical logical conditionalization, then like Epperson and Zafiris we turn to the domains of topology and category theory. Metricized spaces are a special case of topology, similarly set theory is a special case of category theory, and so the efficient causality that physicist's are familiar with will be incorporated into this engagement of time.

> Against many popular interpretations of [EPR-type nonlocality], [Epperson and Zafiris's] interpretation depicts EPR nonlocality as a non-metrical, topologically formalized logical conditioning of potentia; this is in sharp contrast to other interpretations that depict EPR nonlocality as an efficient causal influence requiring a superluminal physical-dynamical mechanism, or as evidence of 'retro-causality' requiring the abandonment of temporal asymmetry and its presupposed correlation with logical asymmetry. (Epperson 143-144)

We respect the actual metrical spacetime limitation of the speed of light as well as seek to affirm our experience of time that involves the past inside the present.

In sum, we have followed our way out of the discussion with Barad regarding the split between discovery and creation, through our discussion with Epperson regarding the distinction between efficient causality and logical conditioning and its resonances with discovery and creativity, external relation and internal relation. For our engagement of time we are thus working within an indeterministic picture, which is neither strictly deterministic nor strictly indeterministic, where we have reconceived our understanding of causality to be inclusive of both the spacetime efficient causal and the internally related logical conditioning such that we can include the past inside the present, where our understanding of this causality is one wherein these factors constrain, inform the present but do not determine the present.

[102]We depart from orienting ourselves within the context of quantum mechanics. Quantum mechanics, as argued by Epperson and Zafiris's relational process-theoretic formalism, involves itself with self-identical objects, with these objects being events, or in Whiteheadian language, actual occasions. The move that they make is embedding these actual occasions into a history that matters, and the way in which this history matters is by means of the mechanism of internal relations of logical conditioning. Where we left off in our engagement of time is taking seriously the ousting of a law of identity as asserted by Bergson and Deleuze. What this means in the context of our relational process-theoretic tools is that the past itself is not a fixed, static, eternal thing that constrains, informs the present. The past itself is *also* in unending becoming, constantly changing, by means of the way in which the past is present. To be clear, the efficient causality does not change, and in this way there is a degree of static, eternal quality to events and moments of the past. Jordan going into the water and transferring a bunch of jellyfish to her truck will always have happened as Jordan going into the water and transferring a bunch of jellyfish to her truck; the light cone of this physical event must still abide.

But we have now a more generalized understanding of causality, and so it is not enough to say that because the efficient causality of the transferring jellyfish into her truck possesses a static, eternal quality that this event of the past is static and eternal. It is in fact not static and eternal, because of the other dynamic involved: the internal, genetic relations of logical conditionings. This is illustrated by means of *how* a past event is present. In the example of Jordan and Kaede's first meeting at the piano bar, that event constrained moments immediately afterwards by means of an identity of embarassment, but this same event constrained moments at a later time by means of an identity of indifference. The way in which the past is present is the identity of that past moment from the perspective of that particular present moment, and this identity will necessarily morph and mutate in time.

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> If there is no more fixity in a life than there is in the milieux conditioning it, how could its conditions not be uniquely variable? No fixed, universal categories and an invariant "transcendental subject": only actual milieux that, once captured by virtual problems, occasion local geneses of transcendental fields that secrete novel sets of categories, each articulating their own intrinsic logic. There are at least two "logics" here: the **primary** logic of genesis and the **secondary** "formal logics" that, as functions of variable sets of categories, supervene upon this genesis. We are amply familiar with the latter: they are the systems of formal logic. The primary logic of genesis (or, equivalently, the logic of expression) does not just determine the becoming of formal logical systems, it leaves its mark upon them: formal systems must maintain a certain openness, they must not calcify completely—their incompleteness is a mark of their debt to this superior genetic logic. Every formal system is not just *open* to (or in advance of) other systems but actively solicits them to envelop it—and such envelopment can alter profoundly its character. Incompleteness is a birth-mark. It says: *No formal system that's not an inadequate bolus of slowed flux!* If the secondary logics accompanying the various sets of categories are captured well by *topos logic*, then Deleuze will have accomplished the dream of "grounding" formal "subjective logic" in a superior but implicit "objective logic" (as we will see, Deleuze upends severely the metaphorics of "ground"). We can *assume* that the primary logic of genesis resembles secondary logics only on pains of dogmatism! Deleuze's "critical correction" of Kant hinges on rejecting this assumption: the ground does not resemble the grounded. (Paetsch 29-30)

Topos logic need not be seen as just the generalization of formal logic, this is the mistake Colin McClarty warns against in "The Uses And Abuses of Topos Theory". It is true that topos is a generalization insofar as it includes the secondary logics, but it is far more than that, the way in which it exceeds secondary logics is not by simple extension of the same. The topological space associated with its topos logic is general and can be specified, this includes the ability of having a *point-free* topological space. Additionally, we use this area of topology and category theory to engage temporal continuity, where each part retains the whole, each element interpenetrating every other, where each part is distinguished by a particular perspective on the whole. We are no longer in the realm of generalized formal logic, of generalized set theory; we are in new terrain. We use topos logic while simultaneously heeding Deleuze's and Paetch's own warning: the ground does not resemble the grounded. Our ground is point-free, our ground is a temporal continuity, in accordance with the lack of identity of a moment, $x \neq x$, in accordance with the ground (the virtual, temporal continuity, point-free) not resembling the grounded (the actual, spatial continuity, extensionless points).

[104]Ann was waiting outside the lot's entrance, inside her car. She needed to get closer. Verify if Jordan was actually sick, or if Victoria's recollection was a trick of the memory, the past haunting her present, the stable ground shaken, earth in upheaval, a darkness sucking in and consuming any Kaede red beacons, no navigation, lost at sea.

Headlights. Ann shrugged lower in her seat, though she wasn't sure why, Jordan couldn't possibly remember her. Perhaps Ann was hiding from his car, the high beams dredging up the past, exposing her role. The truck came out of the lot and turned away from Ann. The bed was glowing green, as if it were radioactive. What was this beach creating?

Keeping her distance, she followed Jordan.

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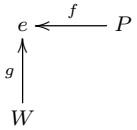
> As this formalism applies to actual occasions as predicative facts in Whiteheadian metaphysics, recall that predication is 'dipolar' because each potential quantum actual occasion / predicative fact comprises both [1] *a causal-physical pole*, by which the potential novel fact is *spatio-temporally coordinated* with, and efficient-causally influenced by, the actual facts of its *relativistically restricted* dative world ('coordinate division'); and [2] a *logical-conceptual pole*, by which the potential novel fact and its unique subjective context are *logically coordinated* via asymmetrical internal relation with the *totality* of actual facts constitutive of its dative world—including these facts' *own* subjectively contextualized internal relations to *their* dative worlds ('genetic division'). Type-theoretically, as we have seen, these dative worlds are properly understood as lower order totalities relative to the subject occasion. But category-theoretically, it must be recognized that these internal relations, whether analyzed coordinately or genetically, cannot be formalized as 'intrinsic elements' of the actual occasion as some 'terminal' object relatum. Unlike set theory, which *can* provide such terminal internal formalization of an object (e.g. as a Cartesian product, or other 'internal' pair structure), category theory can *only* define objects via *their relations to other objects and other relations*. Formally, this is precisely representative of the philosophical notion that an actual occasion as 'object relatum' is, itself, an integration of internal relations with other dative occasions, which are themselves integrations of internal relations, such that the structure of these dative internal relations, no matter how far down, is preserved throughout. In other words, the classical and set-theoretically definable conception of an object relatum as possessing some 'objectively and sheerly intrinsic constitution' is as incompatible with [our] definition of the dipolar, subjective-objective (i.e. relational) actual occasion as it is with the category-theoretic definition of an object relatum. In the category-theoretic formalism, even the most primitive objects cannot be defined this way; rather object relata are always fundamentally understood as relations themselves. (Epperson 131-132)

Epperson and Zafiris include both external, coordinate relation and internal, genetic relation in their formalism of quantum mechanics; this is resonant with our engagement of time that includes both of these as well. Similarly, external, coordinate relation is of the causal-physical pole bound by spacetime limitations like the speed of light, in which we have the efficient causality already familiar to us in physics. Internal, genetic relation is the way in which the virtual informs, contextualizes, constrains the actual through a logical conditionalization. The way a novel objective-subjective event, Whiteheadian actual occasion, is framed type-theoretically to be an order higher than its dative world, than the internal relations that condition (but do not fully determine) it, is resonant with our understanding that the virtual is in unending becoming, a process of accumulation that does not stop, growing larger with each passing moment, with this novel virtual conditioning (but not fully determining) a novel actual.

Category theory diverges from set theory at a fundamental level with respect to definitions. Set theory is resonant with essentialism: essences, extensionless points, axioms are static objects defined by means of static definitions. For example, we might say something like $x = 5$, or x is an integer, or e is an electron, each of these identities comes with a fixed list of properties that each possesses in isolation. We oppose the essentialist, representationalist, timeless, notion that there exists a static, rigid, fixed, definition of, for example, the electron from which a list of static, rigid, fixed properties are listed. Contrary to this, the objects of category theory are only ever defined through relationships, not as inherent, fixed definitions said to be there all along or bestowed from outside the system. For example, we might say that x is defined through a set of relationships $\{f, g, h\}$ where each of these relationships engages x from a specific point of view, a specific perspective. Notice, this meshes very well with an antiessentialist physics: we learned that, contrary to classical ontology and epistemology, an electron does not have an always already determinate existence as either particle or wave. Rather, the nature of the electron is dependent on context, on the Bohrian phenomenon constructed. Thus if we were to say e is our categorical object for an electron, how is it defined?



We can say that there is a perspective on the electron, the point of view of P, that engages the electron as a particle, indicative of, for example, using a double-slit apparatus with a which-path device attached. We can also say that there is a perspective on the electron, the point of view of W, that engages the electron as a wave, indicative of, for example, using a double-slit apparatus without a which-path device attached. The definition of e is no longer a list of static, inherent, essentialist properties, but rather a function of its relationships, dependent on the point of view taken. What e is in isolation of these points of view is unintelligible, as it is defined *by means of* these relationships. Notice that this relational understanding allows us to account for processes, for internal relations, where the definition of an electron is not simply a set

of external relationships between the electron as an essence to other essences. Rather we are accounting for the production of what the electron is through the specification of the processes, practices, apparatuses. We can thus put the definition of e succinctly by collecting all of the relationships e has together, and defining e as the set of all of those relationships.

[106]We are wading into the mathematical-physics waters. Knees. We now understand conceptually what we are trying to do with the mathematical-physical engagement of time, but we don't yet have the mathematical tools to conduct this engagement. We start with mathematical definitions in order to springboard off of them discussions about how these tools interface with what we are engaging conceptually and how these tools interface with examples of lived experiences.

A **category** $\mathcal{C}$ consists of

Objects A, B, C, ...

Objects are in our electron example as e, P, W, and we understand an object's definition through its relationships. We refer to the collection of all objects in a category $\mathcal{C}$ as $\mathrm{Obj}(\mathcal{C})$.

Arrows f, g, h, ...

Arrows are in our electron example as f, g. An arrow is a relationship between objects. We refer to the collection of all arrows in a category $\mathcal{C}$ as $\mathrm{Arr}(\mathcal{C})$.

Every arrow has a domain and codomain such that the operation

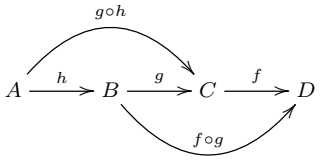
$$\mathrm{dom}: \ \mathrm{Arr}(\mathcal{C}) \longrightarrow \mathrm{Obj}(\mathcal{C})$$

assigns a domain to each arrow f in the category $\mathcal{C}$ given by $\mathrm{dom}(f) = A$ and the operation

$$\mathrm{cod}: \ \mathrm{Arr}(\mathcal{C}) \longrightarrow \mathrm{Obj}(\mathcal{C})$$

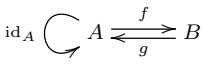
assigns a codomain to each arrow f in the category $\mathcal{C}$ given by $\mathrm{cod}(f) = B$, thus giving us the form of each arrow as $f: \ A \longrightarrow B$.

Arrows adhere to what we call composition. The intuition of composition is best grasped with a diagram.



An arrow $g \circ h$ is read "g after h". This is the composition of g and h in this diagram. Composition of arrows satisfies associativity, which means that $(f \circ g) \circ h = f \circ (g \circ h)$. The diagram above demonstrates how both sides of this equation return the object D.

For each object A there exists an identity arrow id_A: $A \longrightarrow A$. Diagrammatically,



such that an arrow composed with an identity is itself, as seen with $f \circ \mathrm{id}_A = f$ and $\mathrm{id}_A \circ g = g$. We often do not include identity arrows in our diagrams in the interest of cleanliness as we understand they are there.

As mentioned previously, category-theoretic elements (such as objects and arrows) are all defined through their relationships, in terms of arrows. This means that there is no requirement for an element to have an inherent, static, essence. This is important, as it means the elements of time, moments, do not have to have an inherent, static, essence, a rigid boundary to their definition.

How does this kind of definition work in practice? Let A be an object in $\mathcal{C}$. A **variable element** of A is an arrow in $\mathcal{C}$ whose codomain is A. The domain of this arrow is called the **stage of definition**, a point of view of A, a particular perspective of A. Recall that the elements in a temporal continuity are mutually interpenetrating, each part contains the whole, such that the whole cannot be arrived at through a sum of its parts. What distinguished each part of this whole was its particular perspective on the whole, its point of view on the whole.

An arrow $f: \ B \longrightarrow A$ is then a variable element of A as it is defined over B, from the stage of B, from the point of view of B. Recall that our relational definition of an object was its set of relationships. Thus we write that f is a part of the definition of A, from the stage of B, point of view of B, as

$$f \in_B A$$

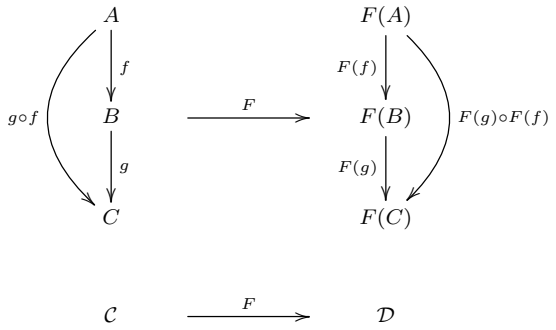
where the definition of A is a set of relationships $\{f, g, h, ...\}$, each from a particular stage, point of view.

We can already feel the ways this will mesh with moments, interface with lived experience. Our example of the moment of Jordan and Kaede first meeting at the piano bar can be encoded as the object A, where A lacks any inherent, rigidly-defined, fixed, static identity but rather its identity is understood by means of relationships to other moments that change in time. Thus a particular one of these perspectives, of these definitions of A, can be understood as the relationship, as the arrow f.

[107]She watched as Jordan walked into what Ann assumed was her apartment, leaving the fluorescent vehicle behind. Ann slowly, carefully got out of the car, a lysed plasmid, where she was inserting herself as a fused gene. She crept towards the window and peered inside: Jordan was covered in welts. She keeled over, looking like she might be vomiting into the kitchen sick.

Darting her back against the wall, completely out of view, needing a moment to calm down. What did Ann do to them? Or Krzys? How many lives has she ruined? Ann had cultivated a self-imposed darkness, nothing was wrong if she couldn't see it, but Kaede, or rather the green light was waving its arms now. Too big to ignore. The ground was shifting beneath her feet. What Ann thought was safe was only safe for a short while. Everything changes.

[108]**Functors** $F : \mathcal{C} \longrightarrow \mathcal{D}$, $G : \mathcal{D} \longrightarrow \mathcal{E}$, ..., are arrows, relationships, between categories that preserve the structure of composition and identity. A functor $F : \mathcal{C} \longrightarrow \mathcal{D}$ maps objects A, B, C, ..., in the category $\mathcal{C}$ to objects $F(A)$, $F(B)$, $F(C)$, ..., in the category $\mathcal{D}$, and maps arrows $f : A \longrightarrow B$, $g : B \longrightarrow C$ ..., in the category $\mathcal{C}$ to arrows $F(f) : F(A) \longrightarrow F(B)$, $F(g) : F(B) \longrightarrow F(C)$, ..., in the category $\mathcal{D}$. Diagrammatically,

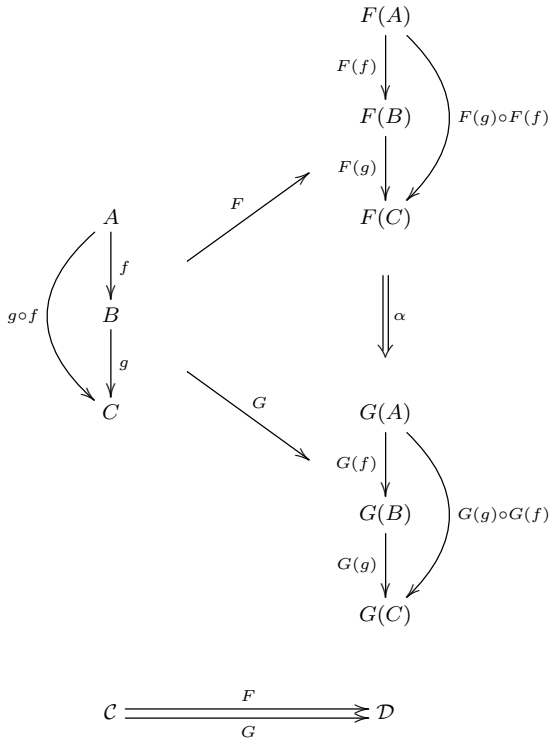


On the left we have objects and arrows in the category $\mathcal{C}$ and on the right we have objects and arrows in the category $\mathcal{D}$. A functor F maps each object A in $\mathcal{C}$ to an object $F(A)$ in $\mathcal{D}$ that preserves composition and identity. Beneath this expanded version of this functor we have included a consolidated encoding of the functor, a mapping, an arrow, a relationship between $\mathcal{C}$ and $\mathcal{D}$.

Natural transformations $\alpha : F \longrightarrow G$, $\beta : G \longrightarrow H$, ..., are arrows, relationships, between functors that preserve structure. A natural transformation $\alpha : F \longrightarrow G$ maps objects A, B, C, ..., in $\mathcal{C}$ to arrows $\alpha_A : F(A) \longrightarrow G(A)$ in $\mathcal{D}$ for each object, and for each arrow $f : A \longrightarrow B$, ..., in $\mathcal{C}$ the following relation holds

$$\alpha_B \circ F(f) = G(f) \circ \alpha_A$$

Diagrammatically



Like before, in lower part of our figure we ground ourselves in the consolidated understanding of $\mathcal{C}$ on the left and $\mathcal{D}$ on the right. We have two functors F, G, that take our objects A, B, C, in $\mathcal{C}$ to their respective objects in $\mathcal{D}$, either $F(A), F(B), F(C)$ or $G(A), G(B), G(C)$. Our natural transformation α maps an object A in $\mathcal{C}$ to an arrow α_A in $\mathcal{D}$, given by $\alpha_A : F(A) \longrightarrow G(A)$, understood as an arrow, a relationship between our two functors F, G. To distinguish natural transformations from other arrows we employ a double-barred arrow as seen above.

We turn to a more condensed diagram for developing our intuition about natural transformations on arrows in $\mathcal{C}$.

$$\begin{array}{ccc} F(A) & \xrightarrow{F(f)} & F(B) \\ {\scriptstyle \alpha_A}\Downarrow & & \Downarrow{\scriptstyle \alpha_B} \\ G(A) & \xrightarrow{G(f)} & G(B) \end{array}$$

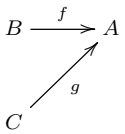
We are looking at a diagram in $\mathcal{D}$ but we understand this to be a more particular diagram within the complete context illustrated above, where functors F, G take objects in $\mathcal{C}$ as their domain. We said that for each arrow $f : A \longrightarrow B$, in $\mathcal{C}$ that the following relation holds

$$\alpha_B \circ F(f) = G(f) \circ \alpha_A$$

Our "zoomed in" diagram is thus the commutative diagram that expresses this relation. We say a diagram "commutes" or is "'commutative" when the different paths we could take agree at their intersections. In the example above, the diagram is commutative because both paths, $\alpha_B \circ F(f)$ and $G(f) \circ \alpha_A$, agree on $G(B)$.

[109]The truck. Ann snuck over to the bright green illumination, as if the bed of the truck was a treasure chest, the kind she used to put inside of her fish tanks as a kid. The whole back was filled with slime. Thick and opaque. Pulsating. Invaginating. Folding in on itself, over itself, through itself, flows that seemed to lack a particular start, particular end, particular direction. The slime was alive. A living light, marking off the active relevant cells, marking off what Ann took to be relevant to her. This was as clear of a sign as any. Green was the opposite of red — the stony coral fluorescent protein, Kaede, must be the wrong marker. Ann scooped up some radiating sludge and dumped it into her bag, enveloping all that it came into contact with, suspending her wallet, pens, lipstick, fusing, becoming a hybrid. Plasmid ligated.

[110]An **isomorphism** is the "kind" of equality that we use within category theory, encoded $\cong$ and reads "is isomorphic to." The equals sign that we are used to $=$ is a set theoretic equality, which is teeming with the essentialism we have previously discussed. When we say something like $5 = 4 + 1$, we are referring to an inherent, static, definition of 5 that is defined in relation to nothing else, it is the fixity of the number 5. When we say that $5 = 4 + 1$, we are saying that the inherent, static, rigid definition of the left side (understood in complete isolation, an essence, *completely given*) is *identical* to the inherent, static, rigid definition of the right side (understood in complete isolation, an essence, *completely given*). In category theory, we are not required to have these kinds of isolated, inherent definitions, we are not comparing essences to see if they are identical. Rather, as we have discussed, definitions in category theory are constructed by means of relationships. It is not the case that the object A has a fixed, static, inherent definition, rather A is defined by means of the set of all relationships $\{f, g, h, ...\}$ of A, over various stages of definition, points of view on A, such that, in the particular example of a relationship f, A from the point of view of B, $f \in_B A$. It is this set of relationships being compared when using $\cong$. This means that our sense of equality is no longer referring to some inherent, static, rigid definition of A, but rather to the internal structure of A, all of the relationships that make up the definition of A. As a crude, mixing together uncritical set-theoretic and category-theoretic ideas in the pursuit of our intuition, we could imagine an object A defined through its relationships $f : B \longrightarrow A$, $g : C \longrightarrow A$ where we understand B to be Jordan, C to be Kaede, and f, g each a relationship of the flavor of sweetness. Diagrammatically,

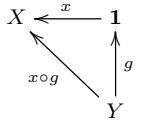


If both Jordan and Kaede consider mangos and candy bars to be sweet, we can then say that a mango and a candy bar are isomorphic $\cong$ to A because they are "equivalent" by means of solely the definition of their relationships, where here any object (mango, candy bar, ...) only has to satisfy being sweet from the perspective of Jordan and Kaede in order to be isomorphic to A, in order to have the same definition in the ways that matter. This might seem superfluous in our example that involved set-theoretic identities, essences, fixed definitions (mango, candy bar, Jordan, Kaede), but our intention is to engage time. A moment, as we have argued, does not adhere to the law of identity, $x \neq x$. Thus we need a way to define and to understand what a moment is, where we explicitly have no such set-theoretic identity, essence, fixed definition.

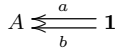
We often encounter a special object in our categories known as the **terminal object**, encoded as $\mathbf{1}$. The definition of our terminal object always has exactly one element for each stage of definition, point of view on $\mathbf{1}$. Thus we can think about $\mathbf{1}$ as the generalization of the one element set $\{*\}$. This means that for the category of **Sets**, which is the special category of set theory, that $\mathbf{1} \cong \{*\}$. Thus the set-theoretical elements a of a set A are in bijective (one-to-one) correspondence to arrows from the one-element set to A,

$$a \in A \quad \Leftrightarrow \quad a : \mathbf{1} \longrightarrow A$$

In any category $\mathcal{C}$ with a terminal object $\mathbf{1}$ we have $x \circ g : Y \longrightarrow X$ for any arrows $g : Y \longrightarrow \mathbf{1}$ and $x : \mathbf{1} \longrightarrow X$. Diagrammatically,



If two different elements of A are defined at the stage of our terminal object $\mathbf{1}$, from the point of view of $\mathbf{1}$,



then for any X there exists a unique arrow $x : X \longrightarrow \mathbf{1}$ such that $a \circ x$ will differ from $b \circ x$, each from the stage of X, from the point of view of X. What these mean is that for any category with a terminal object, the elements defined at the terminal stage, from the perspective of $\mathbf{1}$, can be uniquely translated to elements at any other stage, any other point of view. This means these elements are *globally observable*. We can understand what this means by engaging our favorite tension between set theory and category theory again: essentialism. If there is a fixed, static, eternal, rigid definition that is inherent, defined in total isolation of what the essence of a mango is, then we can claim that this essence is something that *all* perspectives on the mango can agree on, that it doesn't matter who you are, where you are, what you are, the mango doesn't care, the mango has a fixed, static, rigid definition to be discovered by anyone or anything clever enough.

These essences, these elements defined from the stage of **1**, from the point of view of **1**, thus do not depend on any stage, on any point of view, they are *global*. But recall, we've been arguing and motivating that *experience* is *emphatically local*. What it means to be *someone* is in stark contrast to being *anyone amongst everyone*. Alice is Alice and no other. Reading a narrative through Alice's eyes, if she were to feel real, would not read like a narrative through Bob's eyes, if he were to feel real. A moment distinctly lacks this kind of global identity. Thus in our engagement of time, we expect to have more than just global elements

$$x \in_{\mathbf{1}} A$$

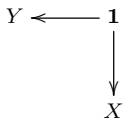
but to also have variable elements

$$x \in_{B} A$$

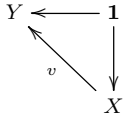
because the identity of a given moment, the identity of the element in question, will always be dependent on the perspective it is being relationally engaged from, whose experience we are referring to, whose perspective we are understanding, whose memories inform, contextualize, constrain the definition of the moment in question, whose virtual overflows, possesses the moment in question. Victoria's appointment with Ann was a fairly standard visit in the pursuit of trying to become more self-reliant as her memory degrades. What we can globally say about this moment involves the efficient causality we know and love in physics. The particles and forces involved follow our laws in the realm of the actual, they must abide by restrictions like not being able to travel than the speed of light. This efficient causality is something that *anyone amongst everyone* agrees on. However, this event, this actual occasion, affects Ann insofar as it brings back a tsunami's worth of thoughts, feelings, and memories that she has done her best to outrun, repress, ignore, escape. This is a local experience of Ann, it is particular to the experience of what it means to be *someone*, of what it means to be Ann in this moment, Victoria does not share this same experience of the appointment. Thus the way in which this appointment affects Ann in particular is not a global observable, is not something that *anyone amongst everyone* agrees on. Regardless, the way the appointment affects Ann in this unique, local, experiential way influences, contextualizes, constrains–Ann's subsequent decisions are causally informed by this emphatically local experience. Going further, Ann clearly has other moments on her mind, moments of the far past, twenty years ago, informing her decisions, thoughts, feelings too. As we saw with the example of the identity of the moment of Jordan and Kaede first meeting at the piano bar, the identity of these past moments for Ann are necessarily different now from what they were at the time, as they are contextualized by the twenty years of time in between up through this appointment with Victoria that triggers their avalanche back into the forefront of her mind. Confer Bergson's example of thinking about a stationary object from the same angle in the same lighting, yet a moment's identity is still morphing due to the virtual that contextualizes it.

Let us be clear, there are still global definitions, "the facts of the matter," which we understand when we exclusively engage spatially, they have a fixed identity, $x = x$, and are placed on a fixed spacetime diagram and given fixed properties like position. It is not up for debate whether or not Victoria went to Ann for an appointment. Diagrammatically,

Where we understand X as the moment in question, Victoria's appointment with Ann, and the relationship with **1** to be engaging the global elements of this moment, the definitional relations of X that everyone agrees on, the efficient causality that we are familiar with. However, at a later moment Y, when Ann follows Jordan back to her apartment and grabs a bagful of the jellyfish, we again have its global elements, our efficient causality,



but in order to engage the virtual, in order to engage time temporally, we must understand how the past, the virtual, informs, contextualizes, constrains, a future moment. This is decidely *not* a global element.



We have labeled this new arrow v to call to mind the virtual, as this is the relation of how the virtual, the past, X, informs, contextualizes, and constrains Y. Notice, it is *not* global, out terminal object $\mathbf{1}$ cannot "see" the arrow v other than through its engagement of Y, the eventual effects, consequences of v; the arrow v is from the perspective of X, *not* from the perspective of $\mathbf{1}$. Thus it can globally be seen, agreed on, understood that Victoria had an appointment with Ann, and that Ann followed Jordan and grabbed a bagful of jellyfish, but we have to *infer* how the past, the virtual, affected, informed, contextualized, constrained Ann such that Ann's decisions were made, decision that are not fully explainable when restricted to efficient causality, decisions that are colored by the morphing, unending becoming identities of past moments from the unique, local perspective of Ann. And from Ann's local perspective, Ann's local experience, she *does* "see", understand, know, *feel* how the past, the virtual, the moment X, her appointment with Victoria, has affected, informed, contextualized, constrained, grounded and impelled the moment Y, her subsequent decisions, but still, only on a local level, only Ann's Y from Ann's X, only from her perspective, her point of view. How X is defined, the moment of Victoria's appointment with Ann, what X means, how X affects, informs, contextualizes, constrains, grounds and impels is not the same for everyone, in fact it is *different* for everyone, $x \neq x$. We no longer can be either Alice or Bob, anyone amongst everyone. We *must* be *someone*. Perhaps that's Alice, perhaps that's Bob, but it can't be anyone. However, the internal structure of *how* the past is in the present, of *how* the virtual and actual are in dynamic reciprocal determination, despite being *emphatically local*, is *the same*, inclusive of all our elements being different from every which perspective and never retaining an identity, this structure is a topological invariant of an autonomous time, separate from any particular subjectivity, possessing each emphatically local experience. We are abandoning identity, $x = x$, in favor of embracing internal structure, $x \cong x$.

[111]The novel, different fluorescent protein: absorbing blue, emitting green. This could be the indicator that connects the dots. Ann owed it to Krzys's family to set things right. Victoria's memory issues will be more precisely diagnosable, more treatable, more able to be engaged if all the relevant pieces were better understood, separated and flagged, if the neuronal component parts could be distinguished, traced, and followed.

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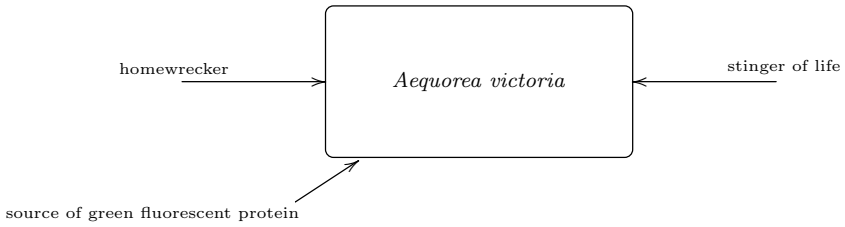

homewrecker
Aequorea victoria
stinger of life
source of green fluorescent protein

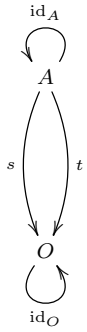
[113]The current model of time can be structured as such,

$$X \xrightarrow{f} Y \xrightarrow{g} Z$$

Grounding this in our lived experience example, we can understand X to be the moment where Jordan and Kaede first meet in the piano bar, the moment Y to be Jordan struggling on the toilet as Kaede tries to help her, and the moment Z to be Kaede driving her home. The arrows f, g are the efficiently causal relationships of particles and forces following the laws of physics. Given that everything involved in this scenario is made up of particles and forces, the current model of time understands this flow of events as being entirely causally determined by the laws of physics of these particles and forces, that the only thing that matters any one instant is the current, immediate positions and momentums of the elements involved, and out of that we would find this exact scenario $X \xrightarrow{f} Y \xrightarrow{g} Z$ play out. Thus we understand our moments X, Y, Z to be extensionless points with causal relationships bound to contiguous relations of extensionless points along the timeline. The directionality of these causal relationships is included but we note that the pseudo-problem modern science has gotten itself into regarding what is called the problem of "the arrow of time" is not well agreed upon. For why we believe this to be a pseudo-problem, a problem that modern science has created for itself, we refer back to our earlier discussion regarding the bias of a faith in determinism, an affirming of the mathematical real line as being *more real* than our own empirical experience, from which our experience is bracketed away as an illusion.

A **representable functor** is a special functor whose domain is an arbitrary category $\mathcal{C}$ and whose codomain is the special category of **Sets**. Our simple example of the current model of time can be understood set-theoretically as a set of objects $\{X, Y, Z\}$, which we understand to be extensionless points, and a set of arrows $\{f, g\}$, which we understand as the efficiently causal relationships. We can thus construct a category-theoretic understanding of this model.

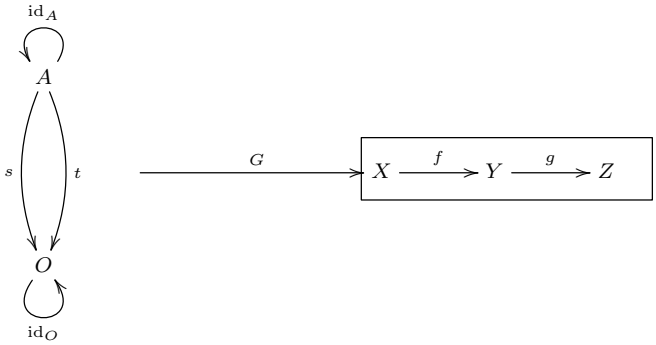
Before we assemble our category-theoretic diagram, we must figure out what the domain of our representable functor for the current model of time will be. It turns out that the category of graphs is what we are looking for, which can be felt considering our current model of time is indeed a graph. But what is the category of graphs?



The category of graphs should contain the internal structure of any possible graph, such that we can instantiate our specific graph of the current model of time. Does this category do that? Every graph can be decomposed into a set of its objects and arrows which we did above. In our category of graphs, the object A can be understood as the set of arrows in our graph. Note, we continue to mix set-theoretic and category-theoretic understandings in the interest of building up intuition with category theory; thus we call attention to how A is not inherently defined, as an essence, to be the set of arrows, but rather the relationships $\{\mathrm{id}_A, s, t\}$ that provide our relational definition of A are such that arrows in a graph are isomorphic $\cong$ to the object A. How do these relationships give an isomorphic definition to any arrow in a graph? Let's check one by one. The relationship id_A is our identity arrow such that any arrow in our graph has an identity, $x = x$, where it is always itself. This is true. We might notice that our objects in our graph, our extensionless points, also possess an identity, thus we have not yet concluded that A is isomorphic to only the arrows of our graph. The next relationship is s which sends an element of A to an element of O. What does s tell us? We invoke mixed set-theoretic and category-theoretic understandings again to help us get there: if we understand A as our set of arrows and O as our set of objects, we say that s is an arrow that picks out a source point. Following the diagram, we start in the domain of s with an arrow in our set of arrows A and the process of s returns an object in the codomain O that corresponds with the source point of our chosen arrow. We return to a strictly category-theoretic understanding which tells us that our arrow s means any element of A has a relationship to an element different from itself O as understood by s. Does this make sense for an arrow? Yes, the arrow itself has a different identity from the source point that is included in the arrow, thus we can encode the relationship between an arrow and its source point in this way. Can the same be said for the objects of our graph, the extensionless points? No, they have no internal relationship to anything but themselves, thus our set of points $\{X, Y, Z\}$ are not isomorphic $\cong$ to A. We might notice that we haven't yet encoded enough internal structure for what makes an arrow in a graph: we have an

identity of the arrow itself, we have the source point of the arrow, but what about a target point? This is what t encodes, a relation that takes an element of A and returns an element of O. We now have encoded the entirety of the internal structure required such that our set of arrows $\{f, g\}$ is isomorphic $\cong$ to A by means of our relational definition (having an identity, a source, and a target), and our set of objects $\{X, Y, Z\}$ is isomorphic $\cong$ to O by means of our relational definition (having an identity). We might notice that our labels s, t are arbitrary, after all, as we continue to argue, there is no inherent, fixed, essentialist definition, and both s and t have the same relational structure. This is true. We label s and t in the interest of being helpful and intuitive, but all that matters category-theoretically is that there are two such arrows whose domain is A and whose codomain is O such that arrows in our graph can have a source point that is different from its target point. We of course still have the case where s and t pick out the same point, where the arrow in our graph is a loop that starts and ends at the same point.

We can now more confidently construct our representable functor, our category-theoretic engagement of the current model of time, by means of a particular instantiation of a graph from the category of graphs



$$\mathcal{C} \xrightarrow{\quad G \quad} \mathbf{Sets}$$

Beneath the expanded diagram we have put the consolidated understanding to build intuition: we have a representable functor G whose domain is a category $\mathcal{C}$ and whose codomain is the category **Sets**. Above, on the left is our category of graphs, G is our representable functor that goes from the internal structure of any possible graph and constructs the particular instantiation of the graph we are using as our simple current model of time, and on the right we have that specific graph of our current model of time.

[114]Victoria was in again, the green fluorescent protein already in her brain, awaiting interaction, awaiting a signal.

Ann explained, “We’re going to try a different trial. A different indicator protein that will hopefully mesh with what we’re looking for and be of better help.”

No response.

“When was the last time you saw Jordan?” Ann needed to find the memories that were still just about there, barely holding on, on the edge of being totally lost, such that she could understand the mechanism of what was happening cellularly in the transitional process.

Victoria looked at Ann and said nothing. Her facial expression looked less consumed by thought, as if recalling the memory were easy, less consumed by an effort to communicate, as if speaking were easy, but nevertheless she remained silent. The dementia squeezed its grip on Victoria’s brain, growing new branches, tendrils, thrust into the language lobes. Ann was running out of time, losing her opportunity to make everything right, or as right as it can be.

“Victoria, are you able to understand what I’m saying to you right now?”

Effort returned to her face, what Ann imagined was an intent focus on each word being said, or perhaps a battle with the awareness of such a question being asked being indicative of something very troubling. This was the worst condition Ann had seen Victoria in since they began their trials together. The gravity of the situation, the past coming back to haunt her, a situation Ann felt at least partly responsible for, squeezed its grip on Ann’s brain, growing new branches, tendrils, thrust into the language lobes.

“How many daughters do you have?”

Go for broke. This was the opportunity to find out how much Victoria knew of what happened, or at least how much she remembered.

Victoria didn’t respond, her attention diverting to brain anatomy posters on the walls. New approach. Ann grabbed a clipboard with a blank piece of paper and wrote the numbers zero, one, two. She handed the clipboard to Victoria, which she took instinctively, finding something more interesting than the posters in it, inspecting the writing in front of her.

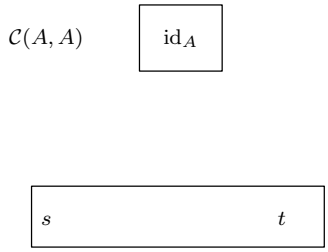
Ann picked up Victoria’s right hand, isolated her pointer finger, and waved it around the three options. “How many daughters do you have?”

Her fingers danced, mimicking more circles around the options as if Victoria thought she was being given an instruction on how to move more than being given a question for her to answer. Her finger stopped at the number one. Ann looked at Victoria who looked up at Ann. This was communication. She felt it. Nonverbal connection. Either Victoria’s memory can only recall one daughter or Krzys never told her what it was they did all those years ago.

She took the clipboard back and turned away towards the brain anatomy posters herself. Recentering. Old approach: back to helping the current situation, determining the puzzle pieces for her dementia. As Ann went to turn around, a new question being formed to tease out an optimal brain signal, it occurred to her that she wasn’t just going back to the old approach of five minutes ago, rather Ann was returning to the old approach that created this mess. Jordan needed help badly and Ann broke the rules to do something about it, going to whatever lengths she deemed necessary. Is this not another impulsive, even if well-intentioned, experiment, pushed through on the back of necessity? Of needing to help Victoria during an admittedly dire time? Ann felt like she owed Krzys then and now she feels like she owes Krzys’s family after everything she’d been a part of. How many more lives was she prepared to ruin in the name of fixing her previous mistakes? Who knows what cold come out of the use of this jellyfish fluorescent protein without more proper studying? This had to stop.

[115]Let us now formally argue that our category of graphs is indeed the category of graphs. A **hom-set** $\mathcal{C}(X, -)$ is a representable functor of the set of all arrows within the category $\mathcal{C}$ whose domain is X and whose codomain is arbitrary. In order to argue that our category of graphs is indeed the category of graphs, we must follow the qualitative argument that we gave above, namely we must argue that the object A is isomorphic to arrows in graphs and that the object O is isomorphic to objects in graphs. To do this, we will investigate the hom-sets of each of our objects, A, O, such that we can conclude that the relational definition matches what we are looking for.

Let's start with our object A. To do this, we specify the X in $\mathcal{C}(X, -)$ to be A so that we can look at the relationships that are constitutive of its definition. We have a total of two objects in our category, A, O, so we will be creating two different sets, where the codomain of the arrows in our hom-set are A and O respectively.

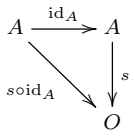


The set at the top is the hom-set $\mathcal{C}(A, A)$, the set of arrows in $\mathcal{C}$ that go from A to A. We only have one of these arrows, the identity id_A. The set at the bottom is the hom-set $\mathcal{C}(A, O)$, the set of arrows in $\mathcal{C}$ that go from A to O. We have two of these arrows, the source arrow s and the target arrow t.

Next we must investigate the hom-set $\mathcal{C}(A, s)$. This move pushes on our set-theoretic intuitions–what does it mean to have an arrow that goes from an object A to an arrow s? Recall, set theory has inherent, isolated, fixed, static, rigid definitions whereas category theory has definitions constructed out of relationships. When we inquire about the relationship between A and s, we are *not* inquiring about the relationship between some fixed, isolated, rigidly-defined entity A and some other fixed, isolated, rigidly-defined entity s, where the definition of each might cause us immense confusion in how they relate (where one is an object and the other is an arrow). Instead, we must remember that our definitions in category theory are built out of the relationships. This means that A is defined as its set of relationships $\{\mathrm{id}_A, s, t\}$. Okay, what about s? Notice, s is a *particular* relationship in our set of relationships that define A and O, specifically it is a relationship whose domain is A and whose codomain is O.

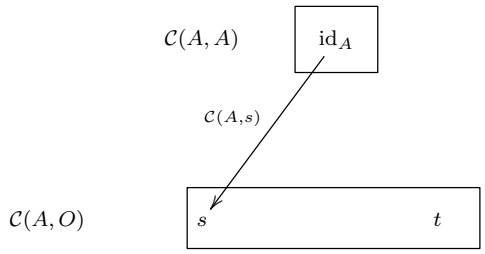
$$s: \ A \longrightarrow O$$

When we refer to s, we are referring to O from the stage of A, from the point of view of A, and in distinction from t. We can imagine the set of arrows that have O as codomain $\{\mathrm{id}_O, s, t\}$ as a definition of what O is and then restricting to the particular relationship of s. This then offers a particular point of view on O, a narrower definition amongst a larger definition. Thus, when we speak of s, we are speaking of a particular point of view on O, namely the one from A that is distinct from t. In our example of the electron, understood from the points of view of the relationship f of the electron as a particle and the relationship g of the electron as a wave, we can understand an arrow that goes from an object A to an arrow f to be an arrow that goes from the object A to the object e, the electron, as understood from the relational perspective as a particle, which we know isn't the full definition of e, which would have to include the contexts where the electron is also a wave. In our example of objects that both Jordan and Kaede find sweet (mango, candy bar, ...), the arrow f was specifically the relationship of what Jordan found to be sweet and the arrow g was specifically the relationship of what Kaede found to be sweet, thus we can understand an arrow that goes from an object X (we momentarily avoid using A as A had a definition within the example) to an arrow f to be an arrow that goes from the object X to the object A, objects that are sweet, as understood from the relational perspective of Jordan. Coming back to our category-theoretic argument of the category of graphs being the category of graphs, what does it mean to have an arrow that goes from A to s?

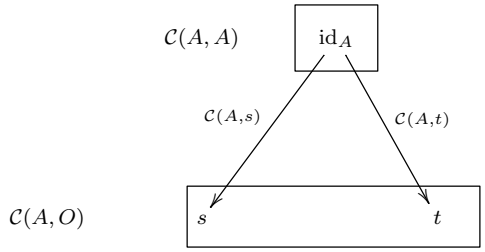


$$A \longrightarrow s$$

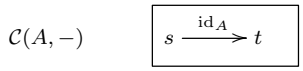
Along the bottom we have the consolidated version of what our diagram is constructing, an arrow from A to s. At the top we have A on the left and s on the right, where we understand s to be O from the stage of A, from the point of view of A. To determine what the arrow is that goes from A on the left to O as understood from the perspective of A, all encoded as s, on the right, we complete the commutative diagram. We know how to go from A to A along the top, that is our identity of A arrow. We can then conclude, through the commutativity of the diagram, that the arrow that goes from A to s (otherwise understood as O from the stage of A, from the point of view of A) is the composition $s \circ \mathrm{id}_A$. Notice, what this composition is saying is that the relationship encoded in our hom-set $\mathcal{C}(A, s)$ is one that goes to s after id_A. We can thus add $\mathcal{C}(A, s)$ to our diagram as an arrow that goes from id_A to s.



By an identical argument, this time for t instead of s, we can conclude that the hom-set $\mathcal{C}(A, t)$ is a relationship that goes to t after id_A and can be added to our diagram.



We can now construct the representable functor that encodes the entirety of the internal structure of our object A! This is the representable functor $\mathcal{C}(A, -)$.



Our identity arrow on A is an arrow, our objects s and t are our source and target objects respectively, and our hom-sets $\mathcal{C}(A, s)$ and $\mathcal{C}(A, t)$ pick out the source and target for our given arrow id_A. Recall that s and t are arbitrary labels given to two identical relationships that are distinct such that we can construct arrows with a source point that differs from its target point. Thus, through our decision to label each as s and t, we can encode the directionality of our arrow going from s to t. Notice, we have constructed a *generalized arrow*. This is the form of any arrow in any graph! The full internal structure of what makes an arrow in a graph an arrow in a graph! We can now, as confidently as ever, conclude that our set of arrows $\{f, g\}$ in our graph is isomorphic $\cong$ to A.

Let us quickly run through the relational definition of O in the same manner.

$\mathcal{C}(O, A)$ 

$\mathcal{C}(O, O)$ 

Above we have the set of arrows that go from O to A, which when we consult our category we understand to be empty. Below we have the set of arrows that go from O to O, which we know to be the single arrow our identity on O. We don't explicate the arrows from O to either s or t as, at least in comparison to our case of A, they are trivial and simply return id_O. We can now construct the representable functor that encodes the entirety of the internal structure of our object O! This is the representable functor $\mathcal{C}(O, -)$.

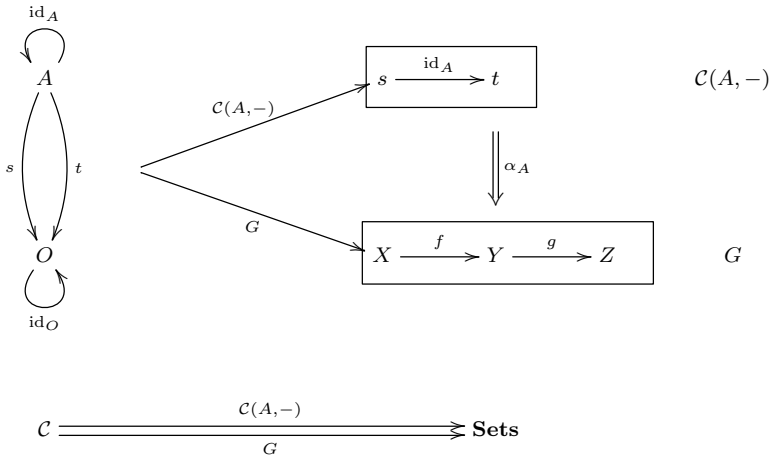
$\mathcal{C}(O, -)$ 

Our identity arrow on O is an object with an identity and that's the entirety of our internal structure for O! Notice, we have constructed a *generalized object*. This is the form of any object in any graph! We intuitively understand the objects of our graphs to be points and so we can understand this generalized object for graphs to be to be a generalized point. We can conclude that our set of objects $\{X, Y, Z\}$ in our graph is isomorphic $\cong$ to O.

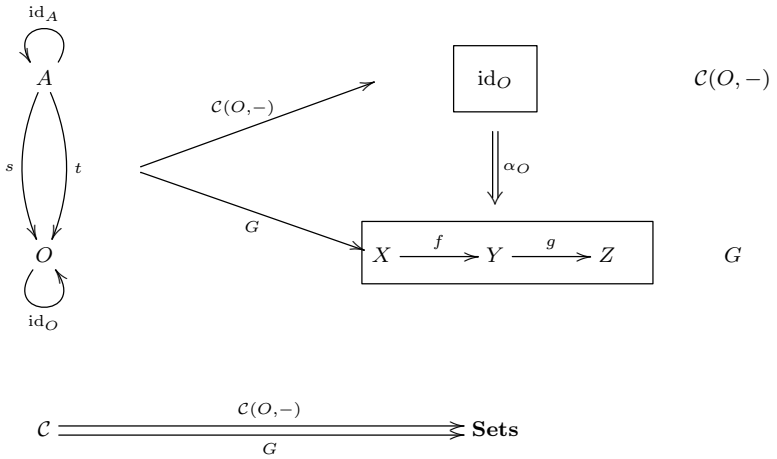
[116]Through this intuition-building exercise we have gotten ourselves close to an important lemma in category theory that will similarly be important for our purposes in engaging time, the Yoneda Lemma. The Yoneda Lemma states,

$$\text{For object } X \text{ of category } \mathcal{C} \text{ and arrow } G: \mathcal{C} \longrightarrow \mathbf{Sets}$$
$$\text{Nat}[\mathcal{C}(X,-), G] \cong G(X)$$

Let us tackle this one step at a time. On the left hand side we have a natural transformation between the hom-set $\mathcal{C}(X,-)$ and a representable functor that is a specific instantiation of our category, G. Recall that G in our example of the current model of time is a representable functor that is a specific instantiation of our category of graphs, and so we can continue to use this example to ground our understanding. Because of this, we have already constructed both $\mathcal{C}(X,-)$ and G. The left side speaks of a natural transformation between them, so let's add that in to our current example. We will look at $\mathcal{C}(A,-)$ first.



Along the bottom we have the consolidated version to ground our intuition, we have two representable functors $\mathcal{C}(A,-)$, G that go from $\mathcal{C}$ to **Sets**. Above, we have our category of graphs on the left hand side. To the right, we have two representable functors, $\mathcal{C}(A,-)$ is our generalized arrow and G is our specific instantiation of a graph, the current model of time. The Yoneda Lemma says that our natural transformation α maps our generalized arrow $\mathcal{C}(A,-)$ to arrows in our specific instantiation G. This makes sense as we have already concluded that our generalized arrow contains the entirety of the internal structure of any arrow in any graph. Thus we can imagine our generalized arrow picking out an arrow in our graph G such that, for example, id_A picks out f and with it s maps to X and t maps to Y. The same can be done with our generalized point



Here our generalized object $\mathcal{C}(O, -)$ is mapped to objects in our graph G, which again makes sense as we have concluded that our generalized object contains the entirety of the internal structure of any object in any graph. Thus we can imagine our generalized object picking out an object in our graph G such that, for example, id_O picks out X.

Now let's turn to the right hand side of the Yoneda Lemma. X is the object of our choice from our category $\mathcal{C}$ (in our example we've been using A and O), so $G(X)$ for us is either the set of arrows in our specific instantiation $G(A)$ or the set of objects in our specific instantiation $G(O)$. Putting it altogether, the Yoneda Lemma states that our natural transformation α is isomorphic $\cong$ to $G(X)$. Let's ground this in our specific example of the category of graphs $\mathcal{C}$ with our specific instantiation graph G of the current model of time, and within *this* example let's ground this in choosing $G(X)$ to be $G(A)$ while considering the relationship s between A and O.

$$\begin{array}{ccc} \mathcal{C}(A,A) & \xrightarrow{\mathcal{C}(A,s)} & \mathcal{C}(A,O) \\ {\scriptstyle \alpha_A}\Downarrow & & \Downarrow{\scriptstyle \alpha_O} \\ G(A) & \xrightarrow[G(s)]{} & G(O) \end{array}$$

Along the top we have our generalized arrow $\mathcal{C}(A, A)$ which follows the relationship $\mathcal{C}(A, s)$ to our generalized object $\mathcal{C}(A, O)$, which in this case due to the relationship we've chosen is the source object of our generalized arrow. Along the bottom we have an arrow in our graph $G(A)$ which follows the relationship $G(s)$ to an object in our graph $G(O)$, which in this case due to the relationship we've chosen is the source of our arrow in $G(A)$. Along the left we have our natural transformation α_A that maps our generalized arrow $\mathcal{C}(A, A)$ to an arrow in our graph $G(A)$. Along the right we have our natural transformation α_O that maps our generalized object $\mathcal{C}(A, O)$ to an object in our graph $G(O)$. We can verify that this diagram commutes by choosing a specific arrow, so let's choose f in our graph G. Starting from the top left, we have a generalized arrow, we follow the natural transformation α_A down which picks out our example arrow f, and then we follow the arrow $G(s)$ which returns the source of our arrow f, the object X. Going the other way, we have a generalized arrow, we follow $\mathcal{C}(A, s)$ to our generalized source object $\mathcal{C}(A, O)$, and then we follow the natural transformation α_O down which picks out the source object of our example arrow f, the object X. The diagram commutes! Now the crux of the matter: the Yoneda Lemma states that as a result of this commuting diagram, our natural transformation α is isomorphic $\cong$ to the elements of our graph G. Another way of saying this is that it is equivalent to refer to our example source object X in our graph G as being the source $G(s)$ of our arrow f from our arrows $G(A)$ or as being a mapping α_O of our generalized source object $\mathcal{C}(A, O)$ such that all structure (relationships) is preserved. We'll say it in a third way, inching closer to why this is so important, the understanding of our object X from the perspective of G is an *internal* definition and the understanding of our object X from the perspective of $\mathcal{C}(A, O)$ is an *external* definition. Specifically, the internal definition comes from an inherent, essentialist definition: we say that G is already *completely given* and then we can break it up into sets of simpler parts that themselves are *completely given*. But the external definition is demonstrative of how we've discussed defining things category theoretically: there are no inherent, essentialist definitions, rather we define things relationally, always from the stage of somewhere, from the point of view of somewhere, and our subsequent definitions are not a closed rigid boundary but rather simultaneously all-encompassing and open through its definition being the set of all relationships, which are relationships that can change, that can grow in number, that can shrink in number.

> The conceptual significance of [the Yoneda Lemma] is that it has the following relational process-theoretic interpretation: An object of a category is determined uniquely up to equivalence by the network of all internal relations that the object has with all the other objects in [the category]. (Zafiris 231)

The Yoneda Lemma states that we can define anything in this external, relational way and lose nothing through doing so. This is important for us because we have argued that we do not want to understand a moment in time as an extensionless point, the epitome of essentialist, rigidly-defined, timeless mathematics. The Yoneda Lemma tells us that we can *always* define something relationally as opposed to the essentialist picture. Let's put this into action.

[117]The first revision of time we seek to make is having the past inside of the present. Our current model of time

$$X \xrightarrow{f} Y \xrightarrow{g} Z$$

understands our moments X, Y, Z to be extensionless points whose causal relationships are bound to contiguous relations of extensionless points along the timeline. The past being inside the present violates the definition of an extensionless point; a point has a rigid boundary, a clear dividing line between what is inside (nothing) and what is outside (everything). We have discussed at length both how the past is involved in our present and how the present itself is not like a razor-edge extensionless point (confer our discussion on melody). We thus start our revision by understanding our moments X, Y, Z not with internal, fixed, $x = x$ identities. Rather, using our lessons of categorical relational defining and the Yoneda Lemma, we will understand the definition of our moments relationally. Instead of the moment Y, which we recall in our example is the moment of Jordan struggling on the toilet as Kaede tries to help her, being understood as some inherent, fixed, static, rigid definition in itself, we will define Y through the set of its relationships. At present this means understanding Z not as Z in itself, but understanding Z as g, which we can read as "Z from the point of view of Y", g encoding the moment of Kaede driving Jordan home grounded and impelled by the moment of Jordan struggling on the toilet and Kaede trying to help her, where crucially Z as an isolated, separated, clearly divided, inherently defined, fixed, rigid identity does not exist, Z is grounded and impelled by its past moment Y.

In order to include the past inside of the present, we must have more than just the immediate preceding moment, more than just the efficiently causal, informing, contextualizing, constraining our moments X, Y, Z. The first revision thus manifests itself

$$\begin{array}{ccccc} X & \xrightarrow{f} & Y & \xrightarrow{g} & Z \\ & \searrow^{h} & & \nearrow & \end{array}$$

The moment X, Jordan and Kaede first meeting at the piano bar, is now directly and explicitly present for moment Z, the moment of Kaede driving Jordan home, grounding and impelling this moment Z, causally influencing Z. Our relational definition of Z is thus $\{g, h\}$, which we can understand as Z being informed, contextualized, constrained by both the moments X and Y, the moment of Jordan and Kaede first meeting and moment of Jordan struggling in the bathroom with Kaede trying to help. This first revision of time preserves consistency of the relationships that might not seem explicitly involved. For example, thinking of Z as $\{g, h\}$ explicitly shows Z's f dependence, even though f is not explicitly included in our set of relationships of Z. Diagrammatically,

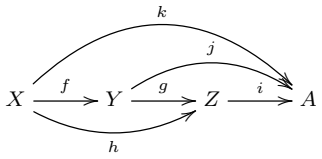
$$\begin{array}{ccc} Y & \xrightarrow{g} & Z \\ & \nearrow_{h} & \\ X & & \end{array}$$

this is how we understand the moment Z. But the past is present for each moment, not just Z. Each part contains the whole within it, and so Z being entwined with X and Y means X and Y should each be entwined with the other two in our temporal continuity. Thus we must make this diagram commute if we are to properly engage temporal continuity, such that the past is in the present.

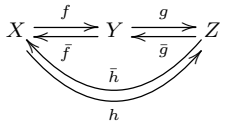
$$\begin{array}{ccc} Y & \xrightarrow{g} & Z \\ {\scriptstyle f}\uparrow & \nearrow_{h} & \\ X & & \end{array}$$

The diagram is made commutative through the existence of f, thus if we are properly engaging temporal continuity, our moment Z relationally defined as $\{g, h\}$ includes the existence of f for consistency, such that our diagram commutes.

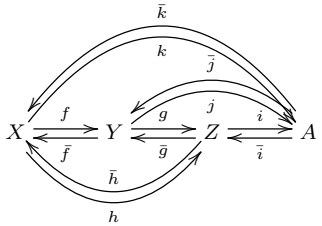
[118]The second revision of time we seek is having reciprocal determination between the virtual and the actual. Mathematically, we can understand time progressing as new moments added to our diagram that are likewise in relation to every other moment



We can understand A here as a future moment of Jordan's after being driven home by Kaede, like when she refused to answer any calls or texts, this moment having a relationship to, being grounded and impelled by, the past. As we have discussed, as time progresses so too does our relationship to past moments; during the moments immediately after the events of Jordan and Kaede's first meeting, after moment Z in our example, the identity of these events were colored by embarassment and meaningfully impacted Jordan in this way, but by the time of moment A, when Jordan feels dead, the identity of these moments is different, one of indifference, and thus influences the decisions, thoughts, and feelings of Jordan differently, but still meaningfully. The virtual is what informs, contextualizes, constrains, grounds and impels the actual, but recall that the virtual and the actual are in a dynamic reciprocally determining relationship. The ways in which an event of the past is present, how it is present, the way it is understood, felt, the way it informs, contextualizes, constrains, grounds and impels decisions, thoughts, and feelings *changes in time*. Thus the identity of a past moment is not a fixed, static one, the identity of the virtual is also in process, in unending becoming, $x \neq x$. We thus need to encode explicitly that past moments are undergoing this process of change, this unending process, lacking a fixed identity due to the dynamic reciprocally determining relationship between the virtual and the actual. The second revision thus manifests itself

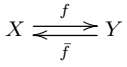


Let us be clear, our elements repel every sense of an identity. Although we label our moments with self-identical labels like $\{X, Y, Z\}$, the identity of each of these moments is explicitly not self-identical *in time*, $X \neq X$, $Y \neq Y$, $Z \neq Z$, as the creation of a new moment is the inclusion of a new part to the whole, of which all other moments have an internal, constitutive, evolving, morphing, changing relationship with. Thus when a new moment A arrives, we have



Previously, the relational definition of our moment Z was $\{g, h\}$. With the addition of moment A, the relational definition of Z is now $\{g, h, \bar{i}\}$. Not only is this a different definition on the face of it, but the moment A has a relationship with each of the stages, each of the points of view, from which we understood the relations $\{g, h\}$ in the first place. Thus if X has a different identity, then h has a different identity; if Y has a different identity, then g has a different identity. Thus Z's definition is in total flux, in unending becoming, in process due to the added relationship of $\bar{i}$ as well as the shifting identities constitutive of $\{g, h\}$. But we still retain the internal structure as diagrammed above.

In a temporal continuity, we cannot sum the parts to reach the whole, every element is mutually interpenetrating, the whole is *in each* part, where each part has a particular perspective on the whole. Recall our category-theoretic definition of an identity arrow: an arrow composed with an identity arrow returns itself $f \circ \mathrm{id}_A = f$ and $\mathrm{id}_A \circ g = g$. Relationally, we can understand an object to be isomorphic $\cong$ to another object if there exists an arrow in one direction and an inverse arrow in the opposite direction



such that $\bar{f} \circ f = \mathrm{id}_X$, $f \circ \bar{f} = \mathrm{id}_Y$. Thus X and Y are isomorphic $\cong$ objects. Notice, *our whole diagram* of our twice-revised engagement of time is composed of this kind of isomorphic relationship. Each of these parts, moments, are not distinct atoms, they are not building blocks that we have reduced our analysis of time down to, they are not mutually external identities in external relation: they are elements of a whole, a *singleton*, where the diagram as a whole is our single element in question; each of these isomorphic $\cong$ elements of the whole thus contains the whole within itself; the way in which each of these elements differ is by means of their perspective on the whole that each of them retains. Consequently, we understand every moment (whole) to be a novel creation. The conditions are just as varying as the conditioned, the virtual is changing in a dynamic reciprocal determination with the actual, and thus a novel virtual grounds and impels a novel actual. Each novel moment is unlike any other moment in history.

By shifting to a relational category-theoretic perspective, we are able to include how the past constrains the present explicitly and how the past mutates in time explicitly. However, having constructed relational definitions is not enough. The Yoneda Lemma states that internal and external definitions are isomorphic $\cong$, but we know from our empirical experience that there is no internal definition for a moment that works without subjugating time to the realm of space, there is no fixed, static, inherent, rigidly-defined identity for a moment in time, $x \neq x$. Thus if we were to only use the Yoneda Lemma to understand a spatialized time relationally but still spatially, where moments have fixed identities instead of temporally changing, unending becoming, in-process identities, we would not yet be engaging time as we intend to. We must press on.

[119]What was wrong with her? Victoria was sitting down in her library, taking in the books around her. She found great solace in the grounding that the past provided. Histories as orienting mechanisms. She knew what was happening, she had dementia. As a child, she remembered her grandmother living with them as she underwent the same. So many school projects about family trees; Victoria always misspelled her fracturing identity as dimentia.

As Victoria got older, she turned towards the past, towards history, more and more. There was always rhetoric about keeping her mind engaged to stave off the ossifying of her own fracturing identity, of losing her sense of the past, being confined to, trapped in, the present. Atlas turned to stone. She took up Latin, Greek, etymology, the origins of much of the language around her. One way of making making sure she always had one foot in the past was through seeing the words around her as all having one foot in the past, that nothing was so simply its surface understanding.

mentior, mentiri — Latin — to lie, to deceive. Her appointment with Ann bubbled back into view; what was she talking about? How many daughters did she have? Did she know something about her daughter? Did she know something about her husband? Her husband—her husband? Her husband... Victoria grabbed a photo on the end table beside her. Krzys. The two of them were in the hospital, with their tiny daughter—daughter, Jordan, unable to hold her. Her immune system wasn't doing what it was meant to. They thought they were going to lose her. But they didn't. Victoria was now more concerned about losing herself. *Mentior* could also be translated as *to invent*, typically in the realm of making up lies, making up stories. Victoria found that sometimes not knowing the true history of a word, but inventing a history of a word could be just as helpful. Both put into practice the embracing of the past, which was what really mattered. The stories she told herself may have been technically false, but they spoke a profound truth, the one she needed.

Victoria chose to be with her past, holding her own hand from when she was just a girl, and in so doing fought off the fracturing of identity through the empowering statement that comes with claiming her own identity. She refused; Victoria did not have dementia, she had di*ment*ia.

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> If we aspire to complement Bergson's inquiry into duration with mathematics, it is not to domesticate duration—and certainly not to displace the first-person experience of it. It is to amplify the alien otherness of time. Why mathematics? Will it really amplify the alien character of time? More than Cage's *I-VI* or Tarkovsky's *Stalker*? Does not mathematics, like Bergson, separate us from habitual images [...]? Even as it extends the intellect, mathematics might be alien to it—as alien as duration. Deleuze casts organic wholes and virtual problems as continuous multiplicities. This identification lets him circumvent Bergson's prohibition upon using mathematics to inquire into time. Topology was indispensable for divining the dynamics of problems. Problems are structurally isomorphic to organic wholes. Thus, topology expresses something of the dynamics of duration. (Paetsch 206)

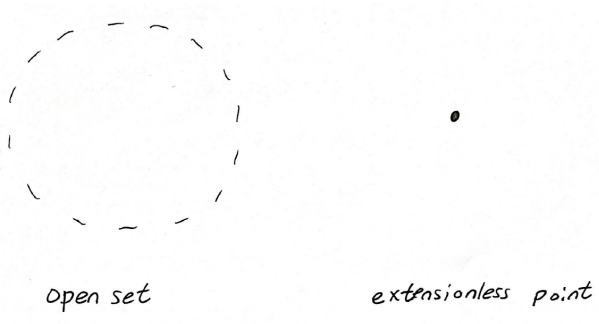
Physics strives to describe the universe as accurately as possible, and the fundamental building block being an extensionless point is a move made in the name of the more *precise* our description equals the more *accurate* description, as nothing is more precise than an extensionless point. However, in the realm of time this accuracy is not true: turning to topology, the imprecision of an open set is more accurate for our engagement of temporal reality than the precision of an extentionless point.

In category theory we learned to define things relationally, but found that we were still defining extensionless points in a relational manner. In topology we will explore the importance of *proximity* to our definitions. "[T]he fundamental question concerns proximity: what do you consider to be a neighborhood, without necessarily appealing to any quantitative means" (Sha Xin Wei 164). Quantities are the localizations of an extentionless point on the spatial continuity real line, thus if we are not using an extensionless point nor a spatial continuity, we do not anticipate temporal analysis to involve quantitative means. What do we mean when we refer to proximity?

> One example comes from atmospheric and geophysical boundaries: where does the planet Earth end and space begin as one ascends into the atmosphere? One could apply all sorts of criteria. The point at which one loses consciousness in a rising high-altitude balloon? The barometric pressure? The flux of ultraviolet light or cosmic rays intersecting a meter held in the hand? The visibility of the people waving their hands goodbye? Take the barometric pressure for example. A macroscopic body intersecting the atmosphere at extremely high speed (tens of thousands of miles per hour) and at a shallow enough angle may even glance off the atmosphere the way a rock can skip off the surface of a lake, but the same body brought slowly through the atmosphere will easily penetrate it. So the manner in which one approaches the planet certainly affect the boundedness of the planet. [...] Of course accepted boundaries are conventional, but the conventionality underlines the material fact that there is no sharp atmospheric boundary around the planet Earth. (Sha Xin Wei 165)

The *boundary* to the definition of the Earth is not inherent, fixed, rigid. It's blurry, dynamic, based on the current specific *context* for this boundary-creation (confer the choice of a Baradian apparatus for a Bohrian phenomenon) and based on *how* this process is enacted (a body approaching the Earth at a high speed and shallow angle versus a slow speed and steep angle are productive of different boundaries for the Baradian apparatus of barometric pressure chosen as one such boundary-drawing to the definition of the Earth). The takeaway here, as it has been elsewhere, is that boundaries, definitions, are not fixed, inherent, rigid. But intuitively when we speak of the Earth, we understand what is meant. The acknowledgement of the lack of a rigid, fixed, inherent boundary is *not* the same as acknowledging that nothing means anything, that communication is impossible, that we're left with a jumbled mess. We are able to *generally* know what is meant when the Earth is mentioned, subject to different contexts, to different processes, and to its constantly changing identity, $x \neq x$, in time. The topological tool of an open set captures this notion well.

To bolster our understanding, we start with a nonrigorous intuition. An **open set** is our boundary-drawing definition unit that concerns itself with proximity, a boundary that is open to the lack of fixed identity in an unending becoming, in a process, across variable contexts. An open set is a set of extensionless points where each extensionless point is surrounded by other valid extensionless points. We want to directly contrast an open set to an extensionless point in our seeking of a fundamental object by which to engage time. An extensionless point has a fixed, rigid boundary, it is an extensionless point surrounded by no other valid points. Pictorially,



The open set allows the blurriness, the dynamism, the fluctuation that we seek for the definition of a moment in time. An open set is never defined in isolation, rather it is always defined relative to a topological space. A **topological space** is a set X defined together with a collection of open sets T on that space. We use T as our letter of encoding because we refer to our specified collection of open sets as a **topology** on a topological space. Our open sets abide by three axioms

1) $X \subseteq X$ is an open set in T and $\varnothing \subseteq X$ is an open set in T.

This first axiom states that it is always the case that the whole topological space X is itself an open set in our topology T (we call this the trivial open set) as well as it always being the case that the empty set $\varnothing$ is an open set in our topology T.

2) Any union $U \cup V$ of open sets in T is an open set in T.

This second axiom states that it is always the case that, given two open sets U, V in our topology T, their union $U \cup V$ is also an open set in our topology T.

3) Any intersection $U \cap V$ of a finite number of open sets in T is an open set in T.

This third axiom states that it is always the case that, given a finite number of open sets U, V in our topology T, their intersection $U \cap V$ is also an open set in our topology T.

[121] "Yerka!" Victoria opened a new can of cat food. The plate from yesterday's food was still full, barely touched, though wet from being recently licked. Victoria washed the dish in the sink and placed down the new food.

Victoria sat down in her library, taking in the books around her. She found great solace in the grounding that the past provided. Histories as orienting mechanisms. She knew what was happening, she had dementia. As a child, she remembered her grandmother living with them as she underwent the same. So many school projects about family trees; Victoria always misspelled her fracturing identity as dimentia.

Krzys was the one who encouraged her mother to stay with them. She faded so early. Krzys sold his boat to pay for treatments, researching all kinds of experimental options, from internationally renowned researchers trying something brand new, to holistic healers known amongst their circles. Witnessing the gradual loss of my mother was draining, and nothing was off the table for Krzys when it came to someone she loved. The memory brought a smile. Victoria grabbed a photo on the end table beside her. Krzys. The two of them were in the hospital, with a tiny Jordan, unable to hold her. Her immune system wasn't doing what it was meant to. They thought they were going to lose her. But they didn't. Victoria had been more concerned with how Krzys would take the loss of their daughter than she was with herself. Krzys was near obsessive when it came to finding a way to keep Victoria's mother with them. He would say how madly in love he was and that nothing could petrify madness.

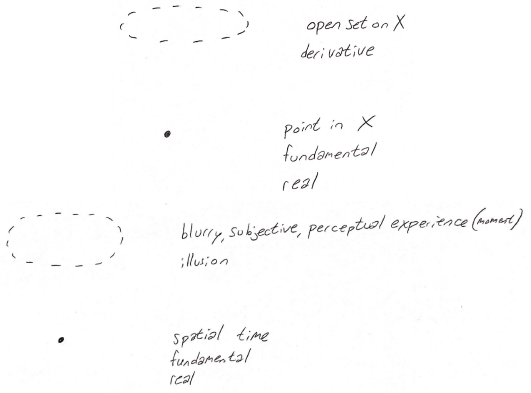
dimensio, dimensionis — Latin — the process of measuring dimension. More memories of Krzys bubbled back into view; each memory, each shade of the past further deepening the supposed dimensions of what she previously thought she understood, who Krzys was, who she was, what their marriage meant. The dimensions of what counted as an identity blurring, the memories bouncing around as echoes of noise as they layered upon themselves, amplifying each other, the next memory starting before the last one finished, contradicting and complementing themselves simultaneously. Andromeda unchained from stone. Victoria sunk herself in her past, holding her own hand from when she was just a new mother, and in so doing fought off the fracturing of identity through the empowering statement that comes with claiming her own identity. She refused; Victoria did not have dementia; she had *dimen*tia.

[122]We seek to understand a moment as an open set, so what is this topological space, the set X, that our open sets are defined relative to? We have a clue: we want this set X to be the union of all of our open sets (moments). Thus

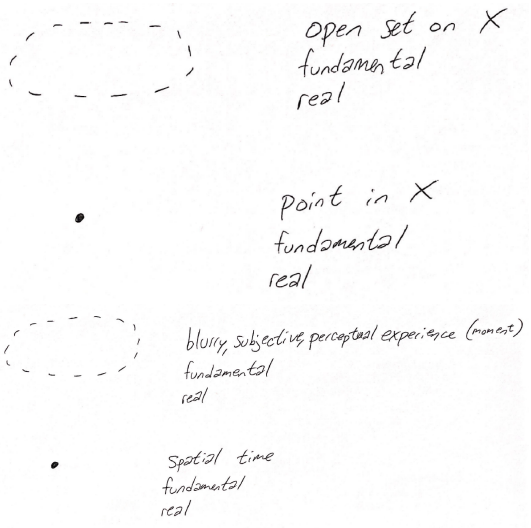
$$O(X) \cong \text{the whole past, inclusive of the present}$$

We read the left hand side as "the open sets on X" where X is our topological space. We are using an isomorphism $\cong$ and not an equality $=$ because we are looking to capture the relational definition of the internal structure of time, one that is open to a lack of identity, a fluctuating identity, whereas an equality is specifically referring to fixed identities. We include the present in the past as we affirm that the present itself is a moment among the entirety of all moments that make up time. It may be helpful to recall that an actualization of the virtual is the way that the virtual *differentiates* itself, the actual is "part" of the virtual insofar as each "part" of the virtual contains the whole within it, the present included, but what makes an actualization is its becoming into being, the moment becomes differentiated, from which this novel differentiated identity feedback loops back into the identity of the virtual, because any change changes the whole, from which a novel actualization is grounded and impelled, differentiated.

The notation $O(X)$ might give the impression that our topological space X is more fundamental than the opens sets, "open sets *on* X," that a topological space X populated by extensionless points exists first from which open sets are constructed upon. Even all of our intuition-building remarks thus far have defined our open sets from extensionless points! This mirrors the denial of time:



The notation is deceptive! It is *not* the case that the extensionless points of a topological space are more fundamental or more real than the open sets. This mirrors our argument:



[123] "Yerka!" Victoria opened a new can of cat food. The plate from yesterday's food was still full, barely touched, though wet from being recently licked. Victoria washed the dish in the sick and placed down the new food. Once the plate hit the countertop, she felt that she had already done this. Today. Numerous times. She checked the pantry and saw that she was almost out of cat food. She remembered that she picked more up only two days ago. She remembered that Yerka was not here. She *remembered*.

Her past continued to tumble in, overwhelming her present with an indefinite number of dimensions that were always there, yet somehow out of her reach. The objects around her were changing. The photo of a tiny hospitalized Jordan colored by not having seen Jordan in weeks. Books of her library colored by not having read any of them in years.

What changed? What switch flipped? She remembered that Ann spoke of a new something-or-other being used in her brain.

[124]We seek to understand the nature of our topological space X such that we can understand and leverage the fact that we need not assign a more fundamental reality to extensionless points of a space. We turn to lattice theory in order to construct a topological space from scratch. A **partially ordered set** is a set A equipped with a partial order, a binary relation $\leqslant$ which is

1) reflexive: for all $a \in A$, $a \leqslant a$
2) transitive: if $a \leqslant b$ and $b \leqslant c$, then $a \leqslant c$
3) antisymmetric: if $a \leqslant b$ and $b \leqslant a$, then $a = b$

Let A be a partially ordered set $\leqslant$ and S a subset of A. We say an element $a \in A$ is a **join** for S, written as $a = \bigvee S$ if

1) a is an upper bound for S, i.e. $s \leqslant a$ for all $s \in S$
2) if b satisfies $\forall s \in S(s \leqslant b)$, then $a \leqslant b$

We define the least element of a partially ordered set $\leqslant$ as $\bigvee \varnothing = 0$. Let A be a partially ordered set $\leqslant$ in which every finite subset has a join. Then the binary operation $\vee$ and the least element 0 satisfy

1) $a \vee a = a$
2) $a \vee b = b \vee a$
3) $a \vee (b \vee c) = (a \vee b) \vee c$
4) $a \vee 0 = a$

for all a, b, c. Intuitively it is helpful to think of our binary operator as the logical-'or,' but we must remember that our formal logics that use $\vee$ as a logical-'or' are operating within a system of intrinsically defined identity, $x = x$, of extensionless points. Notice, our use of the binary operator $\vee$ between elements $a \vee b$ is resonant with our use of the union $\cup$ between two open sets $U \cup V$. We are in the process of building a topological space that allows for open sets (our moments) to be fundamental. We've not once claimed that the elements of our partially ordered set a, b, c are extensionless points. It will be instructive for later to think about a, b, c not as extensionless points but as open sets.

A join-semilattice is a partially ordered set A equipped with our binary operation $\vee$ and a least element 0. We encode a join-semilattice as $(A, \vee, 0)$. A simple example is as follows

$$0 \leqslant a \leqslant b \leqslant c$$

In order to ground intuition, we turn to our example of time with the caveat of not including our second revision of reciprocal determination. In the above join-semilattice we can imagine having the same scenario we've been using, of Jordan and Kaede meeting at the piano bar encoded in a, of Jorden struggling in the bathroom with Kaede trying to help encoded in b, of Kaede driving Jordan home encoded in c. We can then understand that a comes before b comes before c. However, the boundary to what these moments are isn't so clear. Do we include the moment where Kaede demands to drive Jordan home as part of b? c? Both? Neither? Context dependent? Ever-changing? This is part of the fuzziness we are looking to embrace. Recall our discussion on melody, limiting our moments down to extensionless points in order to affirm a number line that is more real than this blurriness as an attempt to clear up this blurriness does not clear the blurriness up, rather it denies the reality of our experience, denies the way in which this unified blurry moment, like hearing a melody instead of isolated and unrelated tones, effects, affects, grounds and impels Jordan, Kaede, ourselves.

The same constructions can be made for an element $a \in A$ being a **meet**, written as $a = \bigwedge S$, the dual of our join. We subsequently have a greatest element $\bigwedge a = 1$ and a binary operation $\wedge$ that we can intuitively engage by calling to mind from formal logic the logical-'and'. Our binary operator $\wedge$ between elements $a \wedge b$ is resonant with our use of the intersection $\cap$ between two open sets $U \cap V$. Again, the elements of our partially ordered set a, b, c need not be extensionless points but rather open sets and we advise for this to be latched onto. Thus a meet-semilattice is a partially ordered set A equipped with our binary operation $\wedge$ and a greatest element 1. We encode a meet-semilattice as $(A, \wedge, 1)$.

Putting our join-semilattice and meet-semilattice together, a **lattice** is a partially ordered set A that is equipped with both operations $\vee, \wedge$ and both a least element 0 and a greatest element 1.

Thus we can refine our example to be

$$0 \leqslant a \leqslant b \leqslant c \leqslant 1$$

There is nothing inherently special about either the least element or greatest element in practice, the lowest element in a partially ordered set can be understood as 0 and the highest element in a partially ordered set can be understood as 1. Thus we can say 0 is the moment of Jordan driving her mother home, a is the moment of Jordan and Kaede first meeting at the piano bar, b is the moment of Jordan struggling in the bathroom with Kaede trying to help, c is the moment of Kaede driving Jordan home, and 1 is the moment of Jordan ignoring all texts and calls, when she is feeling dead. Without reducing any of these moments to extensionless points, we understand our logical-'or' $\vee$ as being the union of open sets, of

moments, that what is being referred to is amongst the union of these two moments where each retains the blurry identity. Similarly, we understand our logical-'and' $\wedge$ as being the intersection of open sets, of moments, that what is being referred to is amongst the shared pieces of the moments in time, where each moment retains the blurry identity, where we might say, dependent on context, that the moment of Kaede demanding to drive Jordan home belongs to the intersection of b and c, $b \cap c$.

[125] "You're aware of who I am?"

"I don't know how long this will last."

"Victoria, do you think—"

"Listen to me. I need more of the green trial."

"I got rid of it all."

"But we had just started using it?"

"I was going to tell you that we were stopping. I can't do it anymore."

"Well you must have just thrown it out, which bin is it in? I need it."

"I dumped it all back into the ocean."

Victoria dropped the garbage lid she was holding. "Why did you ask me how many daughters I have?"

Ann fell silent. "Jordan was so sick, you know this."

"Yes, she was. She got through the worst of it though."

"We expected her to die. There was no other path, every which way we looked at the situation it ended the same. It was that dire. You remember, don't you?"

"What is it that you're saying?"

"We needed to think outside of the box. We were grasping at straws to save her life."

"Did Jordan die?"

"I don't know."

"What does that mean?"

"Krzys killed himself shortly after."

"After what, Ann? I'm sick of living in the dark."

"One of them has a mark on her ankle. I don't remember which. We didn't make records."

Victoria stared at the woman in front of her a bit harder. She was furious but had trouble putting her finger on the what. Awareness fading. Snatching a pen attached to a clipboard, scribbling on her hand.

[126]A subset I of a join-semilattice A is said to be an **ideal** if

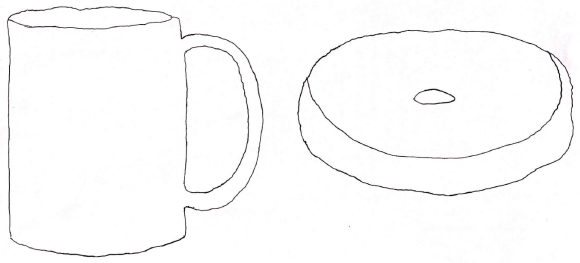
1) I is a sub-join-semilattice of A; i.e. $0 \in I$ and $a \in I$, $b \in I$ imply $a \vee b \in I$
2) I is a "lower set"; i.e. $b \in I$ and $a \leqslant b$ imply $a \in I$

Returning to our example

$$0 \leqslant a \leqslant b \leqslant c$$

we can say that the ideal at a refers to the moments that start at the beginning of the partially ordered set (0, Jordan driving her mother home) up through a, the moment of Jordan and Kaede first meeting at the piano bar. Similarly we can say that the ideal at b goes from 0 up through b. For any $a \in A$, the subset $\downarrow (b) = \{a \in A | a \leqslant b\}$ is an ideal of A. This is the smallest ideal containing b, so we call this the **principal ideal** generated by b.

A semilattice arrow is a map that preserves structure, i.e. a map that preserves, in the example of a join-semilattice, the distinguished least element 0 and the binary operation $\vee$ such that all relationships that existed with $\vee$ still hold. Notice, we are discussing a relational definition again, like what we did during our excursion into category theory. A semi-lattice arrow is a mapping that preserves the *internal structure* while letting go of any notion of a fixed identity. Recall our intuitive discussion on topological invariants when we engaged a coffee mug and a donut.



The internal structure, defined by means of the topological invariants, for these two objects is the possession of exactly one hole, the handle of the coffee mug and the center of the donut respectively. Thus one object can be changed into the other, evolve into the other, morph into the other, thus no longer retaining the sense of identity we ascribe to "coffee mug" or "donut," $x \neq x$, but still retaining the internal structure. This is another example of an isomorphism $\cong$, we say the coffee mug and donut are isomorphic $\cong$ if the only thing we care about is having an object with one hole. We are learning how to engage something that possesses no fixed identity, $x \neq x$, we do so via the internal structure between isomorphic $\cong$ objects; the lack of a fixed identity does not leave us with a jumbled mess, we can still engage time on time's terms, there is internal structure.

Let $f : A \longrightarrow B$ be a semilattice arrow. Then the set $\{a \in A | f(a) = 0\}$, what we call the kernel of f, is an ideal of A. However, a surjective lattice arrow, i.e. one where every element of the arrow's codomain is mapped to by *at least* one element in the arrow's domain, is not determined by its kernel. For example, if $A = \{0, a, 1\}$ is a totally ordered set, there is a lattice surjection from A to the two element lattice $\{0, 1\}$ having kernel $\{0\}$, the same kernel as the identity mapping on A.

Each of these lattice arrows have the same kernel and thus the lattice arrow can't be determined from only access to its kernel. Pausing, what is it that we're trying to do here? We are inching towards constructing a topological space X that has open sets (moments) as fundamental rather than extensionless points as fundamental. Part of both our reason for doing this and the process of doing this involves an embracing of a lack of identity, $x \neq x$, as both our moments and the whole union of our moments, the virtual, the past, change in time. We are looking to engage the internal structure of time such that we can meaningfully engage time without spatializing time, i.e. subjugating time to a domain of fixed identity, where we have equalities $=$ and formal logics relating timeless, inherently, rigidly defined extensionless points, where the methodologies of deducing from static axioms or reducing to static eternal simple parts dwell. We are building our topological space (the virtual) through lattice theory. In accordance with the lack of identity, $x \neq x$, of the virtual, we need to understand what

of the internal structure is necessary to have in order to preserve isomorphism $\cong$ of our lattice, of our topological space X, of the virtual, of the past. What we have just concluded is that it is not enough to have the kernel of our lattice arrow because the kernel is not enough to recover the way in which our topological space X is changing. Understanding what we need to have for our lattice arrow to be an isomorphism $\cong$ is important because there will eventually be a fork in the road where the elements of our lattice can become fixed, extensionless points, recovering point-set topology and the intuition that the extensionless points of our topological space are more fundamental or more real and all of the similar set-theoretic baggage we are trying to shed for engaging time, and it is at that point that we will choose not to have our elements become extensionless points.

Continuing, to determine the surjective part of our lattice arrow $f: A \longrightarrow\!\!\!\!\!\rightarrow B$ we thus have to look at the inverse images of other elements of B besides 0. In particular, we may consider $\{a \in A | f(a) = 1\}$ which satisfies axioms dual to those defining an ideal. We call this subset of A a **filter**.

Let I be an ideal of a lattice A. The following are equivalent:

1) The complement of I in A is a filter
2) $1 \notin I$ and $(a \wedge b \in I)$ implies either $a \in I$ or $b \in I$
3) I is the kernel of a lattice arrow $f: A \longrightarrow\!\!\!\!\!\rightarrow 2$ where 2 denotes the two element lattice $\{0, 1\}$

An ideal which satisfies these is called a **prime ideal**; dually, its complement a prime filter. Prime here refers to an ideal or a filter which is *maximal* amongst ideals disjoint from filters, amongst filters disjoint from ideals.

[127]The past was being rewritten. The story Victoria knew, the story she'd been living, was a lie. The last truth she felt she knew, the last foothold of stability she can rely on, a memory to fall back on, was the limitless love of Krzys, his love for her mother, for Jordan, for her. The life Victoria had lived was crumbling, getting foggier, hazier, what was it all built on? She felt the dementia threatening to take away her memories. She felt the dimentia threatening to reduce the available dimensions. Clinging onto names teeming with history: Who was her daughter? The one she's raised? Is she her *real* daughter? Does she have a second daughter, real or otherwise, living out in the world?

Victoria parked the car at the beach. Nightfall. Jordan's truck adjacent. Victoria walked towards the shore, the black abyss of the agitated foundation blending with the horizon where a foggy, starless sky loomed over, threatening to swallow the sea by sheer proximity. The water was still an impenetrable murk, but there was a dim, persistent glow of green, incubating beneath the surface. Jellyfish bloom. Each crystal jelly lighting up the area directly around them. The green light was enough to see directly in front of her. Holding her hands up, she read her own handwriting

[128]If our lattice arrow $f: X \longrightarrow Y$ is continuous, then by the definition of continuity, f^{-1} is a structure preserving arrow which restricts to $f^{-1}: O(Y) \longrightarrow O(X)$. We now return to category theory! The category of **frames** is the category whose objects are complete lattices satisfying the infinite distributive law

$$a \wedge \bigvee S = \bigvee \{a \wedge s | s \in S\}$$

and whose arrows are continuous maps that preserve structure, the finite meets and arbitrary joins. Our continuous lattice arrow is thus a frame arrow $f: X \longrightarrow Y$.

The category of **locales** is the category that is the *opposite* of the category of frames. In category theory, the opposite of a category is the construction where all of the arrows are reversed. Thus, by the definition of continuity, our inverse continuous lattice arrow is a locale arrow $f^{-1}: O(Y) \longrightarrow O(X)$.

Notice, the objects of our locale are composed of *open sets* in contradistinction from the extensionless points that compose a frame. Working within the category of frames is thus the domain of point-set topology, whereas working within the domain of locales is, well, different. The fundamental unit being an open set means that a point-set space, a frame, can only hope to, at best, *approximate* the locale in question, as it tries to put fixed, rigid boundaries of precision on something whose fundamental objects were not so fixed. We could say this is a form of spatializing. Depending on where we start, we can approximate extensionless points out of the open sets of our locale, or we can construct open sets out of the extensionless points of our frame; neither frame nor locale, extensionless point nor open set is more fundamental or more real than the other. Our understanding of the state of the field is that locale theory is mostly pursued by those involved in pure mathematics, exploring the area "because it's there". It is our argument that locale theory finds an application within physics: it is the appropriate topological space used to engage time on time's terms, where there is unending becoming, no fixed identity, $x \neq x$, inclusive of the virtual and the actual and the dynamic reciprocally determining relationship between them. To do otherwise would be to spatialize time, which is exactly what we are pushing against.

And so, we've done it, we have a locale $O(X)$, a topological space where open sets are fundamental. We retain the entirety of our understanding and usage of open sets in a topology T, where we understand the elements of our locale to be the open sets in our topology. Crucially, converting this locale into a frame would be an *approximation*, the worst consequence of which involves fixing the identity of our moments into extensionless points or even setting up a mathematical regime that is a hop, skip, and a jump away from affirming extensionless points in time as more fundamental, concluding that our empirical experience is an illusion. We clarify, we do not assert that open sets are more fundamental across all of physics, rather we are learning from our excursion through lattice theory and locale theory that point-set topology and point-free topology are *meaningfully different*, with neither having a claim at which is more fundamental, where each has to be used as the appropriate tool for the appropriate occasion. Thus we do not claim that our empirical experience of time is an illusion, rather we learn and develop new tools that better engage time in accordance with our empirical experience. This being said, that means the spatialized times of Newton and Einstein are still important, productive, and immense feats. We embrace them on the condition that we acknowledge them to be spatialized times and not time understood temporally, inclusive of the virtual and actual and the dynamic reciprocally determining relationship between them. Thus we would like to be able to understand the mechanism of approximating a locale with a frame, as we expect this process to extract spatialized time.

129

[130]We know that an extensionless point of a space X is the map

$$\mathbf{1} \longrightarrow X$$

By analogy, we claim that it is reasonable to say that a "point" of a locale A is the map

$$O(\mathbf{1}) \longrightarrow A$$

where we have open sets on $\mathbf{1}$ because the fundamental objects in locales are open sets. Through the axioms of open sets, we understand $O(\mathbf{1})$ to be the 2 element set $\{0, 1\}$, the empty open set and the trivial open set. We can then rewrite our localic point as

$$2 \longrightarrow A$$

The category of frames is the opposite category of the category of locales, so if we want to know what an extensionless point is in our frame that approximates our locale, we can flip the arrow in our definition of a localic point. Thus we get that a point p of our frame that is approximating our locale is understood as the frame arrow

$$p : \ A \longrightarrow 2$$

We've learned that a frame arrow is determined by its kernel $p^{-1}(0)$ and its dual kernel $p^{-1}(1)$, which are respectively the prime ideal and the prime filter of our locale A as they are each the maximal ideal disjoint from a filter and maximal filter disjoint from an ideal. We know that our prime ideal is also a principal ideal

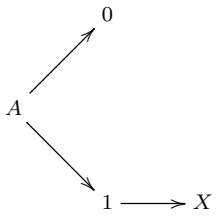
$$p(\bigvee(p^{-1}(0))) = 0$$

which says that the join of all elements of A whose p-image is 0 that are then taken along p return 0. This is a principal ideal because it is the smallest ideal we can generate. Thus

$$p^{-1}(0) =\downarrow (\bigvee(p^{-1}(0)))$$

our ideal is a prime principal ideal. The same argument can be run dually to conclude that our filter is a prime principal filter.

What this means is that the extensionless points of our frame approximating our locale A are in bijective (one-to-one) correspondence with our prime elements, i.e. with our prime filters that generate prime ideals (the inclusion of the qualifier principal is a special case we've considered). Diagrammatically,



where we understand our one element set involves our prime filters, which generate prime ideals in the locale via its complement, and our prime filters are our extensionless points of the space X. Note that this process is dependent on what our starting locale A is, so it is possible to have a locale A that maps nothing to 1, consisting only of ideals and no filters. We say that these locales "don't have enough points" to be approximated by a frame.

Notice the clever reversal! Instead of regarding open sets as sets of extensionless points, we regard extensionless points as sets of open sets. Namely, the set of open sets that map to 1 is our definition of an extensionless point, constructed out of a locale. To be clear, if X is a space and p a point of X, then the prime filter in $O(X)$ which corresponds to p is $\{U \in O(X) | p \in U\}$, the neighborhood filter of p.

We can encode the arrow of filters of a locale A to the extensionless points of its corresponding space as

$$\phi : \ A \longrightarrow p(X)$$

[131] "Mom?"

The feelings were too complicated, too tangled in a series of lies, stories, the process would be too difficult. She didn't have the will to fight. Victoria barreled past Jordan and into the water.

"What are you doing? There are jellyfish in there, they sting! Mom!"

Jordan was following her in but this wasn't her decision. She had to live out her own life, her own lie, her own story, making it real.

Medusa, the mortal Gorgon. Of the realm of the living, of the realm of the lying, of the realm of invention, of the realm of time. She wielded the power of condemning those around her to the realm of the eternal, the timeless, as she continued her journey of movement, flight, unable to be fixated, grounded, not stone herself but turning those around her to stone. Victoria knew jellyfish were medusas, able to turn her living body into a mountain, like Atlas, like the stone Andromeda was shackled to.

Victoria sunk herself into the light, submerging her whole body. She looked up at the daughter she had raised. Neither of them had any footing on the ground, it was far beneath. The water and the jellies blurred her vision but her daughter was still visible, the boundary of her being blurred, distorted. Jordan was flailing, no doubt trying to interfere.

[132]Returning to time, we want to understand a moment as an open set and the virtual as the collection of all moments, and see how this meshes with our spatial understanding of time. We define

$X \equiv$ the spatial past, (inclusive of the spatial present)
$p(X) \equiv$ a particular extensionless point of X, which we choose to be the spatial present
$O(X) \equiv$ the virtual, the moments of the past (inclusive of the actual)
$A \equiv$ a particular moment of $O(X)$, which we choose to be the actual, the moment that differentiates itself as the present

We must be clear, understanding the virtual as an integrated *sum* of all of our moments would be to think spatially. Each moment contains the whole within it, we are engaging a temporal continuity. Thus each novel moment affects the identity of the whole and each of its parts, as each contains the whole.

If we encode the mapping that restricts to, picks out the actual from the virtual as f and the mapping that restricts to, picks out the spatial present from the spatial past as $\bar{f}$, together with our arrow ϕ that maps the spatial approximation of our localic moment A to $p(X)$, we construct the following diagram

$$\begin{array}{ccccc} & & X & \xrightarrow{\bar{f}} & p(X) \\ & & & & \uparrow{\scriptstyle \phi} \\ O(\mathbf{1}) & \xrightarrow[O(x)]{} & O(X) & \xrightarrow[f]{} & A \end{array}$$

We include more moments than spatial extensionless points because there is always a virtual that is informing, contextualizing, constraining the actual, we are always in the *middle*, never at the beginning. Let's understand this through our example, where our 5 moments are the same moments that we used before in our lattice. We can understand t_1 as being the spatialized time extensionless point associated with the differentiated moment M_3, which we know involves the interpenetration of M_1, M_2, all of which informing this moment. We can relate the efficiently causal relations at t_3 in all of their precision to this blurry, dynamic, temporal moment. The same holds for t_4 with M_1, M_2, M_3, M_4 and t_5 with M_1, M_2, M_3, M_4, M_5.

$X = \{t_1, t_2, t_3\}$
$p(X) = \{t_3\}$
$O(X) \cong \{M_1, M_2, M_3, M_4, M_5\}$
$A \cong \{M_5\}$

We again pay a reminder that despite A looking like a single element set, M_5 in fact contains the whole of the virtual within it, in this example $\{M_1, M_2, M_3, M_4, M_5\}$. We delineate A as the set $\{M_5\}$ to communicate the particular perspective that M_5 has on the whole. We again pay a reminder that we use isomorphism $\cong$ instead of equality $=$ for our definitions of the virtual and the actual because we are not fixing their identities, rather we are engaging their internal structure, allowing the identities of $M_1, M_2, M_3, M_4, M_5, A, O(X)$ to change, morph, become in time.

[133]Fracturing–

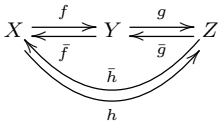
Bi — Latin —a prefix meaning two. *Di* — Greek — a prefix meaning two, but with nuance, often meaning *between* or *through*. Did she have two daughters, or raise one between them? Did the so-called "truth" matter regarding which was her *real* daughter? Was she herself two different people, one living a truth and one living a lie? Does the so-called "truth" enact this dividing line between the two or reinforce their inseparability? Victoria chose to be with her past, holding her own hand in this very moment, and in so doing fought off the fracturing of identity through the empowering statement that comes with claiming her own identity. She refused; Victoria did not have dementia, she had *di*mentia.

[134]We can now put our category-theoretic and our topological puzzle pieces together! Let us remember our key takeaways

1) Our moments will be defined relationally such that a moment can be informed, contextualized, constrained, grounded and impelled by the whole past, not just the immediately preceding contiguous extensionless point, including the unending becoming of past moments themselves by means of reciprocal determination, and such that a moment is not defined *in itself* as an inherent, fixed, static identity. We acknowledged that the latter part only lead to us defining a moment *relationally* as an inherent, fixed, static identity, which prompted

2) Our moments will be open sets on a locale, such that they embrace a lack of an inherent, fixed, static identity.

Let us bring back the twice-revised category theoretic model we constructed.



We said that we could refer to a moment Z as the set of arrows whose codomain is Z. Let's formalize this.

A **covering** of an object Z is an arrow into Z. We can then define or construct the object Z as the total set of coverings of Z

$$\{\ Z_i \longrightarrow Z\ \}_{i\in I}$$

Notice the resonance with topology, a topological space is likewise defined or constructed as the total set of open sets on the space.

In our example, our set is composed of $h:\ X \longrightarrow Z$ and $g:\ Y \longrightarrow Z$, understand as the moment Z, the moment where Kaede drives Jordan home, is related to, defined through, grounded and impelled by the moments X and Y.

We have motivated and argued that relationships are fundamental and productive of objects, productive of identities, so it is both beneficial and clarifying to define an object not as an object in relation to other objects (which keeps the object-oriented, set-theoretic, always already constituted eternal essences backbone), but for an object Z to be the set of all arrows into Z. We encode this as

$$\{\psi_i:\ Z_i \longrightarrow Z\ \}_{i\in I}$$

which we consolidate down, both for cleanliness and to better bolster our arrow-oriented understanding, to

$$\{\psi_i\}_{i\in I} \cong Z$$

We call this a **sieve**, and in our specific case a sieve on Z. Our moments are now defined through a sieve, a set of coverings. Let's better understand the properties of a covering in our category.

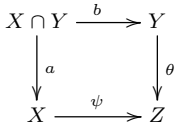
A **Grothendieck topology** on a category $\mathcal{C}$ is a collection of collections

$$\tau(Z) \supseteq \{\psi_i\}_{i\in I}$$

for all coverings and for each object (where here we've only specified the object Z as an example), such that the following properties hold

1) If a covering $\psi':\ Z' \longrightarrow Z$ is an isomorphism $\cong$ then ψ' is a covering in τ

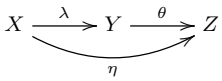
2) If a covering $\psi:\ X \longrightarrow Z$ is a covering in τ, and a covering $\theta:\ Y \longrightarrow Z$ is a covering in τ, then the intersection of the coverings is a covering in τ. Diagrammatically,



We can understand this diagram by choosing a particular perspective in our Grothendieck topology such that we can define our sieves

$$\tau(Z) \cong \{\psi, \theta\}$$
$$\tau(Y) \cong \{b\}$$
$$\tau(X) \cong \{a\}$$

3) If a covering $\theta : Y \longrightarrow Z$ is a covering in $\tau(Z)$, and a covering $\lambda : X \longrightarrow Y$ is a covering in $\tau(Y)$, then $\eta : X \longrightarrow Z$ is a covering in $\tau(Z)$. Diagrammatically,



where $\eta = \theta \circ \lambda$

A **site** is a pair $(\mathcal{C}, \tau)$, a category and a Grothendieck topology. In a site, we can understand and treat our objects in the category as open sets, defined relationally and understood arrow-theoretically via sieves of coverings.

[135]Holding her breath, the lack of oxygen making her head feel lighter. Her thoughts were fracturing, bouncing around as echoes of noise as they layered upon themselves, amplifying each other, the next memory starting before the last one finished, contradicting and complementing themselves simultaneously. Losing her identity. She felt it. The dementia, the dimentia, there wasn't going to be much time before she lost her agency. Jordan was thrashing around. She could hear faintly a string of apologies, desperate pleas not to leave, hysteria, confusion. Victoria opened her mouth. Jordan noticed, stopped, treading water, staring down at her mother beneath the surface, surrounded by layers of translucent green. Victoria had lost the ability to speak for weeks, she felt how important final words would be, she felt how important an explanation would be.

[136]The actual moment A of our arrow $\phi: A \longrightarrow p(X)$ can now be understood not simply as a categorical locale, but as a site $(\mathcal{C}, \tau)$ whose elements that inform, contextualize, constrain, infect, define, overwhelm, its virtual are understood as open sets, open sets that change, evolve, become *in time*, embracing a lack of any inherent, fixed, static identity. We can rewrite this arrow as

$$\mathcal{C} \xrightarrow{\phi} \mathbf{Sets}$$

Recall that an arrow of this form is a representable functor. Here we will be even more specific, when our category $\mathcal{C}$ is equipped with a Grothendieck topology, that is, when it is a site, then this arrow is called a **presheaf**. We were interested in this arrow as a way of connecting the temporal virtual and actual to the spatial understandings of past and present.

Diagramming a moment from the *beginning*, not the middle, is related to an experience of time where the amount of past that is present is a limit case of as little as possible. We have on the mind a piece of inorganic matter, whose causal trajectory is entirely determined by the spatialized time of physics. We must be clear, this is a particular experience of time, one such "mode of being" in time; but our engagement of time as an autonomous property of the universe must be able to include all experiences of time from which each "mode of being" is a particular restriction of. Our presheaf diagrams this limiting case moment as

$$X \xrightarrow{\phi} t_1$$

$$\mathcal{C} \longrightarrow \mathbf{Sets}$$

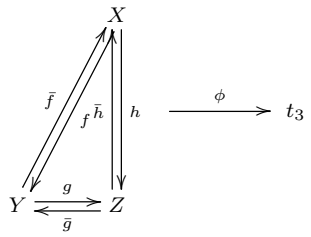
We can see that the virtual, the past that informs, contextualizes, constrains, grounds and impels this actual moment is just the moment itself, thus we can understand our spatial extensionless point t_1 as being causally related to the immediate moment. The next moment in such a system looks like

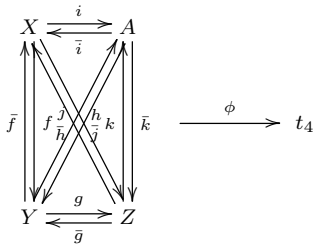
$$Y \xrightarrow{\phi} t_2$$

which is exactly what we would expect given our familiarity with classical causality. However, let's look at what this second moment looks like *in general*, that is *for time itself*, before restricting down to a particular "mode of being" like inorganic matter. This more nuanced, more complicated diagram should resonate more closely to our own "mode of being" as humans, where we have a more nuanced, more complicated experience of time than inorganic matter.

$$\begin{array}{ccc} X & & \\ \uparrow \bar{f} \;\; \downarrow f & \xrightarrow{\phi} & t_2 \\ Y & & \end{array}$$

This thus encodes how the past moment X and the present moment Y *both* causally inform the spatial present t_2. This engages the internal structure of time as an autonomous property of the universe, the past, the virtual, history amassing – it is via a particular "mode of time," be it the experience of being Jordan or the experience of being Kaede, the experience of being Ann or the experience of being Victoria, where we understand each of these "modes" as being possessed by some degree of the one, whole, unified virtual, differentiated in its actualization, the actual being discrete, not sharing their own "personal" virtuals with anyone else. The virtual is accumulating, its identity morphing with every moment it swallows, the novelty of this identity grounding and impelling its next meal, the unending becoming of time itself, the ground was shifting beneath its feet stably in place of currents sweeping gyres inside its head...





[137]Her mind fleeting–trying to capture, to nail down, to stabilize any phrase of love, of acceptance, of forgiveness, of anything. But nothing stuck, nothing calcified. There was no time. Victoria inhaled. Lungs filled with silt and slime.

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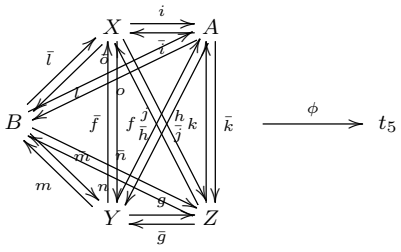
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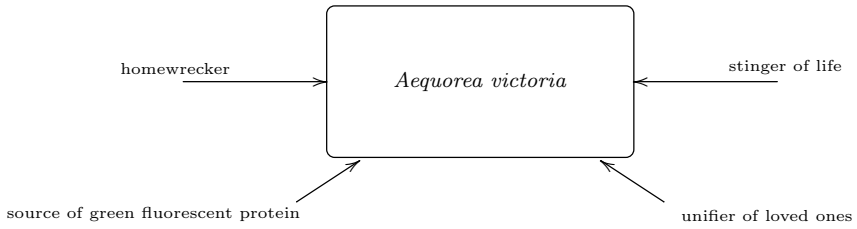
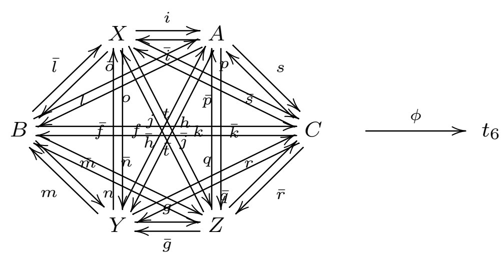
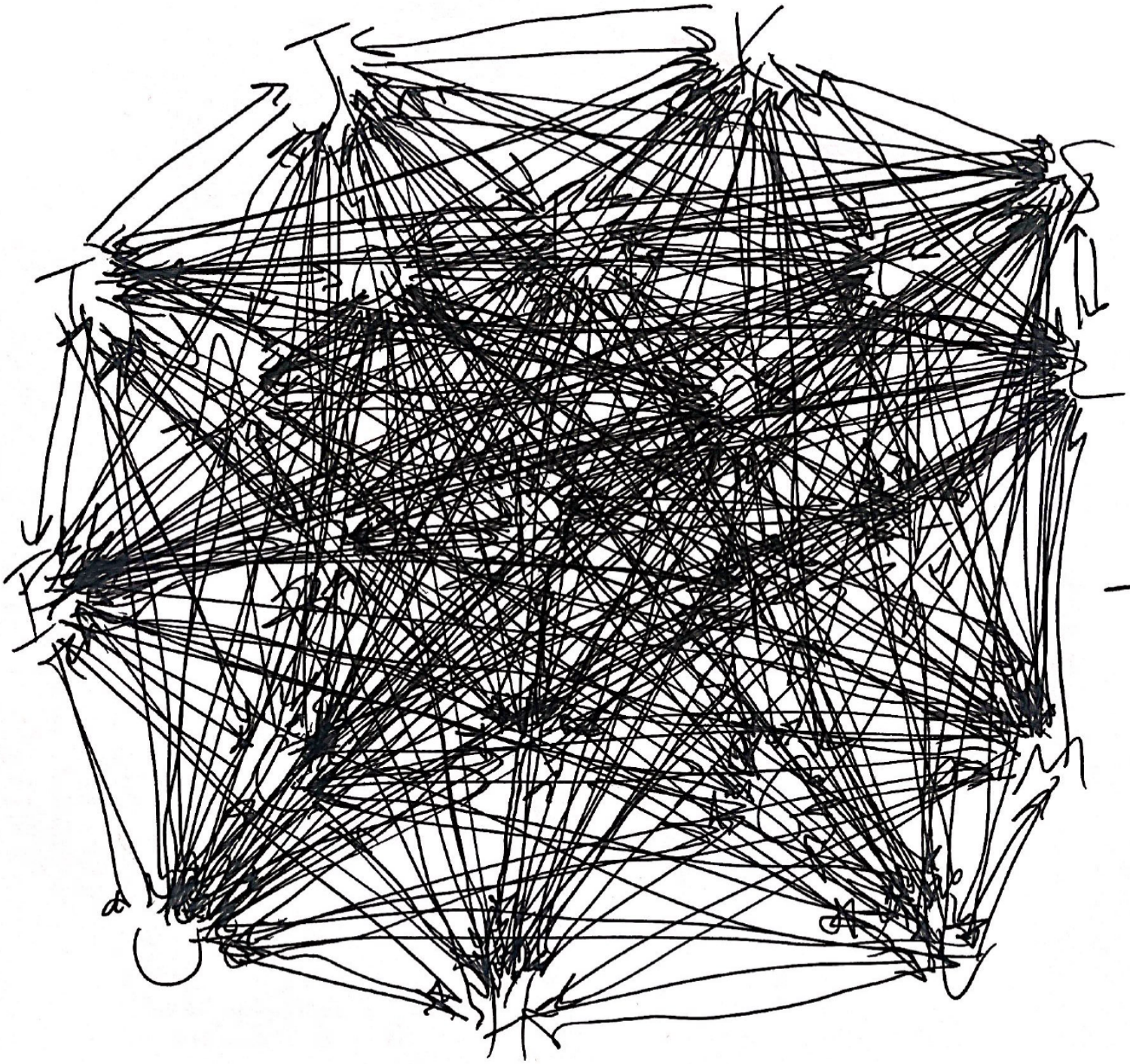
139


homewrecker
Aequorea victoria
stinger of life
source of green fluorescent protein
unifier of loved ones

140

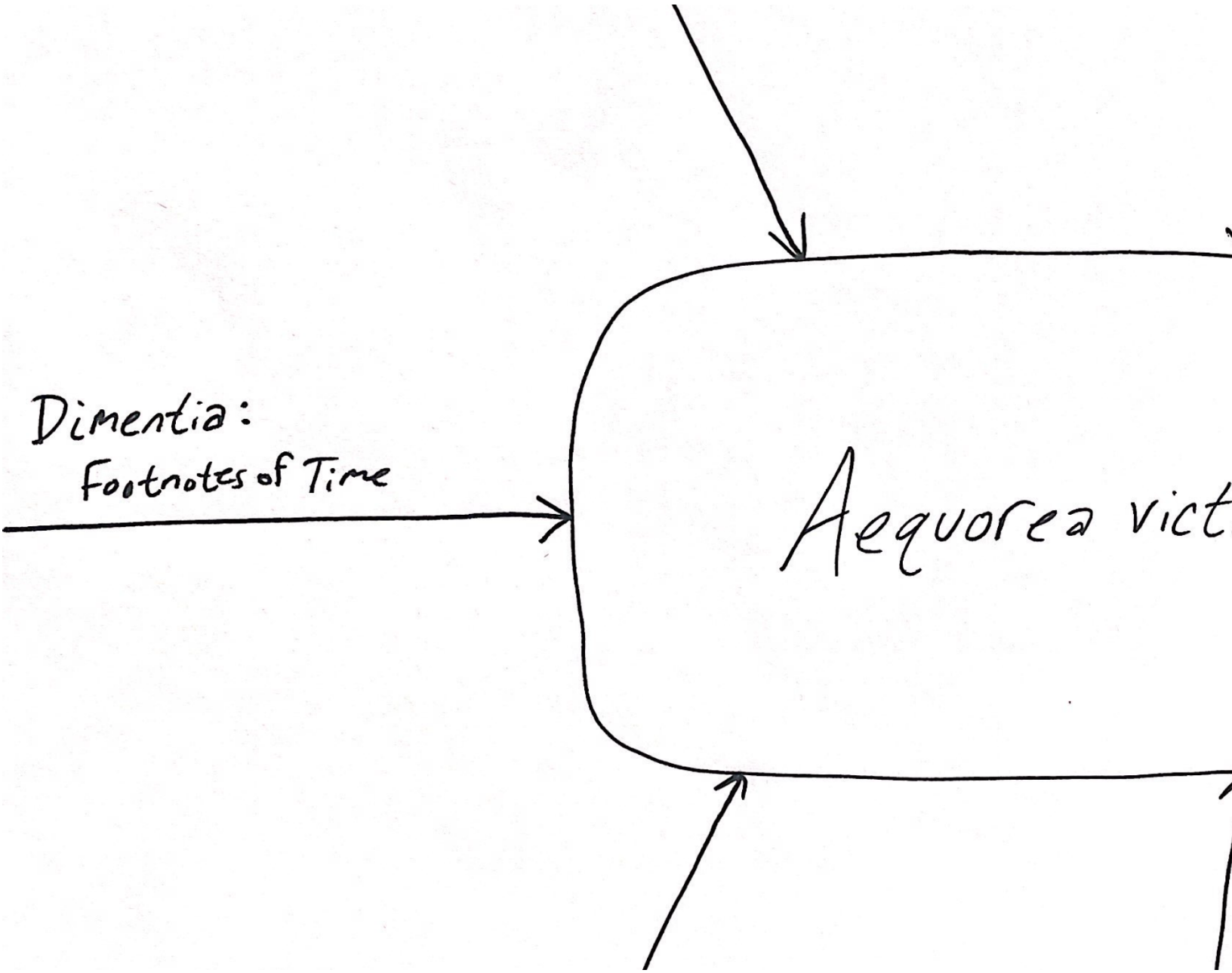


[141] What makes a narrative satisfying? When it feels satisfying. When there are themes repeated, character's that progress through emotional arcs, self-references and call backs, a circle that closes by returning to the beginning, a beginning and end always understood as middle. In a phrase: the past is present for the story. The past is present for the experience of the story. If all that was written was a string of sentences of the form, "Alice sent x to Bob" it is overwhelmingly apparent that this is neither a narrative through Alice's eyes nor Bob's eyes, even if it could be. Experience is emphatically local.



[143]A text is an already formed object, something to engage. Footnotes are our experience with a text, our own engagement of a text, writing in the margins, underlining, drawing faces, adding question marks.

There is no text of time. Only footnotes of time.


Dimentia:
Footnotes of Time
Aequorea vict

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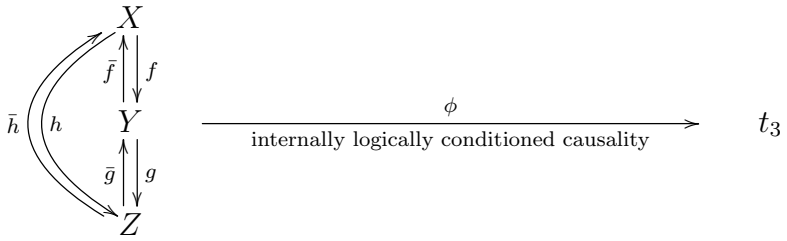
VIRTUAL $\xrightarrow{\text{grounding, impelling}}$ ACTUAL

LACK OF IDENTITY NOVEL IDENTITY

$(\mathcal{C}, \tau) \xrightarrow{\text{presheaf}} \mathbf{Sets}$

GLOBAL LOCAL



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