The most ancient style of film and animation, and the world's first cinematographic special effect, STOP MOTION, is the subject of these brief musings. In his stunning work "Stop Motion: Passion, Process, and Performance," Barry Purves discusses the classical significance of this strange art, and analyzes how it evolved out of the colorful and playful world of theater and stage magic. His is an excellent account of what stop motion is from a historical and cultural perspective, but here I am going to develop a different account: of the metaphysics behind and the artistic meta-mechanics behind the vast art of stop motion.

Harold Whitaker and John Halas begin their vastly influential work, "Timing in Animation," with a very important observation. They identify that an utterly imperative aspect of good animation is a solid understanding of physics. This is why they cite Newton's 2nd law of mechanics. This was a significant move in the way we think about artistic animation, as it forces a type of scientific investigation into the methods behind all animation. More importantly, however, not only need we reflect on the physical phenomenon behind our craft, but as the spirit of this observation goes, we must investigate for ourselves the presuppositions we make when talk about animation. Indeed, this is no pedantic debate: if we wish to truly create our story in the world, we need to understand from where the craft that is used to express it draws its existence.

From where did life come? What is the essence of motion? These are the questions the stop motionist asks. History has shown us that great animators are often great philosophers, and that the practice of philosophy over one's art actually helps him or her to not only appreciate their art on a deeper level, but also increase the technical quality of their work. I wish to analyze stop motion from this philosophic lens, jumping into the conversations that have been going on over the matter. In the hopes of deriving a powerful way to think about what is ontologically going on in an animation and appreciate what the animator is doing, we will begin jumping from the earlier comments about physics.

What is Animation?

In order to develop an account of what stop motion is, we need to identify the players going on behind the scenes that make it what it is. What is it that we mean when we say the very word "animation?" If we look at the way people use the word and refer to it, there are two clearly defined concepts that present themselves. There is animation as

1) Motion, in a mechanical sense   2) Spirit, in a metaphorical sense

Animation *as motion* is the physical side of things. In physics, the whole field of classical mechanics revolves around the task of describing the position, velocity, and acceleration of objects in time. If something is moving on a mechanistic level, and it has a measurable change in position over time, we'd say it has a motion to it. Newton, Lagrange, Hamilton, etc., all developed very elegant theory on the matter, and drove our mathematical understanding of motion to deeper levels. We can associate this type of physics-based approach with the technical side of animation.

Animation as spirit is the non-measurable, abstract side things, then. This is the sense in which Aristotle described the distinguishing feature of all living beings in "De Anima," or "On the

Soul." A basic etymological look at the very title of this text tells us where the word to animate comes from! When someone seems full of vigor, we describe them as animate. Life is itself a sort of animating principle existing within a physical ensemble of components. This is the other side of animation that we think of it – as life.

We can see that the concepts of Space (as in physical dimensionality), time (which arbiters change allows things to happen in space), and how a being relates to them are inextricably linked to the study of animation. Indeed, these are primal parameters in nature, which to some capacity all human art gives witness to – just as science. Indeed, even as a fresh child only briefly exposed to stop motion, I found myself having no choice but to inquire further as to the nature of time and seek to understand more about the nature of the existence of this natural force. What is time? It turns out to be a very interesting question. Is time a constant process, or does it change based on something else in nature? If it is constant, how do we explain the ridiculous events like time dilation or "clock drift" as in special relativity? If time has dynamics, then how can we even wrap our minds around that?

There are many fascinating attempts at answers in the world of physics – and there are many other debates about the nature of space that an inquisitive mind could find quite beautiful – but I must limit the discussion to a particular idea on time as it relates to animation. This idea comes from quantum mechanics and the genius mind of Max Planck. After late 19th-early 20th century blind epistemological optimism was refuted by a slew of theory-shaking scientific disasters, Planck postulated the "Quantum Hypothesis." In order to try and explain a curve he fit on top of unexplained thermodynamic data, he proposed that energy, on a fundamental level, came in tiny, integer amounts. A sentence that can be said in one breath still baffles men and women of genius – how is it that reality is discrete? Planck proposed fundamental units of space and time as well. Under this model, time, on an absolute level, passes in units of 5.39×10^{-44} seconds, and space on 1.6×10^{-35} meters. In other words, reality moves in chunks on a fundamental level, from one step to the next. We cannot divide reality as infinitely small on a physically meaningful level, as Zeno of Elea suggested we could in his famous paradoxes. The validity of the quantum hypothesis seems to stand strongly to scrutiny.

But how does this relate to animation? It is often said that stop motion is creating a new world within this one. It is worth noting that on a design-level, it is very much doing that as people are free to choose at what rate they want time to pass. Indeed, rather than "reality" passing in Planck seconds, we use frames as the basis instead. The frame rate he animates in is the physical time axis for that world. Most commonly, people will animate in 24 frames/second – but that is an arbitrary convention based off of a publicly shared aesthetic taste. The nature of the animation, though, goes deeper than the convention people hold on to. The artist has complete control over the time in the world he or she crafts: and time is the most primordial of the essential elements needed for life.

But perhaps there is an error in my thinking – and stop motion still abides by regular time. It is, after all, measured in frames/SECOND. We can certainly control/create space in our animation by our mathematical usage of shape and perspective in the camera's eye, but one could disagree with the idea that stop motion creates its own sense of time. A world in stop motion is necessarily anchored to ours and thus the animator doesn't control time at all, thereby not actually animating at all because he isn't partaking in that essential creative, interconnected relationship

between time and space. This is a very interesting objection if we look at where it points us. But first, let us take an interlude and note some of the practical features of stop motion on this note.

The presocratic philosophers are often overlooked in the history of animation – but the metaphysical foundations of stop motion – the primitive ancestors of its current form as an activity of the human spirit – began with them. Heraclitus, the originator of the famous "one cannot step in the same river twice," spoke in riddles regarding "change" as the only constant feature of the world. If one sits on a frame, there is no animation – yet animation is by definition involving more frames, and thus affirms Heraclitus.

Starting at 24 FPS, we can then wiggle that value. Just as distance = rate x time, animation length (frames) = frame rate (frames/second) x time (seconds).

- In the limit where the number of frames in a film goes to 1, animation becomes photography. No one would argue that a single photograph qua photograph is supposed to be telling a full story in the same way a stopmotion tale is supposed to. So if we isolate a certain parameter in the stop-motion equation, we end up deriving a different art form!

- As armature and puppet design grow in our emphasis on them, and thus their percentage of the project that they occupy becomes larger, we say they asymptotically approach 100%. If we go all the way, and forsake the rest of the animation and only focus on the puppets, stop motion becomes sculpture.

- As music, sound effects and the like approach 100% of the project's importance, it quickly turns into the ancient craft of music and auditory story telling. Thus, stop motion can be thought of has having a high-order of "generality," in that many other arts can be derived from it or are at least necessarily contained within it. This is of course part of what makes it so difficult and take so long to produce, not to mention how long it took humans to discover it. A successful stop motionist is going to need to be a mechanic, a painter, a musician, and much more: it's no wonder why people team up to make videos in this way.

The generality stop motion has is an important and unique debate few arts share. Aesthetics only cares for beauty, and reality's involvement insofar as beauty is involved. Computer animation (CGI) certainly generates beauty, but its reality is contained only in the form of electric charges across transistors in a computer memory bank. Aesthetics cares not for reality, since it does not, a product level, distinguish between stopmo and CGI. If a stop motion and a CGI film ended up looking identical in product, there would still be the difference that one was forged from the cold hard slab of reality. The stop motionist cares for this distinction – and it is her interconnected, embodied engagement in all of the arts that confers upon her this reality.

With this mind, we can actually think about the animation as fundamentally only existing in the framerate it was shot in. If you have some number of images, you can play them at different rates – and while they share the same content, they are different animations. A single frame couldn't be animate. In fact, two frames would still be difficult to call animation because it will lack the mechanical notion associated with the spirit of animation. It's not until maybe 6-7 frames that you can start telling a story- there simply isn't the physical data there to establish a continuous visual tale. But wait; can't we imagine all kinds of stories with only 4 frames, if those frames have enough information and we allow ourselves to sit on those 4 frames for a much longer time per frame? If we enjoyed a series of 4 interconnected painting for 5 minutes, we could say we viewed a slow animation at 0.014 frames/second. There can certainly be meaningful content, but the animation

itself is less existent, because there is less physical dimensionality change per unit time. We will take this further soon. Note, however, though that frames/second is a unitless quantity. My argument is as follows:

> In stop motion, 24 frames = 1 second. To make life-like quality movement, we need to set a boundary condition on the film. To get our beloved and recognized unit, we simply divide, so 1 = 24 frames/second, likewise 1=1second /24 frames. But the casual observer would observe 1 to be a unitless number. We unconsciously give it "units of stop motion," are told to film in it, and happily do so because truth-be-told it's a great frame rate. But of this fact that "x units of spatial orchestration = y units of time passage," the fundamental postulate of stop motion, defines animation qua animation's very essence. When explaining to students, I claim that each frame rate is its own language. For this reason, I viewed learning to animate in 24 fps as learning a new type of language: new methods of spacing out puppet movements, new ways of mentally engaging the animation, just like communicating with a foreigner for the first time.

There is a provocative implication here – indeed, this leads to a profound facet of stop motion: that its very existence requires a pivotal type of process-based union of time and space. This is of course true for all arts in varying degrees, but it here helps us to see the above map of how stop motion relates to the other arts. But stop motion stands out specifically on this fundamental of a category because of the way its inherent mechanics as an art self-reflect on the nature of creation. Animation by its essence is a game we play with reality itself – on a physical, mechanical level as well as a psychic, spirited level. Space and time are EQUAL to eachother here. This could boggle the mind seeking to understand it sense.

It's important to remember that the universe's rules are followed on a physical level. Stop motion, as cool as it is, does not make spacetime bow. I don't think anyone would really want it to, either, considering the physical implications of that. But the deeper point that the internal critic doesn't see is that in every bit of animation there exists, in a real sense, (at least from the reference frame of a metaphoric being like Man), a local contradiction to spacetime. Its existence is blinking in and out of the bigger picture existence; but its very presence – the performance of the animator – creates its own physical, metaphysical universe; a function of the animator's twisted mind. Take any young child, whose genius Picasso made note of when he said that "Every child is an artist. The problem is how to remain an artist as we grow up." Witness this child, a carefree girl, growing in the world and exploring a deep art. This one- she's an animator, that one- she's a musician. A child animating laughs and plays her days away enjoying creation itself on an urgently fundamental caliber. What is more pure than her anima in motion- her living qua living? What else could unify one's self to the axioms of the universe in so Dionysian (embodied, natural, furious) and Apollonian (dreamlike, illusionary, sublime) a fashion?

> Brief Aside: There are many senses in which stop motion does not actually create life, nor does it create its own universe. It is wished that charitable minds read with hope that different intuitions can provide valuable ways of seeing things. It would be boring and academic to go into pedantic details over the issue, though with more space of course we could. Generally, metaphysical anti-realism leads us to more aesthetic views, but it also doesn't commit to anything in particular. Stop motion may be a lot of things, or it may be

nothing and completely empty of any "meaning," whatever "meaning" is defined to be. The formal status of the situation may be that there's no reality to it at all.

But let us turn the question of the skeptic, who criticizes stop motion as lacking in genuine reality, back upon himself. To him we say "what of reality indeed, my friend?" It is a fluid substance in animation. Questions of reality are spices on the tongue and a flickering of colors in the eye. The stop motionist demands that his craft be real, and it is made real through being created. As earlier discussed, there will be no aesthetic difference between a same-result CG and stopmo clip; but there will be a metaphysical difference. The person who engages with the craft on a deeper level will appreciate this difference: not only philosophically but also as a physical difference in the film's archeology: again, a computer chip full of CG encoded data vs the ruins of a once beautiful animation site. But reality is an ill-defined substance, and the stop motionist drinks in reality like water.

Thus, to briefly sum up, animation in general concerns itself with formal, physical aspects of reality. Stop Motion in particular has a very explicit concern with story telling in an artistic sense using reality as the very medium. This gives it the coupled artistic/spirited relationship with reality. From the void comes the laws of physics, from which mechanical animation is a possibility. From physics comes "this one, she is chemia; that one, she is bios-logos, the account of life," which artistic animation is a celebration of.

So, what is stop motion then?

As any animator knows, stop motion teaches us that if we take on a difficult project without understanding how much goes into it, we will end up learning a lot. Indeed, Stop motion teaches "Not too much! Not too fast!" In logical notation, we could codify this as the statement as

$\sim T * \sim F$

Indeed, not too much truth, but not too much falsity. We cannot fathom what is at the core of this art with reason because it is not rational. Chikamatsu Monzaemon, one of the geniuses behind traditional Japanese puppet theater, said in a famous 1720 interview on Joruri theater to someone who claimed that theater had to reflect reality rather build up a new one:

> When someone tells this to me, I say 'Your view seems plausible, but it does not take into account the true methods of art. A retainer can only resemble a real retainer? Why should not a real daimyo resemble a stage's daimyo? Art is something which lies in the slender margin between the real and unreal. It exists in between the skin and the flesh. It is unreal, yet not unreal. Real, but not real. Entertainment can only be within this dividing rift.'

Forsooth, at the center of stop motion is paradox. At the core of all the puppetry and animation and set making and music is a rich, insurmountable contradiction. And behold, the central charm of stop motion is in all of the ways an animator can mine content and meaning out of its paradox.

Not only is stop motion a clever trick, a sublime illusion, and a grand orchestration of different arts, but more fundamentally in its essence it is ontologically paradoxical. You give an object motion by taking its motion away – you give it action by stopping it. Indeed, I repeat. Stop motion is a paradox. It is an error and an enigma. It is an inarguable unification of fantasy and

reality, just as it is a unification of space and time. It uses, on a meta level, the very mechanics of reality to create a fantasy.

It is a shifted timeline, highly nonlinear. Any unit of time in our world could have passed in between when the frames were shot, but there is still a continuous story in the world of the animation. What is stop motion? It is the art of dancing between seconds. It is as close to time magic as a human has power to control. The stop motion itself goes deeper than the end product: be it a film or video files. Truth be told, as an animator knows, he or she is the only one who gets to witness the true miracle of the performance.   Luckily, the performance echoes through its medium – reality – so that all can hear.

The first and last thing to learn about art, is to do it for its own sake and not care about getting caught up in the world. The true artist is a philosopher of art – not an academic, but a scholar of HIS or HER art. For each new frame is a sunrise. Each fraction of a second is a new world of challenge, and each click of the mystic clock a puzzle in itself.

The Artist as an Animator

Just what is it that the animator is doing?

I like animating when I'm most in the void. Truly that is the best time to animate. Why? Because then one has lost one's sense of time together entirely. To animate, and to create time, we must first lose our sense of time. The bell won't chime until your ready to commit to eternity. One animates once one is no longer in drunken delirium and no longer wasted away but rather has been both and is in the netherworld. Indeed, in that moment he has lost his distinguishing mind and sees quite clearly the nothingness in the void. He sees that each moment contains a mystery within itself.

Let his soul get the most battered, bruised, and tired it can possibly get! Let the moment he admits his exhaustion but presses forward in the attack be the beginning of his session. That is the empty moment, pregnant with friction at the thought of an impending genesis. Let that moment be suspended, and suspend atop itself a new reality. Only if an artist steps into that emptiness can genuine animation erupt from within him. Forsooth, the animator uses his hands like tools – but he animates with his soul.

With his craft he sculpts meaning like clay. We as viewers only see clay, which carries an image of the meaning. With his mind's eye he sees that all before him was vanity and illusion, just as all in the future. He makes that illusion real. He feels his heartbeat and is content to let it merely be. He will give a thousand heartbeats for a single frame. He has a faith that's arbitrary, but he doesn't shy from it – and admits it with his action. It is not virtue that he uses. In fact his courage has shattered. He marches forward with the creativity that has been imbued and forged into his discipline. Stasis rears its ugly head before he who's lazy: the animator seeks to leap beyond immobility. He sees a deeper reality behind truth and falsity – that of essential being. The animator unifies the abstract with concrete. He glorifies his being by making artistic what is mundane, by turning mechanics into aesthetics. If stop motion is time magic then he is a time mage.

He has given up on practical reasoning, long having abandoned the principle of utility, in pursuit of his art. He has even given up on his health, and probably his wealth. He has earned, through this sacrifice, freedom from worldly concerns. He thus cultivates enough room in his soul for chaos to brew – eventually enough chaos to create a world. He is unencumbered by such concerns: and thus able craft worlds with his reasoning.

Stop motionists are provably the most deranged of people, as they cannot merely "be done" with their work after some crossed milestone. They MUST sit on it. They are brutally forced to be with themselves through the entirety of the creation process. And when they finally release their work, they will have sat with its success and failure for many times already. The musician experiences her music alongside performing it – the animator experiences her animation over many days and nights. An animator feels the terror of her error, as she knows she had 100% control over the world. Why are animators misfits? They give themselves permission of will to animate in a world where no one thinks it's needed.

Without doubt, the self-reflection stop motion forces on us can sometimes be too much to bear. The depths of human soul an animator has to look into often reveals shocking things about ourselves: and therefore the honesty that is asked of an animator is not to be trifled with. This honesty is what can make stop motion so devastating at times. During the gluttonous feasting scenes in Jiri Barta's masterpiece "Krysař," or "The Pied Piper of Hamelin," we cringe at how grotesque the truth of our human condition is. Jiri Barta demonstrates this honesty in a way that spares no-one here: it is obviously not humans on the screen, but the clarity of the message tells us just how much we are human, all too human.

Thus, why does the animator animate? It is the same question as what is animation. It is not for any conceivable reason or rational impetus. There is no core substance to comprehend. It is because, all axioms revealed, he simply cannot do otherwise. There is no smoke nor mirror, there is only life. He sees that everything is fundamentally empty on the inside, and he responds to the chill that such insight invokes with activity– motion – stop motion. Indeed, it has been said that singing is praying twice. Animating, then, is turning every moment into a prayer in and of itself. Animating is turning the directed consciousness of waking life into a continuum of meditation. The animator says "Ah, existence, how you flow so gracefully from one moment to the next, free of all confusion of tongue, as if a waterfall of honey. Let each twitch of my muscle be a testament. Let my silence express my suffering soul."

The animator is the vessel of the reality of the animation. Animation is nothing without an animator. Unlike the phenomenon behind mechanical animation – such as that induced by gravity, electromagnetism, which will exist without our discussion of it – animation in an artistic sense will not if an animator is not doing it. An animator himself does nothing. A farmer himself grows nothing. Animation is a design science, where all an animator can do is orchestrate. This is perhaps the most fundamental thing to the animator. He does what he is. He overcomes the cleaving paradox of animation with his grand unification of action and being. The animator is alive because he is creating life.

To animate is to be animate.

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On the Planck time

The Planck time is derived from other fundamental constants in nature, and is defined as

$$t_{\mathrm{P}} \equiv \sqrt{\frac{\hbar G}{c^5}} \approx 5.39106(32) \times 10^{-44} \text{ s}$$

Where $\hbar$ is the reduced Planck's constant, G is the gravitational constant, and c is the speed of light. Most modern physics and quantum mechanics textbooks should provide more theory on the matter.

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