

Creative and Scientific Portfolio

by

Abhinav. Tejasvi. Mohur

B.Sc. Biochemistry (Hons)

Carleton University

Submitted in Supplement to Academic and Professional Resume

These works were not endorsed by any party or institution but stemmed from my passion for science and as a researcher. I have included only excerpts of my works as I aimed for brevity. Zooming in would allow to read the content. I have also included some notes concerning each work I did explaining the motivation behind each work. I hope this helps to convey my passion for science.

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1. Biology

1.1 SARS-Cov-2 Mechanism

Following a public lecture by Ian Gold from *McGill* during the COVID-19 pandemic. I applied my literature search skills to shed light onto the virus to social media. I tried to bridge the gap between Expert Knowledge and public perception as my country was facing a crisis and I wanted to help against harmful misinformation.

This was done before I started my B.Sc., and it would prove helpful as a module in my studies, 3 years later would have us implement computational tools to analyse the virus, extending my ability to communicate as a scientist and my research skills.

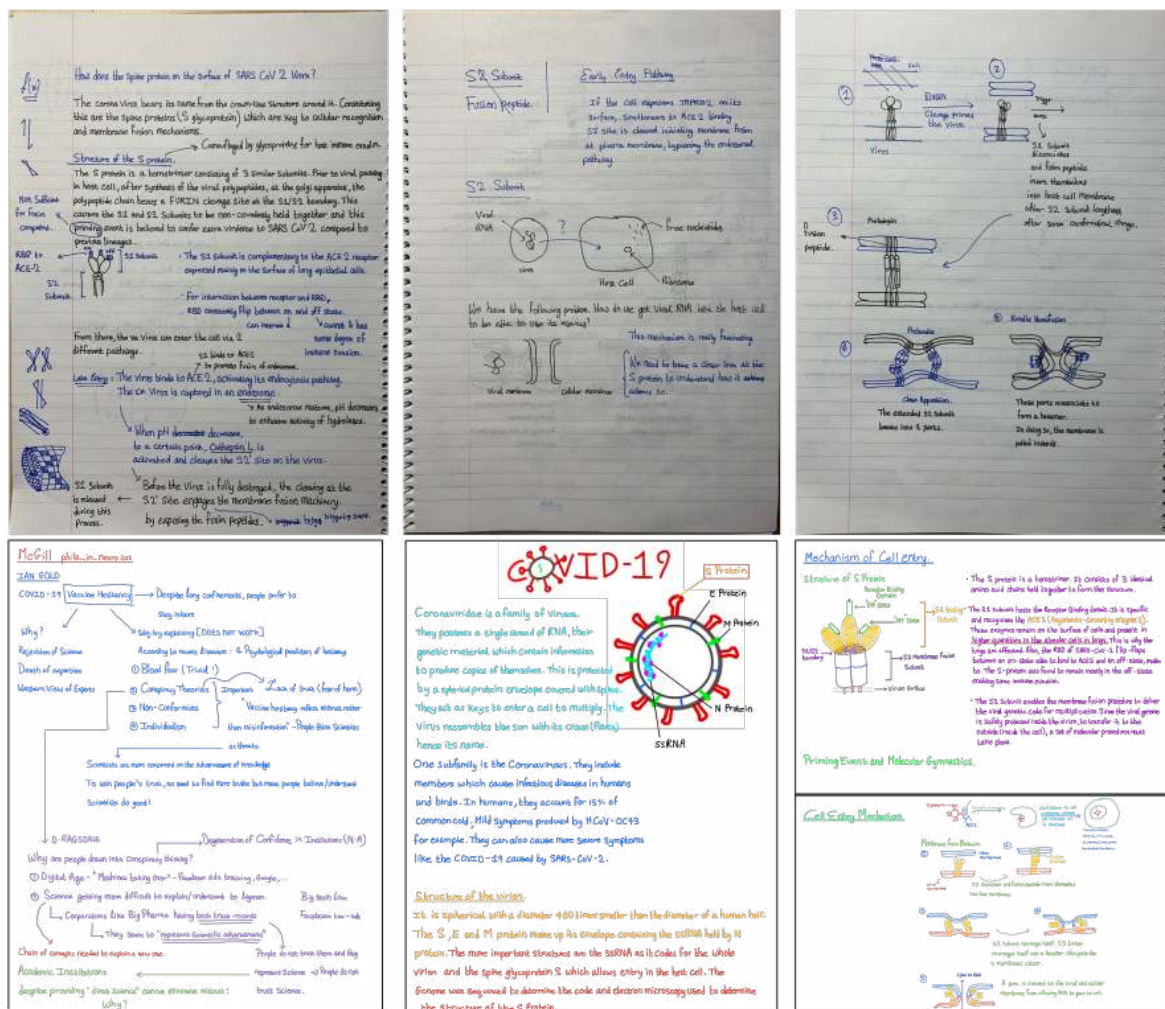


Figure 1: Only partial excerpts of document were included owing to document length considerations. Top figures represent molecular mechanisms gathered from 2020 and prior papers, and Dr. Paul Bates from Penn *Un*'s symposium. Bottom left are notes from Ian Gold's Lecture on Vaccine Hesitancy and bottom middle and right some pages on my attempt to democratize scientific knowledge in times of need.

1.2 Prey-Predator Dynamics

Following the success of my COVID-19 post, I aimed to make other areas of biology more fun. Before introducing epidemic models, I aimed to provide my audience with a simpler topic. The *Lotka-Volterra* model suited the aim. To keep up my credibility as I would be posting public and answering questions, I did some background work in getting a proper grasp of the topic, mainly linear algebra and differential equations and their applications to population biology. I had to be able to justify all the concepts used and explain them in laymen's term. This too was prior to starting my bachelor's degree.

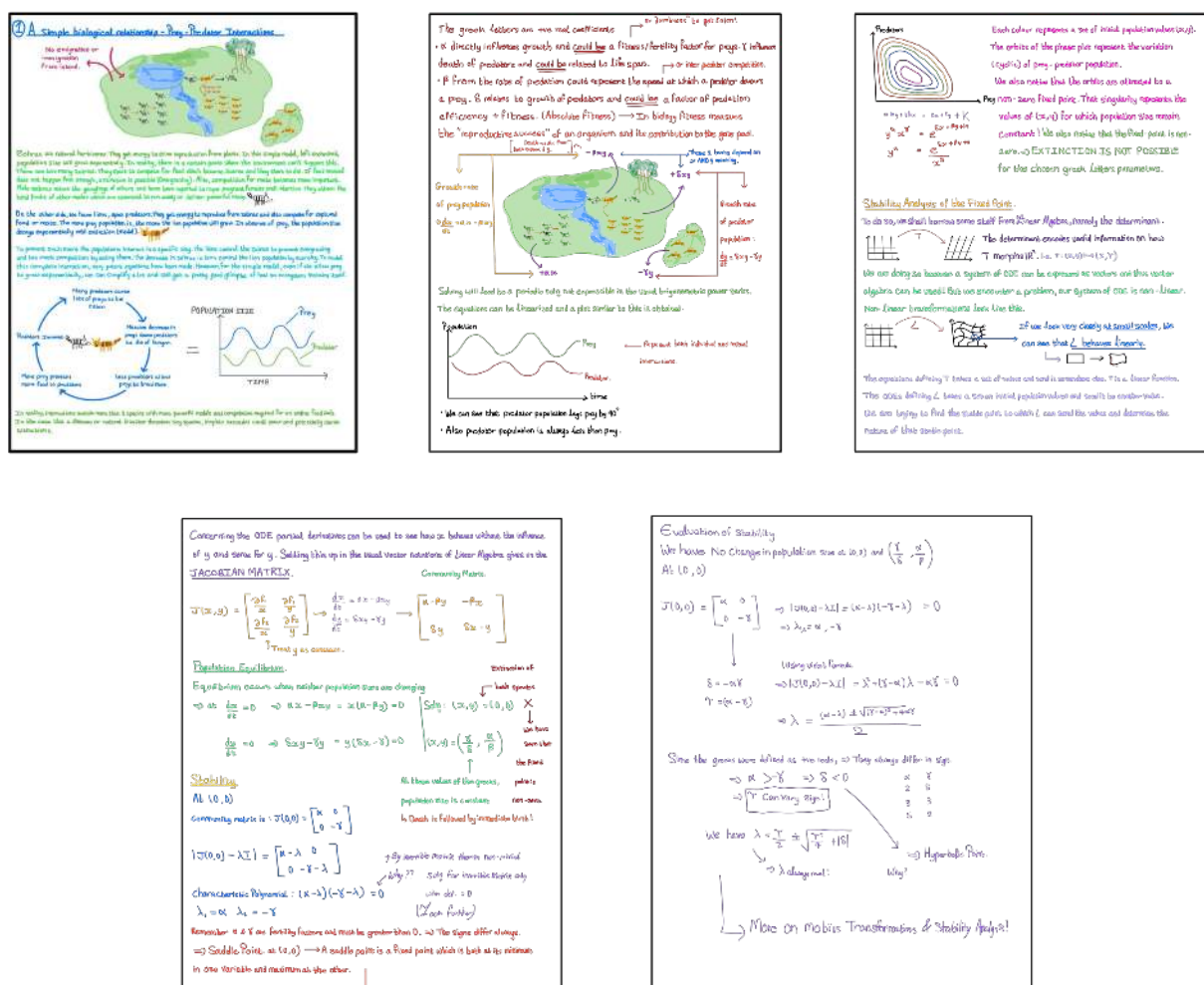


Figure 2: Top left panel was the work presented and the other panels are some of the background work, simplified if audience required more information on justification. I aimed at something more friendly compared to the heavy population dynamics textbooks while still maintaining consistency.

1.3 Physiology & Mutagenesis

Concluding the courses of Physiology and Mutagenesis and DNA repair, I wanted to consolidate my knowledge for future applications. I found sharing knowledge a good way to keep things fresh in my head. I tidied up and filled up some holes in my understanding in some physiology notes. I ensured it was accessible to a first-year audience by anchoring concepts on what I learned in *Cambridge's A Level Physics and Biology* and bringing it together to naturally and simply explain more complex processes. I was satisfied in my preservation of information for my future use. It was also appealing to students in other fields like engineering, who could understand what I shared with them due to us originating from a common base.

I also prepared one from my mutagenesis course. DNA damage and repair mechanisms was a frequent topic of discussion in papers and with the research supervisors I encountered. I wanted to be able to keep these in mind and simplifying them while maintaining accuracy would help. Since it is something, I am pursuing research in, I found it worthy to do so. It also allowed me to communicate more clearly with my professors and understand papers faster. This document had less popularity than the other ones; maybe owing to its niche nature. I am currently doing another one on apoptosis.

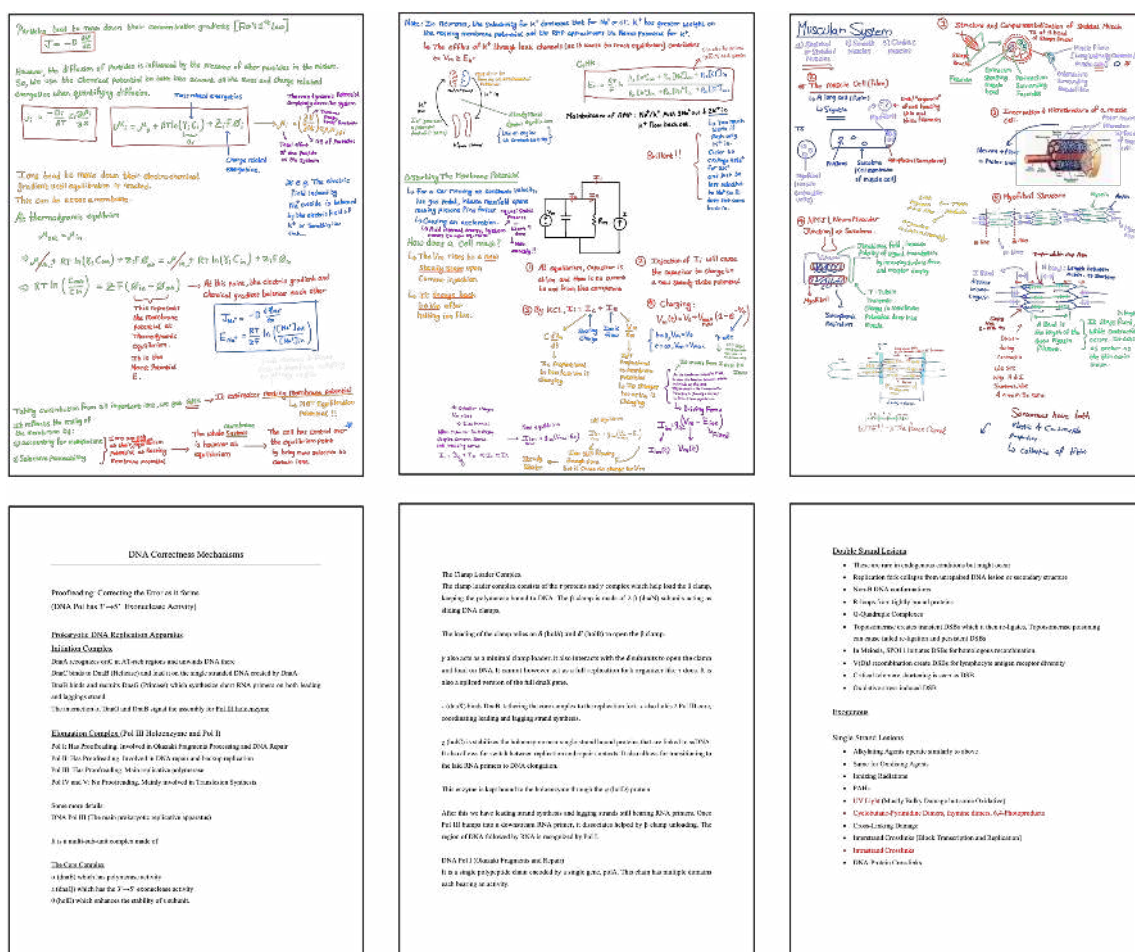


Figure 3: Top panels some of the physiology documents. Excerpts from two topics are included, and full document includes other systems. Bottom panels are highlights from the DNA repair section and some mechanisms involved

2. Physics

2.1 Visibility of Universe Expansion

This was my first attempt at diversifying my science communication into physics in 2020 Lockdown. I only had a *Cambridge A-Level* exposure to the subject then, and I managed to cobble together something to explain some astronomy phenomena. It received great feedback, beyond my expectations. It gave me more confidence in pursuing my passion for physics and mathematics. I borrowed from some explanations on YouTube and furnished it with some established cosmological model which I thought would complement neatly and give the audience a taste into how the abstract manifests into phenomena we take for granted.

This post was intended to have a sister too; namely explaining white dwarves, neutron stars, and blackhole formation and physics.

But at that time, I unfortunately lacked the skills to understand deeply Electron degeneracy pressure and could only understand concepts like *Heisenberg's* Uncertainty Principle, *Pauli* Exclusion Principle, superficially. I lacked the insight and physics/mathematical maturity to explain it in simple terms at that time.

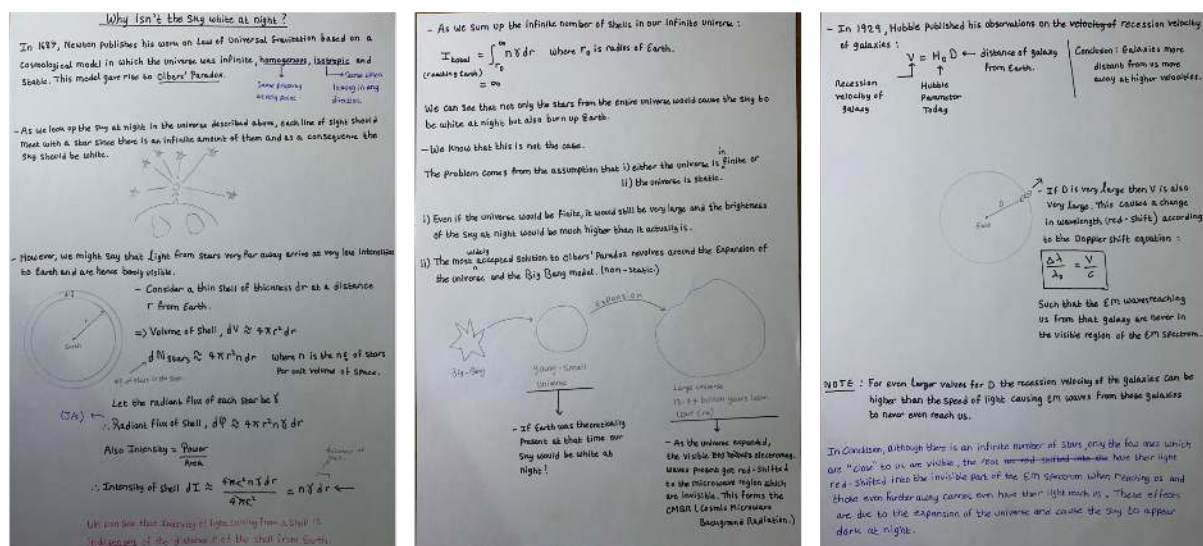


Figure 4: The three panels from left to right makes use of mathematics which I had good command on. It was a simple enough method to explain the cosmological phenomena while giving the audience a little insight about the expansion of the universe which is so often talked about but rarely understood. Grounding that concept into everyday phenomena could offer an appreciation for a possible explanation that science provides, I thought so.

2.2 Entropy

I was curious about entropy. I wanted to frame my findings in a pop-sci context; heat death was a common enough denominator. This one proved one of the hardest research projects I carried out; spanning 3 months, while I had to learn classical thermodynamics from *Yale's* Online courses, Entropy in the context of information theory, and finally, I was forced into statistical mechanics from *Stanford's* lectures and quantum explanations for the microscopic explanations. The result was fruitful, endowing me with a notion of entropy which was so useful in all my scientific judgement throughout my degree. I was happy to make my audience mature from entropy as being “the amount of disorder” to “number of configurations” and the second law being a “natural” statistical consequence akin to a physical version of law of large numbers.

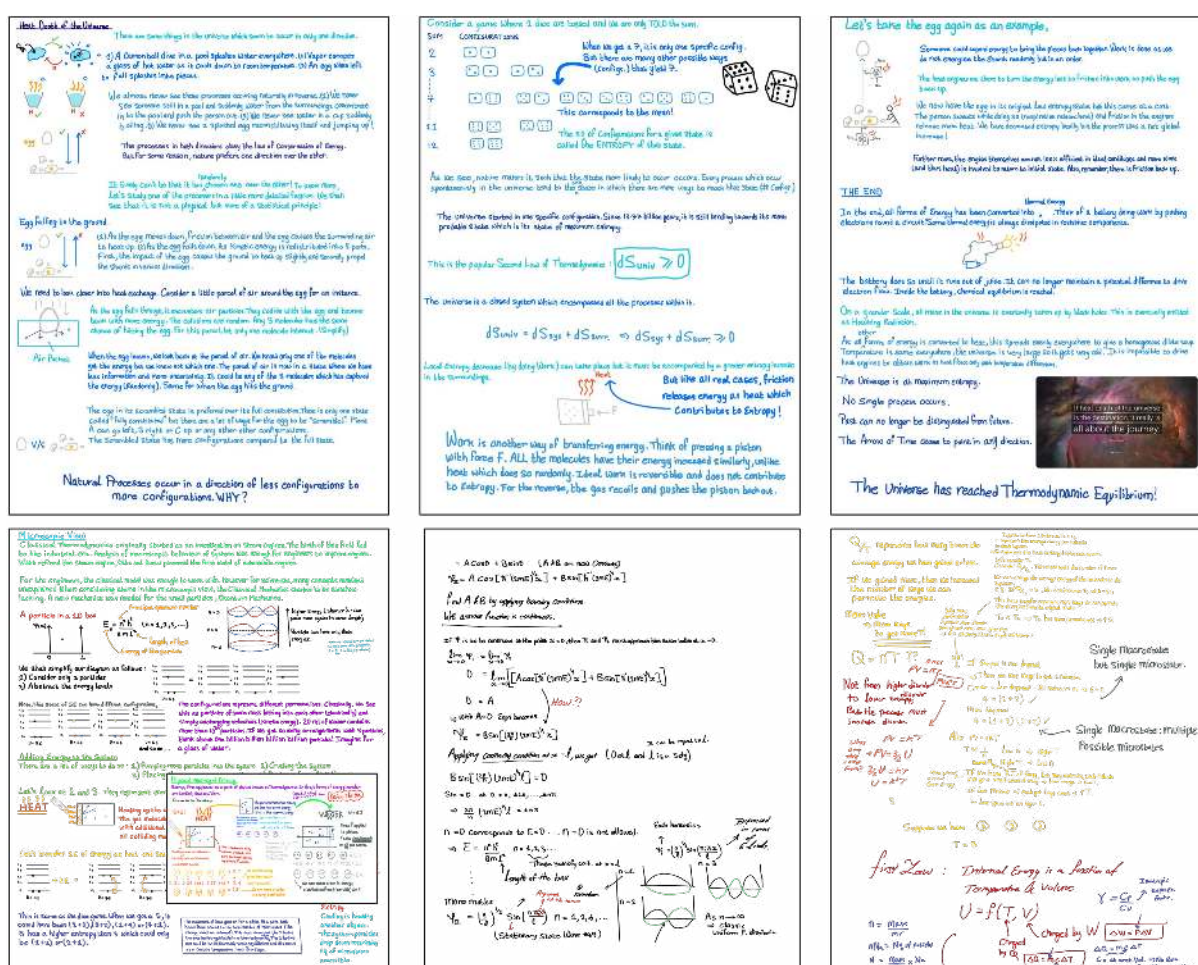


Figure 5: Top panels represented what I presented to audience. Bottom panels are some pages of my works/research spanning 3 months, mainly owing to the need to grasp the mathematical insights of statistical mechanics. Quantum mechanics was used sparingly, only the particle in a box to explain energy levels and microstates. I ensured I got a solid grasp of the concept in case I would be caught off-guard with questions. I also built intuition on the difference between heat and work and provided an acceptable explanation to the lay person.

2.3 Geodynamo

After gaining some confidence in my ability, I set my eyes to the geodynamo. I initially completed the “simple” explanation to provide to my audience but later came back to it after around 3 years to formalize it, after maturing in my scientific ability. Before when I just mention that different latitudes travelled at different velocities, I got to understand the *Coriolis Effect* mathematically, and I was also able to conceptualize it with the *Magnetohydrodynamics (MHD) Equations* after getting more familiar with *Maxwell's Equations*, and vector calculus. My motivation for doing this one was awe upon seeing atmospheric electric phenomena and in YouTube videos, how the shape of Earth's magnetic field change when interacting with a solar flare. The shape shown was very different from what I learned about magnets in textbooks and I was curious.

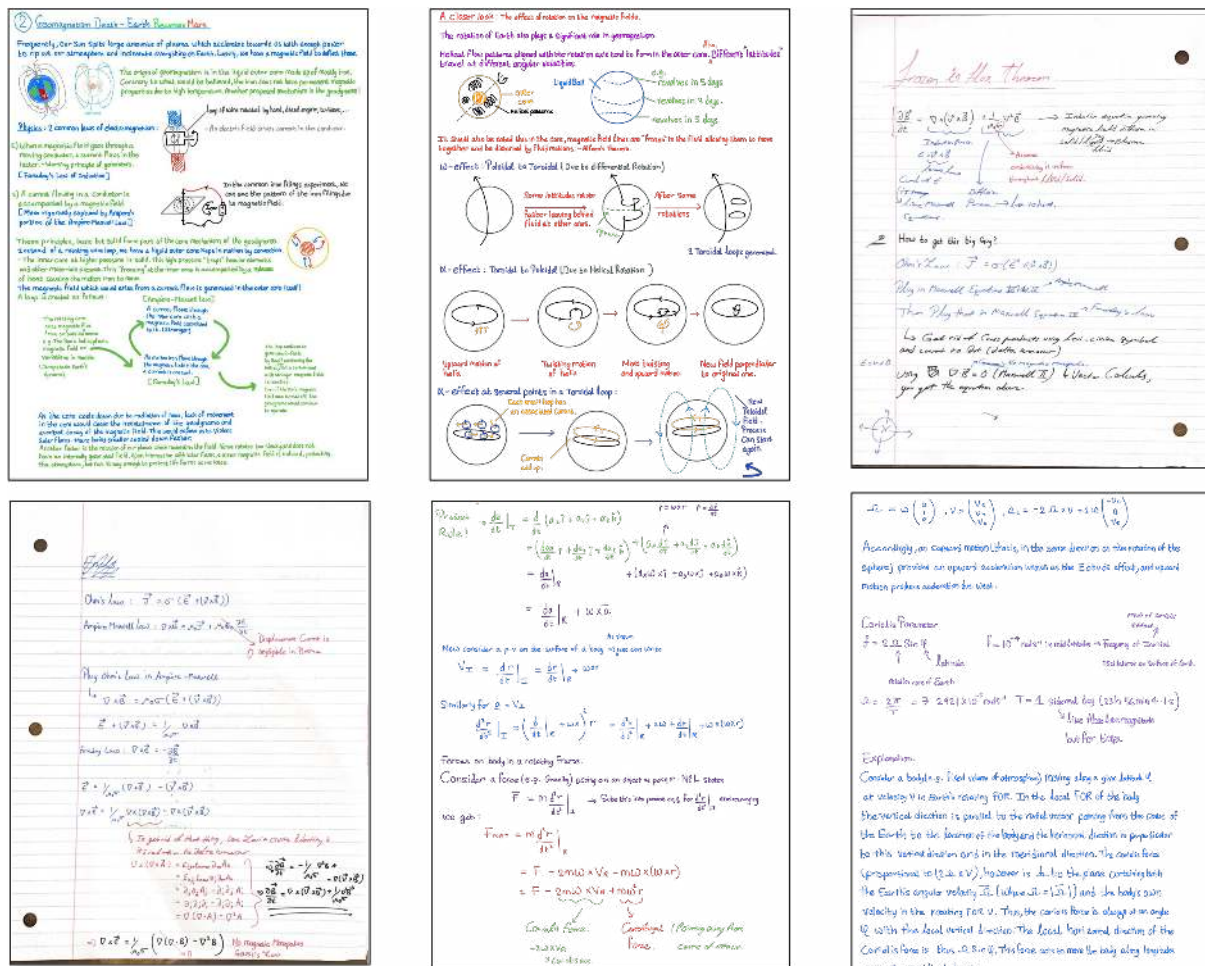


Figure 6: Top left panel is my original publication on the subject; the top middle one was a remnant of my initial research. The remaining are excerpts from what I gathered from *Alfven's Theorem*, *MHD*, *Coriolis Effect*. This allowed me to form the model in my head, through first principles about the Geodynamo.

3. Mathematics

3.1 Statistics and Linear Algebra

I am not trained mathematician. Through physics I got some appreciation for it. I can handle connecting concepts and making mathematical models borrowing from some areas of pure maths, but I am not well trained in proof-writing like my peers. I wanted to do something in the field; I tried to remain humble about so and chose something which was likely to reach a broad audience. The Normal Distribution was my choice, and I attempted its derivation through simple thought experiments, relying on YouTube, and Mathematical texts I could lay my hands on. I went to some of my peers to review it before publishing to my audience. Studying statistics naturally gave me so much leisure when doing data treatment for my lab experiments; I was able to justify my hypothesis testing methods, and what drawbacks each had, and explaining what ANOVA interactions meant when doing my thesis presentation. It is not something I regret, and this post sparked my interest in statistics.

I also took Linear Algebra as part of my university courses. I could not take LAII or LAIII. This was a common experience by other biology students. It would have been hard to fit-in into a class with mostly maths/physics students. I set to make a document aimed at non-math majors like me, allowing us to appreciate the “true” meaning of concepts like transpose, vector spaces beyond matrices just being linear transformations, and revealing a deeper structure which I found beautiful and wanted to share with others

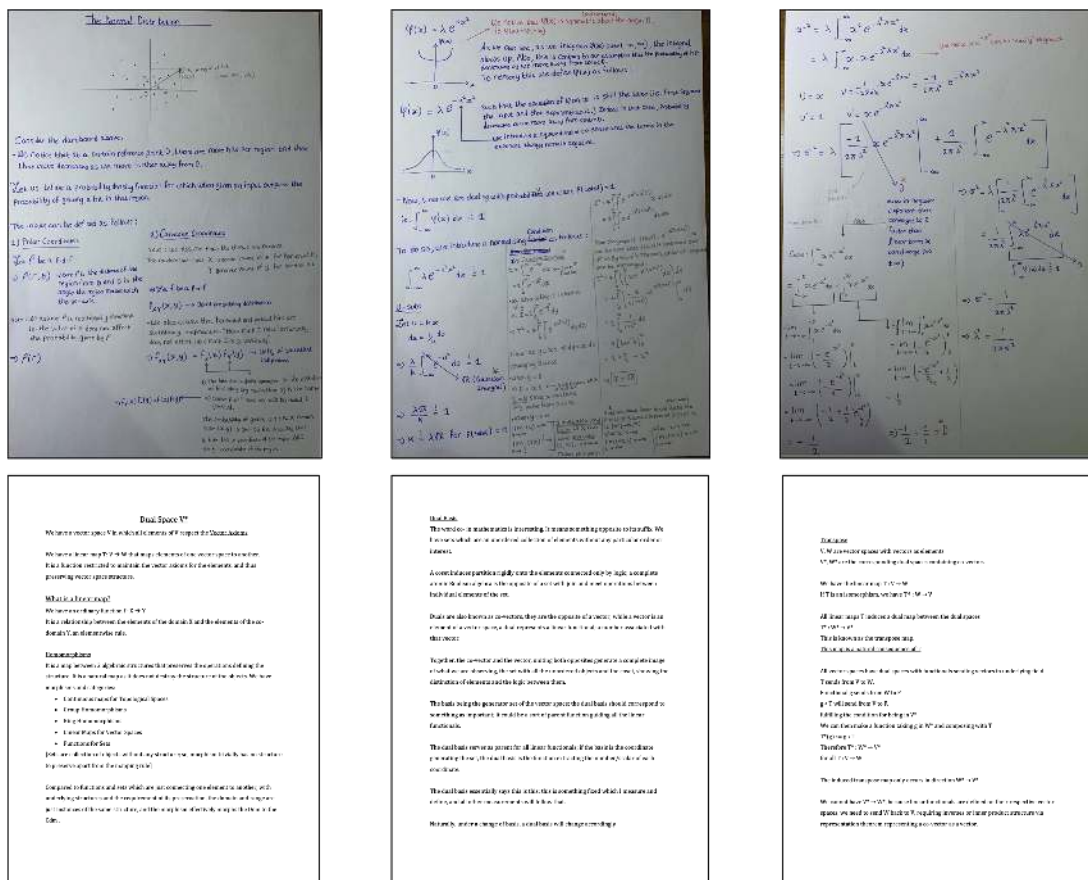


Figure 7: Top slides are parts of my derivation of the normal distribution. All pages could not be included. Same for the bottom panels and conceptualization of vector spaces in linear algebra. That document spanned 40 pages.

3.2 Cartesian Product and Topology

This is of my posts on abstract mathematical concepts which I wanted to make more “fun” by showing non-intuitive concepts can stem from familiar ideas like multiplication.

On a sidenote, this one proved useful in a video game puzzle detailed *Verity in Destiny 2: The Final Shape, Salvation's Edge* Raid. This was an encounter notorious for how long it took to solve. The combination of entries followed that logic, and I was so happy when I saw that something niche which I worked on was featured in such a place.

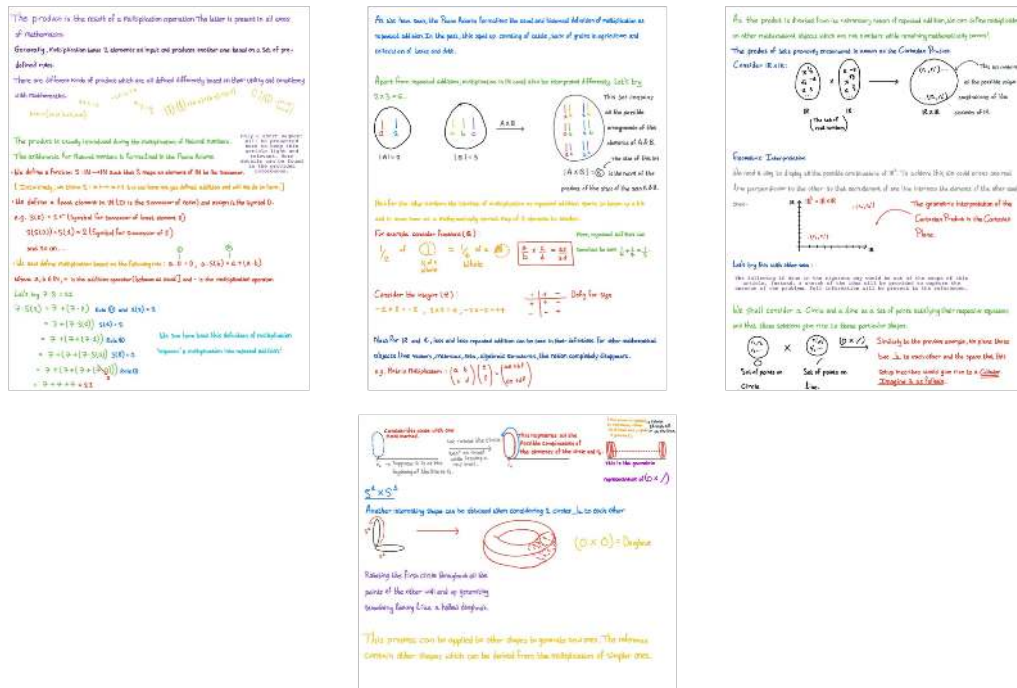


Figure 8: Building from ideas of natural number multiplication to cartesian product in topological spaces to yield absurd but funny concepts.

4. Art-Science Hybrids

4.1 Complex analysis and Poesy

This took birth as a reaction against AI/LLMs being much better than me at doing what I was doing, in less time. I sought something it could not do. I sought something mathematical which could trigger emotions in humans.

What I did was interpret what I was going through emotionally at that time through the lens of complex analysis.

I was in a period of personal confusion; I sought a smooth definition to explain what I was doing and where I needed to head to for. I would always hit obstacles which I could not overcome in my head. I interpreted my requirement to know everything as seeking a function.

Knowing all the edges of my life with infinite depth would allow me to situate myself. This corresponded to gradients and integrating dx . Regrettably, I hit insurmountable obstacles which I could not wrap my head around.

I interpreted seeking within as another dimension; that I existed beyond the 1-dimensional thought about myself, what was external was the real axis; leading to equating my inner self with the imaginary axis, and my whole being, as a complex-valued function.

To get better information about myself, I would have to know myself within and without, and that would correspond to complex integration, with *Cauchy-Riemann* Equations guaranteeing analyticity. This would ensure that my knowledge of myself.

I was not interested in my daily life stable life, corresponding to holomorphic region, but the points where I break-down, singularities to get information. This corresponded to contour integral needing only zeros and poles in whatever region of my life I chose, a curve C .

Real integration implied accumulating area with bringing no new self-knowledge.

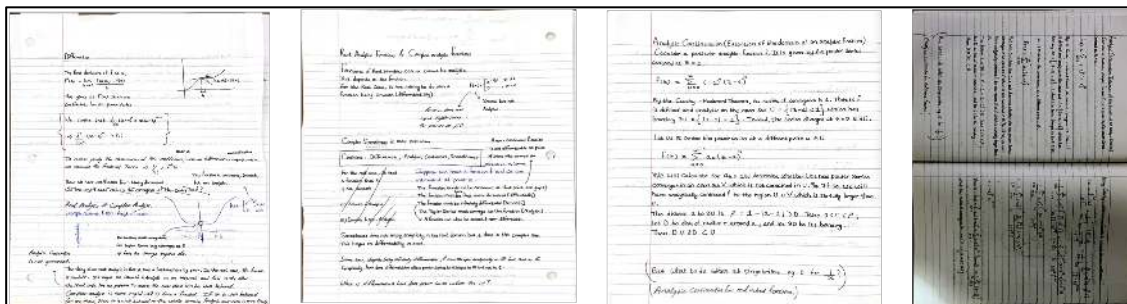


Figure 9: Some pages of my notes on complex analysis

Wheel of Auspicious Vision

There is light. Live in the moment. Let go, you will find peace.

It is a matter of perspective. The sea looks different through sunrise to sunset.

See it in one way or the other, shine the torch left or right, both are valid, all is seen, all is ~~true~~ real. Light forgives all forms, endless perspectives to be embraced.

In darkness there is no perception. There are just things. I hurt and obstacle in darkness, I bring it in the sun, I see a flaw, I am concerned, I am in pain when I cannot change my fate. The sun passes through, new perspectives arise, the flaw vanishes.

I obsess over it, I keep looking at it throughout the day, the mind takes shortcuts, I get used to all perspectives, the light forgets all differences, infinite states flow harmoniously with the cycle of nature.

In memory the pain remains, beyond perception, the flaw remains, the obstacle is still an obstacle. I do not trust the light, it asks for faith, I need understanding, to see with the mind's eye, to see in darkness.

I am loss in darkness; there is no reference. I wanted to go in there and shatter the source of the pain, cursed idols veiled into the night causing madness during the day. I cannot see, nor understand. I am scared; my mind calls back endless previous dangers.

I take the risk to feel it; interesting how processing emotions and the tactile sense share a verb. Piece by piece, I add up the feel of small pebbles, each edge a small change in gradient. I hope to generate the greater picture of the surface.

$$\int f'(x) dx = f(x) + C$$

I come back with one eye in light and one in darkness. I see the cursed idols as they are, giant monoliths. Those touched by darkness but stayed in the realm of light remain bitter. They live in only the light dimension. We understand, on a line the pole is a block to further expansion. They are justified.

Those with 2 eyes see the underlying complex plane, light and dark orthogonal but form a greater unity. If we cannot climb the pole, we go around it. Humans are ingenious, we are not limited to what we were given, we were gifted with creativity and imagination. We map the whole plane, in both light and dark; form subjected to perspective and static formlessness, both being true.

Apply analysis, and analytic continuations, going around the poles of the meromorphic function. The flat surface is trivial to us; it is boring, only poles and zeroes contribute to the mapping of our understanding.

More generally, suppose that f is a meromorphic function on an open set Ω in the complex plane and that C is a closed curve in Ω which avoids all zeros and poles of f and is contractible to a point inside Ω . For each point $z \in \Omega$, let $n(C, z)$ be the winding number of C around z . Then

$$\frac{1}{2\pi i} \oint_C \frac{f'(z)}{f(z)} dz = \sum_a n(C, a) - \sum_b n(C, b)$$

where the first summation is over all zeros a of f counted with their multiplicities, and the second summation is over the poles b of f counted with their orders.

5 Humanities-Science Hybrids

5.1 Measure and Philosophy of Science

This is a branch of a current project. I was reading a short book on philosophy of science by *Samir Okasha*. I made me question much of what I took for granted when running experiments in science and how we agree to conventions as scientists, which philosophers leave as open questions.

The interpretation of probability is well established in philosophy. I wanted to take a deeper dive into the other aspect of measure theory, namely measuring, and the sigma algebra. I wanted to see the inbuilt assumptions on our system and if possible shed new light onto the subject.

If not, I am satisfied till now with how my perspective changed upon digging more into measurement and philosophy of science.

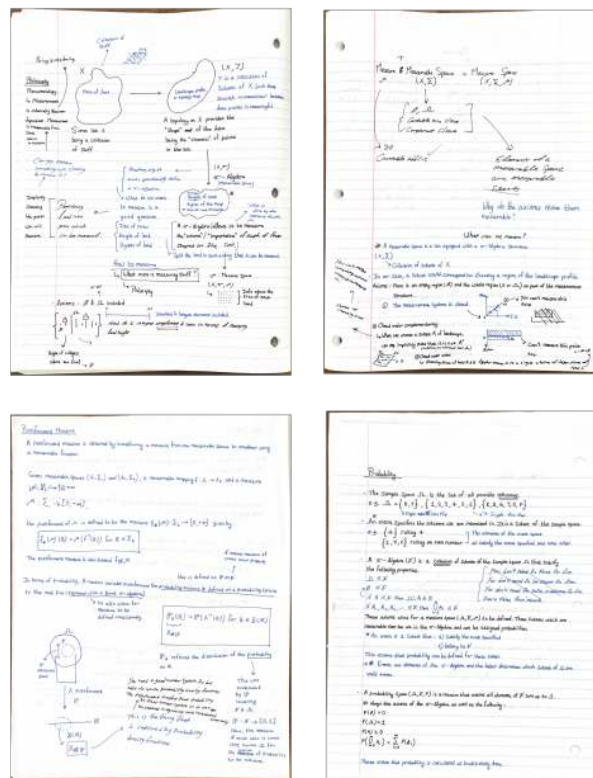


Figure 10: In the last lines of the top left paper, I list some of the things I found when measuring. They seem tautological. I did not include all the content as some was not relevant to the philosophy of science discussed here.

6 Humanities

6.1 Lacan

This one makes a more minute reference to science. It was more of a passion project I had for psychoanalysis. Lacan is known to be hard to understand. I spent about 4 years dealing with the subject. I wanted to construct a bridge to allow others to cross faster. It starts with *Freud's* contribution, goes through *Saussure's* linguistics, and I finally introduce some Lacan concepts which would make primary literature and YouTube videos easier to digest. I wanted to have more people to have conversations about Lacan. I truly think he is a genius. I only redefined artistic and scientific aspirations in the contexts I laid about *Lacanian Psychoanalysis*.

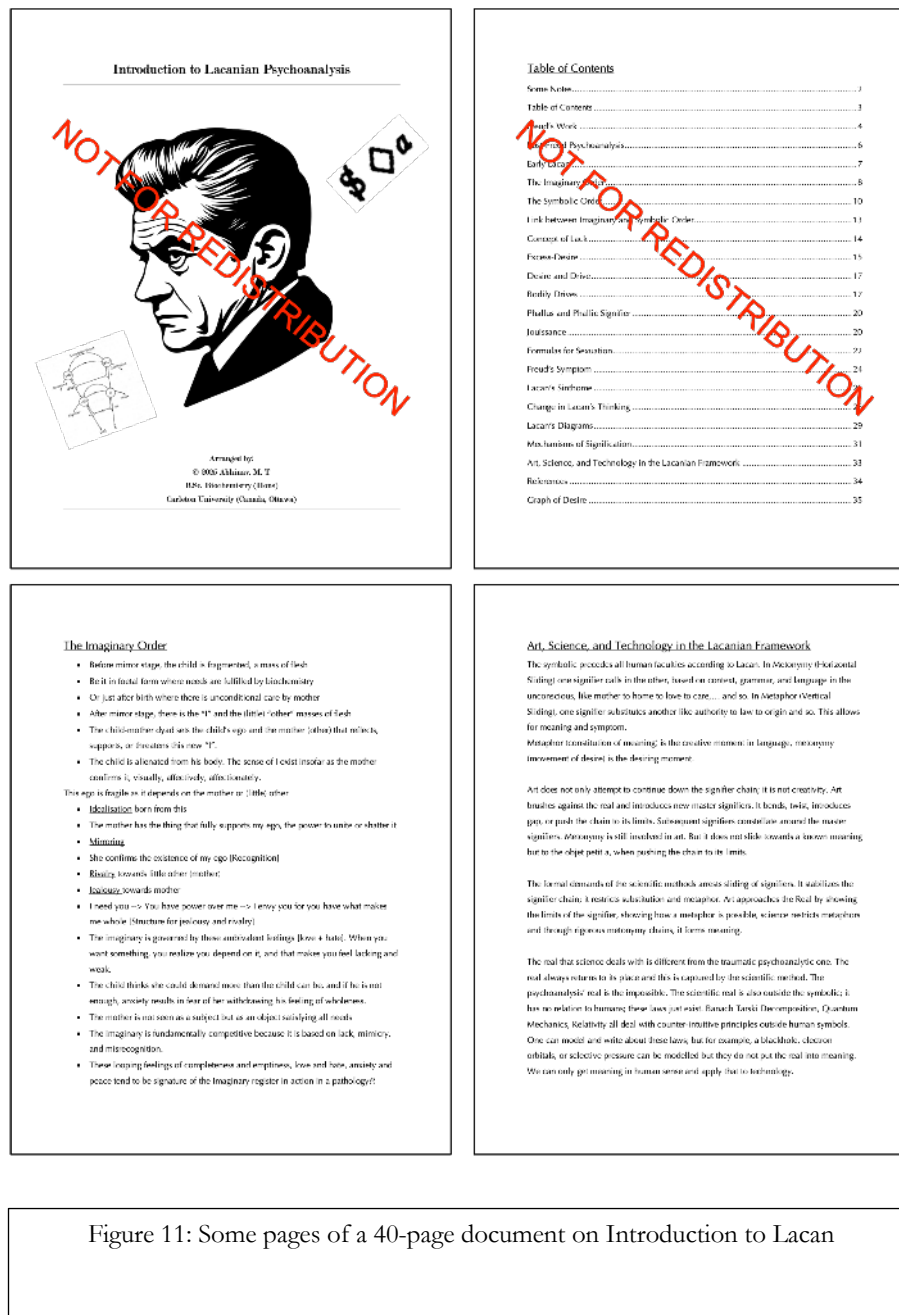


Figure 11: Some pages of a 40-page document on Introduction to Lacan

6.2 Tentative Scientific Thinking in Humanities

My time as an undergrad science student gave me good skills apart from practical ones, mainly critical thinking, hypothesis, and argument formation, and literature search which transferred well into humanities.

This allowed me to make a simple digest of *Marx's* Historical Materialism.

In similar spirits, I did so for the concept of beauty throughout history, and the prediction of the new tendencies of the elite towards reinforcing aesthetic superiority. In both, I was able to apply some things I gathered from science to reinforce my arguments, namely Evolutionary Psychology and *Zahavian* Signalling. This was in addition to other more humanities-conservative techniques.

Through literature search, I felt sometimes philosophers have a good grasp on a concept before science can catch up. I think philosophy is useful to a scientist and to being human, although to a moderate extent.

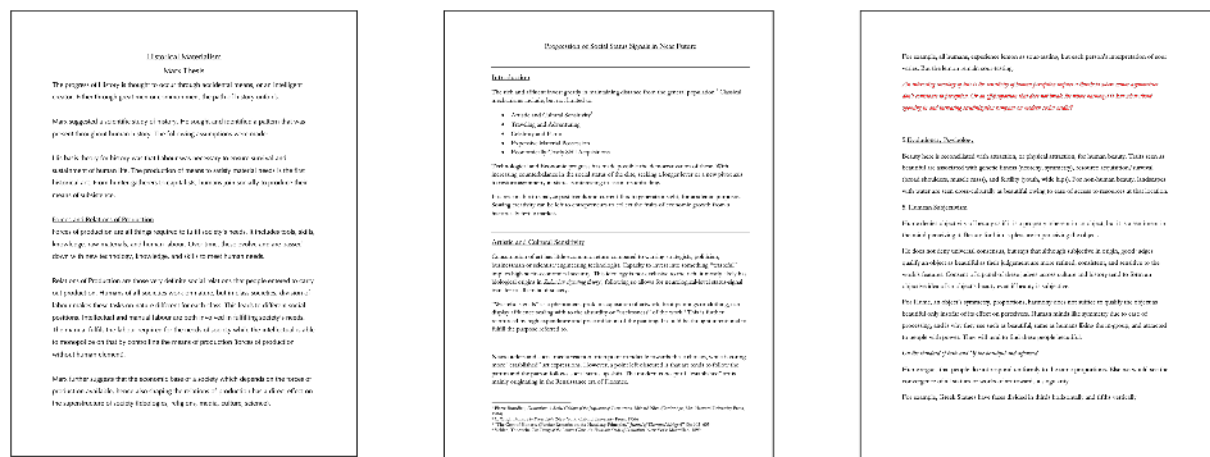


Figure 12: Left, On Historical Materialism, Middle, On Aesthetics and the Elite, and Right, On Aesthetics Ideals Through History. Full documents not shown.

7 Poesy

7.1 Antediluvian

This work was about the deluge on information on social media in modern times. Having a strong identity is rewarded in modern times with little time taken in earning it. It has unforeseen consequences onto the mental health of people as seen by the fast rise and decline of influencers as opposed to more traditionally revered figures. I borrow from eastern philosophy that realization of a lighter ego is required. In an age where the economy finds in profitable in selling and rewarding identities, that would allow for smooth sailing. I borrow from a common *Biblical* theme.

Antediluvian *Echoes through time*

I thought people were materialists. Should they be punished?

No. Depression will ensure they seek depth

Our heroes will journey into the collective unconscious and emerge triumphant from the sea

They will adorn themselves with ancient archetypal treasures and we will revere them

The Uncastrated Male, The Divine Feminine. So many new personalities

Jung is becoming eerily more popular

Everybody aims to be a hero.

The sea is not a friend. One wave brings gifts, the other, ruin

Heroes hold on to their identities with great might

Heroes must die; Campbell omits that

The sea always keeps her secrets

Another primeval flood to drown *Gibborim* and *Nephilim*

She reclaims her gifts

We've seen that before. An Ark, again we must build

A ship, hollowed within, like the empty self, riding the waves, not sinking

7.2 Song of Death

Shortly, this is me accepting imperfection in things despite wrestling with finding deeper stability in things. I believe nature soothes because we humans have a mental inclination towards perfection, idealism. Nature allows us to recalibrate and see wholeness with its imperfection, manifested materially.

Song of Death

Dance of Life

To explain the shifting tides in my emotions is to explain a lack of anchor in the world

With time you can explain anything. But why?

I fear this ever-changing world. I fear an ephemeral self

I want to calcify it all

This is life, right?

Metabolism is a directed bipartite graph

Chemical reactions, with crystal precision

A lipid membrane shielding them from the extracellular chaos

We trust in these predictable patterns

The deeper patterns I uncover, the deeper I see the roots of chaos

The fundamentals of this world won't yield; it is I who must

No amount of order can contain primordial chaos

Kosmos and Kaos must flow in harmony

The cell must interface with its environment to adapt

We must bear the eyes for tomorrow

I understand just enough to know I do not fully understand
