Timekeeping, Power, and the Living World

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Jeremy Rifkin wrote in Time Wars (1987): \?All of our perceptions of self and world are mediated by the way we imagine, explain, use and implement time. I have been working with time as part of my projects for many years. Like value or money, it is a human system that has been imposed on the world that really should make no sense.\ But it is so pervasive: society now\ is obsessed with time - it is the most used noun in the English language.

Working across all of different types of timescapes - analogue time, digital time, blockchain time: seconds, minutes, hours has made me realise how constructed it is, how frequently altered and adjusted,\ and how all of the different constructs weave together and intersect in interesting ways. Time is inherently difficult to pin down. In physics the smallest possible timescale is basically a thousandth of a thousandth of a thousandth of a thousandth of a second (plank time - which is only useful for checking concepts, a conceptual time). In cosmic Hindu units of time, the largest unit is trillions of years. One of the things that I love is that, scientifically, there is no definition of what \?now\? is that everyone can agree on and that there can be no objective thing as the present moment. It is both beautiful and terrifying all at once.\

Our relationship with time is inherently linked to how we measure and quantify it. Clocks might appear - as the writer Joe Zedah says: \?stable, correct, neutral and absolute\? but this is not the case. It is a
mathematical construct that has
been shaped over centuries by science but also power, religion, capitalism and colonialism - daylight savings, for instance, is an arbitrary thing we made up. So is the seven-day week - and I have been exploring, in various different projects and experiments, what it might mean to construct new types of clocks or work with different types of time.\

ANALOGUE TIME

There seems to be a very human desire to know time in the smallest possible unit - from hours to minutes to seconds - and time keeps being cut and cut into smaller and smaller

pieces. Some of earliest western timekeeping devices evolved in the 14th century for monks to ring in the canonical hours of prayer, chunks of time divided into just over an hour. The ability to measure minutes came in the late 16th century and the second was added in 1656 with the invention of the pendulum clock. The perfection of time kept by pendulum time meant that it could be standardised - the idea of a \?mean time\? - an average calculation of the Earth\?s rotation -\ was invented.\ \

Every city, town and village in Britain used to set its clocks to its own local solar time, measured according to when the sun rose and set in that particular location. But as \ industry brought in standardized timetables, land this type of local timetelling was put aside The city of Bristol was one of the last to agree to standardized time: The main town clock on the Corn Exchange building kept a third hand to denote \?Bristol time\? for the local population who refused to adjust. It remains there to this day.\

DIGITAL TIME\

Technology (and science) is hugely reliant on being able to keep standard, accurate time. Every computer either uses a quartz crystal clock contained within it or syncs to a cesium atomic clock to maintain micro second level time. It is necessary for most computational processes to work. But wheres The clock face shows the passage of time. Through the space of one second to another, it is relational, in dialogue with what has preceded it. The way of reading time changes with digital time, with LED numbers that show what Charlotte Kent calls a \?perpetual present - that there is no sense of past through present into future, but just the now. here was no sense of past through present into future, but a display that could only offer a perpetual present that stems partly from the instantaneous depiction digital time projects. But that uniform march of time now faded in favor of instantaneity. Within a digital space, time is a point, eliminating any interval.\

Computers use UTC as a way of keeping time - so essentially every computer in the world is attuned to hyper accurate atomic clocks. Atomic clocks monitor the frequency of atoms to determine a universal, standardized measurement of time (something quite nice and symmetrical about the very smallest unit being the thing that is necessary to explore the depths of space) but are still subject to phenomenon like temperature, humidity, gravity, all of which affect its accuracy. They are analogue clocks that exist in the real world. Scientists talk about the accuracy of this type of time in terms of certainty, or rather uncertainty - it has \? an HYPERLINK "https://en.wikipedia.org/wiki/Measurement_uncertainty"uncertainty of 1 second in 300 million years\?.

Coordinated Universal Time is calculated through the output of around 200 atomic clocks and defined and regulated by the International Telecommuncation Union. To change or add or subtract a second in order to keep the time in sync with the earth\?s rotations becomes a long, bureaucratic process which has to be agreed by every nation in the world. The opportunity to do this happens once every several years.\ in 2023, the ITU World

Radiocommunication Conference will decide whether to HYPERLINK "https://www.gpsworld.com/utc-to-retain-leap-second-at-least-until-2023/"abolish the leap second, completely unmooring us from our relationship with the sun.\

UNIX TIME

Google, Microsoft, Meta and Amazon launched a public effort in July this summer to scrap the HYPERLINK "https://en.wikipedia.org/wiki/Leap_second"leap second because of the way that the irregularity causes problems with machines (Google suggesting the idea of a leap \?smear\? - adding the leap second's changes in many many tiny steps over the course of a day)

Computers also have other forms of telling time within therm which the leap seconds interferes with: unix time or epoch time is a system using for describing a point in time. t is the number of HYPERLINK "https://en.wikipedia.org/wiki/Second"seconds that have elapsed since the Unix epoch, which began at midnight on 1 January 1970.\ excluding HYPERLINK "https://en.wikipedia.org/wiki/Leap_second"leap seconds. Any time before 1970 is epresented as a negative number representing the number of seconds until January 1st, 1970. There is also a flaw in this way of telling time. UNIX time uses a 32 bit integer system that can't compute past a set number: after 03:14:07 UTC on 19 January 2038 the time value will be greater than 32-bits.\ Systems built assuming that the time would always fit withing 32-bits will result in undefined behavior potentially causing those systems to crash.\

BLOCKCHAIN TIME.\

Another form of computer based time that I have become increasingly interested in is Blockchain time.\ Because the blockchain is a closed system, it has to create its own way of keeping time. The latest block number becomes the way to keep time.
The amount of time it takes to mine a block varies across different chains (for bitcoin it is around 10 minutes on average, for ethereum it can be between 10 - 19 secs) but it is irregular. Although it is set to a constant value, things are mined more quickly or more slowly than expected. When this happens the proof of work algorithm changes, becoming easier or harder accordingly. Bitcoin difficulty level is reevaluated for example after every 2016 blocks which is roughly every 2 weeks. But there is a constant adjustment of how time is created, dependent on all of the people who are interacting with it.\

Blockchain time still contains uncertainty but it is a different kind of uncertainty, not driven by slight reactions to the natural world. It is built into the system with a response of what should happen. During the process of making, it is possible for two blocks to be mined simultaneously by different miners and attempted to be put on the network at the same time. One block will be accepted onto the chain, the other becomes a discarded orphan block. There is a temporary fork, where for a small moment there is uncertainty which of the two ways it will go (this links to what we were talking about with latency). Although no matter

what the decision is, time keeps going forward, the way that the time is made will be different.

The language used to talk about clock time on chain is interesting. It has to be called using something referred to as an oracle, a mechanism that is bridges systems on the blockchain with systems in the real world (in programming there is a certain amount of mysticism in some of the terminology used, intentionally or unintentionally). Clocktime is one of these things that has to be called in.\

There are also questions raised I feele about the timescale of blockchain and its \? - it still is a very new way of telling time. There is no deep time for blockchain - even the way that it is structured only looks out a few hundred years (the last bitcoin is predicted to be mined in around 2140?). You mention that you find the
familial language of generations (parent blocks, uncles) intriguing since the time scale is so much less than our human generation of 25ish years. Maybe blockchain time is just so much smaller than ours and that a block is equivalent to something much larger than minutes.\

LINK TO NATURAL WORLD

These new ways of telling time, inside of computers and various systems push us further and further away from the telling time with nature, and taking cues from looking at our surrounding environment. Cycles, tides, plants all offer us ways of understanding where we are.\

Indigenous communities around the world have and still use ecological calendars, which keep time through observations of seasonal changes. Native American tribes around Lake Oneida, for example, recognize a certain flower blooming as the time to start plowing and setting traps for animals emerging from hibernation. As opposed to a standardized clock and calendar format, these ecological calendars, by their very nature, reflect and respond to an ever-changing climate.\

Advancements in timekeeping have been driven by commercial reasons and the necessity for people & places to coordinate, evolving from being linked to natural cycles (sun, moon, seasons) to something mechanical, reproducible and split into smaller and smaller units. Language and metaphors are needed to talk about the climate crisis that sit outside of the systems that have helped lead to it.

CIRCADIAN BLOOM\

Circadian Bloom is an ongoing project that is the start of an exploration into ideas around other, non-human ways of keeping time. In this iteration, each screen is filled with an image of a plant that has a particular type of chronobiological clock -\ one that will consistently open and close its flowers at fixed times of the day - so that the piece essentially works like a kind of clock. These plants behave this way regardless of external stimuli - for example: a

night-blooming cactus will only bloom at night, even if it is exposed to darkness during the daytime and light at night; a morning glory moved into permanent darkness will still flower in the mornings. The clock is designed to start at dawn and end at dusk, and changes daily to reflect the precise longitude and latitude it is programmed for. Throughout the day the imagery of the different flowers evolve in real time\ in synchrony with their natural counterparts, blooming and closing at the correct time of day.\ Because the length of daylight changes throughout the year, looking at it at the same time\ will result in different flowers being shown (7am will be in darkness in winter months, but will be daylight in summer). Circadian Bloom harks back to an earlier, medieval way of constructing time in temporal hours when the hours of available daylight divided into twelve, so that an hour was dependent on when and where a person was.\ \

The project is inspired by Carl Linnaeus\? idea of a floral clock or \?horologium florae" that he proposed in his Philosophia Botanica in 1751 after observing this phenomenon of certain flowers opening and closing at set times of the day. But since then, the flower clock has remained, mostly, a concept. A flower\?s circadian rhythm is \?filled with complications\? \ geography, climate, light levels, seasonality all play a part \ which makes it nearly impossible to grow a true horologium florae that would cover the entire day and function as a clock. But by working digitally, I am able to make it real and create a tension between the highly precise and accurate time keeping methods that sit inside computers and the impractical, imprecise images that result.

There is something quite absurd about taking this accuracy and visually obscuring it so that the resulting clock can only really be understood as such as long periods of observation over days, revealing that it is not just visuals of flowers but something that is in sync with the natural landscape.\

CORPSE FLOWER\

Flowers can tell time in other ways also. The corpse flower,\ a rare tropical plant native with an incredibly complex life cycle. It comes from\ to the equatorial rainforests of Sumatra, in Indonesia has a bloom that can grow to more than eight feet in height and open to a width of four feet across.

But It takes seven to ten years for a single corpse flower to gather enough energy to begin its bloom cycle. Some that are in botanical gardenes have not bloomed for 50 years. When it does flower, the bloom lasts only one or two days. Some people travel around the world hoping to see a corpse flower at the moment it blooms.

But even this is changing in recent years: Kew claims that in their greenhouses, \?flowerings have become a remarkably common occurrencehave seen more than three times as many titan arums flower at Kew in the last six years than in the previous 120 years!\?, mirroring perhaps the instability that is being shown in other elements of nature.\

DEEP TIME // SHELL RECORD

Nature also offers another way of understanding time: deep time -\ time scale of geologic events, which is vastly, than the time scale of human lives. The concept of time\? was first described in 1788 by the Scottish geologist James Hutton, who saw that geological features created by erosion,\ required timescales much longer than the 6,000 years that the Bible suggested. We now know that the earth is 4.5 billion years old - a number that is impossible to comprehend.\ But it is there inscribed on the landscape.Earth\?s history is divided into a hierarchical series of smaller chunks of time, referred to as the geologic time scale. These divisions, in descending length of time, are called eons, eras, periods, epochs, and ages. Our impact is becoming inscribed: the Anthropocene is an unofficial unit of geologic time, used to describe the most recent period in Earth\?s history when human activity started to have a significant impact on the planet\?s climate and ecosystems.

\The Shell Record\? is a project that is made up of an image of the hundreds of shells that I collected from the foreshore of the Thames. Making this work took several months finding and collecting shells from different locations along the Thames River, which is one of the largest open archaeological sites in the world. The act of scavenging for objects (including shells) along the Thames, otherwise known as mudlarking, dates back to the 18th century. It is now a highly regulated activity and illegal to remove anything from the bank of the river Thames without a permit from the Port of London Authority, who own the foreshore to the high water mark. Ownership of the river has passed back and forth from different bodies and institutions (Environmental Agency, British Waterways, The Crown, The City of London Corporation) and been the subject of multiple acts of parliaments

When mudlarking It is easy to see how the history of the river has changed, even through something as simple as shells. There are a multitude of oyster shells, which no longer live in the Thames as large amounts of pollution destroyed their population but were prevalent in Victorian, Georgian and even Roman times. Some even have the stamp of the farmers who cultivated them. It is possible to find shells that clearly do not originate from the Thames but are testaments to the history of trade - cowrie shells that I found in Bermondsey that must have arrived back when it was an active wharf. There are new types of shells that have been brought in by globalisation and new shipping routes. Scientists see that shells that have been in the river since the Ice Age are now \?rare, outcompeted & replaced by a massive influx of invasive species\? & think that these new species will eventually become fossil time-markers for the Anthropocene. I\?m always interested in taking a single object and unpacking it, and this piece was a way to start to understand the change and flux in the human and natural worlds.

LABOUR\

Time is not just a subject matter for me: I work
with large data sets in developing the majority of

my work and those are derived from forms of categorization and cataloging that determine how we can see, or imagine, the world. Tiime plays into your use of data sets in your work through labour. It takes a huge amount of time to create a dataset. Commercial datasets are made using crowdsourced labour, who complete tasks for tiny amounts of money and where the work has to be completed as quickly as possible. Instead I\?m working in a clean space with the privilege of the artist, taking time to consider and look at each picture and definition.\

MYRIAD

Myriad (Tulips) is an installation of thousands of hand-labeled photographs of tulips; these photographs were later used as the dataset for Mosaic Virus 2018 and Mosaic Virus 2019. By choosing to make the dataset an artwork it draws attention to the skill, labour and time that goes into constructing it, whilst also helping to expose the human element in machine learning, usually hidden by algorithmic processes.\

Each piece of technology has its own associations and connotations: Myriad (Tulips) is surfacing some of these. I took ten thousand, or myriad of photographs of tulips over the course of three months whilst on residency in the Netherlands. The subject matter of tulips was deliberate, allowing me to make connections between speculation and value through tulipmania in the subsequent Mosaic Virus pieces but also drawing in the history of flowers in machine learning datasets. The iris flower dataset, created by British statistician Ronald Fisher, contains 50 samples of 3 different irises and is used as a test case for many statistical classification techniques in machine learning. It is included in the package Scikit-learn so that every machine learning programme that uses this package also contains within it somewhere a hidden flower dataset. This unexpected link brings the installation into the history of machine learning. But by referencing Fisher, I am also referencing\ the fact that he was also heavily involved in racism and eugenics (foreshadowing perhaps some of the inherent problems with machine learning, bias and datasets). Even something as simple as a flower contains within it hidden layers and narratives.\

By creating my own dataset, it forces me to examine each tulip and subsequent image, and inverts the usual process of creating this type of\ large dataset, which are usually built using mechanical turks and imagery that has been scrapped from the internet. The project was driven by the rhythms of nature, the collection of tulips stopping not because a certain number had been collected but because tulip season had\ ended. The process of making datasets is almost like craft - repetitive, time-consuming, often unauthored, but necessary in order to produce something beautiful. And there is a skill to it (something that is recognised by copyright law). If the dataset is too big, if there are too many images, the results will be too good and the quirks and oddities that make it an interesting medium to explore will disappear; if it is too small it will not have enough information and become flummoxed, either producing nothing or one or two variations from the training set again and again. had a direct connection to the objects I was documenting. It is easy to forget in the digital age

that information is physical and that things that are seen on a screen once started out in the real world. The process was physical - buying, moving, stripping hundreds and hundreds of flowers - labour that is often obscured, even in this rendering of a dataset.\

The labour that is visible is that of categorisation. Computability is often accomplished by categorisation - in order for a particular image to be retrieved, or understood within a dataset it needs to have a label. In the installation each photograph has a handwritten label underneath it with some of the categories that were used - the colour of a tulip, the state of the flower, the stripiness of the petal - drawing attention to the subjectivity that accompanies such decisions. Even something as simple as a tulip is difficult to put into discrete categories (is it white or pale pink? Is it orange or yellow? Is it a bud or has it just started to bloom?). To take just one of these - colour (which has its own acknowledged difficulties in the history in the botanical classification, openly opposed by Carl Linnaeus as \?a necessary or desired trait\? in describing plants) -\ is to start to explore the haziness around the definitions and perceptions of it. Something is always lost when material form is translated into language, and the result is always a result of the person choosing words. Because machine learning is so heavily dependent on language and categorisation, there is always a human decision somewhere along the chain of using machine learning and that it is not this absolute correct thing.\ What I perceive as an orange flower could very well be seen as yellow to someone else. Herein lies the issue concerning datasets: implicit bias becomes virtually unavoidable. However, in using photographs that I have taken I am able to impose greater control over the meaning of the images and how they eventually are processed by the algorithm and the resulting errors or assumptions that are made are mine and mine alone.\

MEMORY AND TIME

And the final way that I want to consider time is in relation to my body: and my own memories.\

The mind is not, as John Locke once thought it was, a tabula rasa that would then be recorded with aspects of consciousness, memories that can be read over again in introspection, storing up perfect experience to be looked upon at a future time. Neuroscientists discovered years ago that the process of recalling\ a memory activates the same processes as the act of creating a memory. Every time we remember something we are also actively recreating it At what point do the images change from one thing to another? At what point do they break down into nothingness?

It is impossible to remember everything, all of the time. Instead, memories can be encoded into physical objects, or placed into collections such as archives, but these again will never be complete. I took photographs that showed historic Malta from a variety of sources, some primary, some second hand, some public, some private,\ to create my own dataset of what the island has looked like. There are similar issues with using archives to the issues that

exist with datasets: what we have deemed important enough to count and quantify means that what is recorded is never simply \?what happened\? and can only show sometimes a very narrow or very incomplete view. In the National Archives of Malta there are acknowledged gaps. In historic \?Plans and Maps\? of Gozo we are told \?it is a very small collection as the majority was not traceable\?; in the photographs section we are told \?there are also a number of miscellaneous albums\? but not what their content is; in the registers there are gaps due to \?incomplete collection of census\?. There are similar gaps in the public and private collections that I looked at. Traces of Things shows how quickly meaning can break down if only a narrow dataset exists. Human memory works by filling in the blanks, creating essentially confabulations, a type of memory error where a person creates fabricated, misinterpreted, or distorted information, often found with dementia patients. In this piece memories are mixed with inventions; inventions are modelled on memories. There is a term used often in computer science and machine learning called \?overfitting\? which is used when a model cannot create new imagery but constantly remembers just one thing, the link to dementia again coming through.\

Repetition is an important part of the process of using machine learning. GANs only learn by iterating through the training set, each time changing and building on what has gone before. The original GAN paper states that this will\ happen until \?\?the counterfeits are indistinguishable from the genuine articles\?; if the accompanying code is run, the images that are produced are automatically labelled as \?fake\? in whichever folder they are saved to. This suggests that there is an inherent perfection of the original, and that a process that changes it or transforms it somehow creates something lesser. This links into the history of digital reproduction where although there are issues with creating copies (compression, loss), there is a constant movement towards finding a solution which will have none of these flaws. But current technology still has the elements of transformation each time something is recalled, or played, or copied, that become encoded into it. These moments are compelling: the creation of a copy where things start to slowly transform.\

CONCLUSION