ETERNAL RETURN
THE MEMOR

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BY MALIN ZIMM

A COMPANION TO THE EXHIBITION

ETERNAL RETURN

BY LUNDAHL & SEITL

CONTEXT / Reminiscent of a theatre left deserted at night, *Eternal Return* is a composite artwork that uses physical objects, VR technology, text and performance to explore reality as speculative fiction. The work is composed of a reality matrix consisting of three intertwined parts.

While "full immersion" is the ultimate goal for many virtual environments, *Eternal Return* makes the visitor aware of their dual presence in both physical and virtual space. Memory is the Biotech of Eternal Return. Every object in the installation - aligned with its digital counterpart inside the matrix - each with its own origin, is the imprint of different layers of time: a railing from the Titanic walkway is held up by the weight of a 3,5-billion-year-old microbial mat, a door handle floats in mid-air, a Victorian headboard, a chandelier, a desk and a sound-proof door from the Steinway piano workshop.

Without a visitor, the installation remains an archive of forms, sounds and scents in no particular order. Just like the universe, before or without the event of biological life, things just happen. Stars collide, neutrons merge, nebulae form, without a single conscious entity to witness and record the event. Performers act as living extensions of the work, adding intuition, temporal and choreographic structure to the VR interface - passing their learnings on to the next cycle of visitors. Much like the traces of Earth's past is recorded in rocks and fossils - as arrangements of minerals in stable structures examined in the present - the state of a memory in *The Memor*, like the human mind, are a stable structure of a neural network, as it is in this very moment, and every return to it, changes it. Together with this text – *The Memor* – sculpture, staging, instructions, change in temperatures, spatialized sound, scents, synchronized movement and touch, *Eternal Return* explore the full possibilities of what a totally anti-disciplinary artwork can be.

/Lundahl & Seitl

PRODUCTION / Eternal Return by Lundahl & Seitl (SWE) and ScanLAB Projects* (UK) is a STRP co-production.

Eternal Return - The Memor is written by Architect PhD Malin Zimm.
Script collaboration: Malin Zimm.

J. S. Bach's Fugue in A Minor BWV 543 written for the organ, arranged by Liszt for piano, is performed by Cassie Yukawa-McBurney.

Dramaturgy by Rachel Alexander.
Performers: Pia Nordin, Lena Kimming & Sara Lindström.

ScanLAB Projects team: Matt Shaw, Max Čelar, Soma Sato, Manuela Mesrie, Reuben Carter, Jacques Pillet, Will Tros- sell, Dorka Makai

strp.nl
lundahl-seitl.com
scanlabprojects.co.uk

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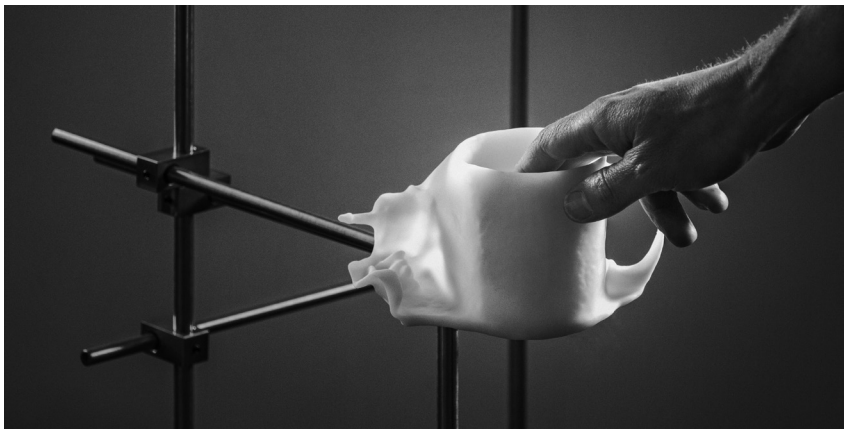
PRELUDIUM

Eternal Return *by* Lundahl & Seitl *is accompanied by this text,* The Memor, *that provides an expanded narrative framework. Objects and scenes in the installation thus take on a multitude of experiential modes; physical, virtual, narrative, emotional. The science fiction story expands as the art installation evolves, yet its parts can be read in any order as a non-linear envelope. As a piece of speculative fiction, the text moves from the old world to the new, weaving history and fiction together by picking up facts floating in the tide and finding new use for them in the narrative. The narrative contains numerous references to demonstrate the method of "playing" the internet for facts and news, encyclopaedic knowledge and archives. The various references are composed together to form a new interpretation of the events in and around the world as it is presented to our senses.*



***Eternal Return* installation detail with 3d-printed cup.**

Waves are the lingua franca of the universe, spoken in all frequencies and amplitudes. Waves is what keeps us together. From the wriggling vibrations of the quantum particles that constitutes our physical existence, to the seismic movement inside Earth, the ocean waves, electromagnetic waves of sound, light and heat carrying information to our senses. Waves is also what keeps us apart. Gravitational waves keep us grounded, making any displacement on earth an energy cost for all beings. Space and time are possible thanks to gravity, keeping them apart, stretching them out to "take place", preventing everything from happening at once, in the same place. A wave is, in science, defined as a transfer of energy. An ocean wave moves the energy, not the water. Sound is a disturbance travelling in air, not the displacement of air.

In the waves of history, there will be the occasional ship, connecting the old world with the new. Energy will travel and build up to a point, followed by a release of power in a different place. Tides will lay things bare and dry, as well as hiding everything under a forgiving veil of water. With the arrival of the water, some lifeforms will populate the biotope, and with the withdrawal of the sea, other lifeforms will occupy the same place. The tide is time counted by the moon. Over the years and decades, the sea will

redraw the outline of land, reach and claim some structures, spare others. We will live in this interface and take it for granted, by virtue of its scale and age. We will get used to the sounds and temperatures of this world and its cyclic wonders. We will admire its calming vistas and curse its unforgiving claims. The waves will keep coming, some of them will take us out, some of them will bring us back.

Speaking with Nietzsche, Eternal Return is an existential waveform, sending humans into cyclic patterns of life and death, moving the energy from one world to another, while the matter stays behind. In the exhibition narrative, Eternal Return is a wave that disrupts the social orders of the world, and an unexpected opportunity to contact the past and the future of Earth. The novel tells the story of how we got to know the universe around us as a resounding archive of life on Earth, capable of putting us in touch with the past, as well as the future.

WAVE (V.) ”move back and forth,” Old English wafian ”to wave, fluctuate” (related to wæfre ”wavering, restless, unstable”), from Proto-Germanic *wab- (source also of Old Norse vafra ”to hover about,” Middle High German waben ”to wave, undulate”), possibly from PIE root *webh- ”to move to and fro; to weave” (see weave (v.)). Transitive sense is from mid-15c.; meaning ”to make a sign by a wave of the hand” is from 1510s. Related: Waved; waving.

WAVE (N.) ”moving billow of water,” 1520s, alteration (by influence of wave (v.)) of Middle English waw, which is from Old English wagian ”to move to and fro,” from Proto-Germanic *wag- (source also of Old Saxon, Old High German wag, Old Frisian weg, Old Norse vagr ”water in motion, wave, billow,” Gothic wegs ”tempest”), probably from PIE root *wegh- ”to go, move.” The usual Old English word for ”moving billow of water” was yð.

SOUND (N.) *swen- ”to sound.” Proto-Indo-European root meaning ”to sound.”

It forms all or part of: assonance; consonant; dissonant; resound; sonant; sonata; sone; sonic; sonnet; sonogram; sonorous; sound (n.1) ”noise, what is heard;” sound (v.1) ”to be audible;” swan; unison.

It is the hypothetical source of/evidence for its existence is provided by: Sanskrit svanati ”it sounds,” svanah ”sound, tone;” Latin sonus ”sound, a noise,” sonare ”to sound;” Old Irish senim ”the playing of an instrument;” Old English geswin ”music, song,” swinsian ”to sing;” Old Norse svanr, Old English swan ”swan,” properly ”the sounding bird.”

From Etymology online: https://www.etymonline.com

Eternal Return **installation detail with 3d-printed piano parts.**

PART ONE

DUGNAD / On the way to the meeting, Paula noticed the soundless arrival of a fleet of bikers, folding down their solarcs to slow down before the gates as the dust behind them settled. She chose a seat in the second row of the tipi, in a self-conscious move to curb her enthusiasm. The bikers handed over their soiled rides to the young assistants at the gate, and were shown into the basket-woven tipi, big enough for the whole tribe to gather. The roof allows both sun and winds to play inside, and offers a soft framework for gatherings of all kinds, not overly festive and always in need of some care and repair around the trimmings. It was called Dugnad, like the tribe itself, named by one of the founding groups of Norwegians, bringing the word for "voluntary work", or more to the bone; "joy of joint effort".

As Dugnad filled up, Paula watched the guests look around inside the structure, untangling shawls from their necks and faces, released to breathe freely of cool air. Paula rose to greet the group, reaching for the hand of the delegate who first met her eyes.

- Welcome to Dugnad. We are so pleased to meet you. Memember Paula Wegha.

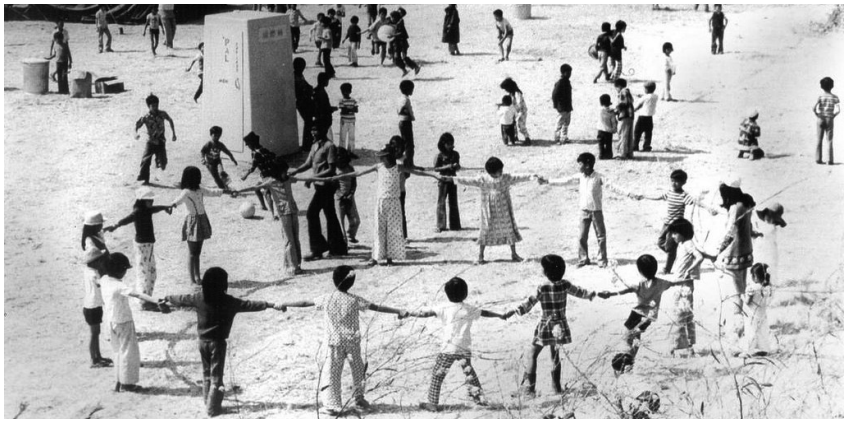
- So pleased. Memember Océ de Broglie. Thank you for having us! The beauty! The line of exchanging handshakes was a smooth choreography accompanied by smiling voices. Paula forgot most of the names immediately except the first one she had greeted, and the guests were shown seats at the head of the room. After a short welcoming by Sabine Fier and Jos F who were assigned presidency of the meeting, Océ opened in an economic, yet hearty tone.

- The beauty! We have long wished to meet and our ride was timely. The past weeks have brought news that makes our combined skills indispensable. We hope to form a consortium over these next days, time is short for this but we have brought our best Orgad and a case of Tequila.

There was laughter that relieved the solemnity of the greeting ritual, shoulders dropped, and the meeting lasted until the sun had played a quarter of a full turn around the tipi. A smell of open fire spread in the air, and a nuance of peach rose over the mountain ridge in the West.

The Coyote Buttes area in Arizona is an exposure of cross-bedded aeolian Jurassic Navajo Sandstone in swirling erosional rock formations.

THE WAITING GAME / Paula was tired from socializing with the new guests. So used to having the same people around her every day, her social responsiveness consumed a lot of energy when she had to reposition herself with new people in real life. She had been a Dugnad member for almost a decade, and her kids had settled in beautifully although the desert setting was very different from their first years in life, lived within hearing distance of the ocean. She was the first generation to grow up in the sub-national order of tribes, born in a former refugee camp in Costa Rica, in 2016. This was when the refugee camp had successfully reformed its existence into a production unit, founded by an overly generous American fund formed in the wake of the crisis of Facebook. The company at the pinnacle of social media had proven unable to uphold its morals, failing to protect its users from lies and



Metaphors associated with water are often used in conjunction with refugee crisis around the world, such as ”waves of refugees” arriving in ”swelling numbers”, ”flooding countries like a rising tide”.

hate. Mark Zuckerberg, the flailing CEO, decided to hit two flies in one swat, offering both economic support and jobs to a big refugee camp in Costa Rica, while earning user brownie points. Until then, not many showed interest in what happened inside the ever-growing refugee-camps, except companies desperate to build their goodwill. Assisted by a fleet of investment and charity consultants, in their choice of distressed people they first looked at the top five-sized camps in the world. But as these were all in Asia and Africa, they had to look closer at the American continent. The Facebook investment coincided with the efforts of the Trump presidency to keep refugees out of the US. Tax reliefs was offered Facebook for placing their money in camps where populations aspired to enter the US. The combination of Facebook's desperate need for reputation laundry and goodwill fishing, and US efforts to stop people in their tracks towards its soon-to-be-walled border, provided the ticket out of misery for the 350 000 people of Alajuelita. This was the first camp to receive the land lease agreement and where Paula's parents would begin a new life, studying theoretical physics together. They knew no other life or place on Earth, but the Facebook donation changed everything. Paula's parents managed to share their time between open online university classes and teaching surfing to the first tourists who ventured into the camp, both another source of income and an important influx of open-minded people who, upon their return to the US, would not hesitate to become the first private investors in funding shares issued by the camp council.

LAND B'N'B / Most people had no idea what went on inside the camps. There was organised education, first pre-schools, then high-schools, then very small and very dedicated universities following the open classes of Harvard, MIT, Tsinghua, Columbia, EPN, Nanyang, LSE and Cambridge. Only a couple of hundred students graduated the first years, but they were as qualified as any, had more guts, less clothes and a hunger, built up by generations, for justice. Once external financing had filled the camps' basic needs of housing, food, clean water and reliable energy sources, self-organisation happened quickly and much under the radar of even the donors. Better housing, workshops and solar powered computer shacks were built. In return for the Facebook donation, the camps were to assist in content approval and mandated to process a certain amount of uploaded pictures every 24 hours. The initial batch size was reached already after 40 minutes and the daily amount increased until the social media company reached a degree of security for users that they had not been able to deliver in years. The company engaged the camp for more qualified work like detecting fake news postings, which proved to be yet another successful delivery from the camp's workers. For the camp, this flow of content was a crash course into the depravity of the Western world: an incessant flow of efforts to get people's attention and maybe also their votes. The refugees amassed their academic intellectual capital while growing increasingly savvy in the workings of the world's top consumers, their preferences, their memes and trends, their decadence and ambitions. While having nothing in common with the consumer habits they encountered, the refugees got to know everything about the top 10 percent' s habits and helplessness. In fact, they reached a level of insight only matched by the secret algorithms inside Facebook's most well-guarded vaults of sociocultural data - the record of the minds that hold the money in the world. No matter if you were the first or fourth generation in the camp, nobody had lived the life of those whose content they studied daily.

Childhood in the camp was spent perfecting survival and social skills among people who had lost everything but their will to put their lives back together. They had real conversations and learned real crafts and tricks of the trade in the physical world. They were not estranged from older or younger people, they had to exercise trust, and they did not take the traditional family structure for granted. In short, they knew everything about depending on everybody around you. If someone was ill, everybody around you would be too. If someone lost their wits, they could be dangerous to others next to them. If someone was depressed, you could only offer your empathy, no drugs. Solitude was as rare a luxury. Nobody was ever alone, not in the way that most Western people are lonely.

The first years of content approval was all manual labour. But soon code students achieved a hyper-

efficient AI that quickly relieved and replaced the hundreds of manual workers, who could then move to more qualified tasks. Soon the fastest coders had a few patents filed and were already negotiating with a freshly started Ugandan camp council to manufacture a household AI assistant. The camps did all their business in Bitcoin, bypassing national banks and facilitating all handling of contracts and agreements. Ten years after the Facebook donation in 2018 to the refugee camp outside of central Alajuelita, its inhabitants began to believe in the promise of a ”rich coast”. Zuckerberg, you have to hand it to him, had made one superb decision: he insisted that the money be entrusted to a council formed by refugees within camp itself, without outside organisations involved either directly or as middlemen, and that smartphones would be handed out to all inhabitants over 15. Already in 2018, the immigration population had reached 350 000 people, mostly Nicaraguans. A couple of years after the first Zuckerberg instalment, famine and disease were defeated, families reunited and formed, and in 2022 the camp held its first democratic council election in Camp Alajuelita.

In 2023, Alajuelita served up a crazy but well-crafted offer to its host nation and benefactors. The deal was that each refugee would give up their plans to enter the US. Neither did they aspire to become Costa-Ricans. What they offered was a lease of the land on which they were already settled, and a great tax commitment to the nation. Witty journalists picked up the deal and rebranded it ”land b’n’b”, or referred to the arrangement alternatively as an ”Uber-nation” or ”Bit-countries”. True enough, the arrangement was examined by the UN, which found it a viable construct, albeit undermining its own power imposed by nearly a century of total focus on the sovereignity of nation states. These in turn were not what they once had been. The American stronghold on economy was already faltering under Trump, but the early 2020s was a hard blow to Silicon Valley, completely outshadowed by competition from all over the world, as the celebrated hotspot for ideas and entrepreneurship imploded in its homogenity. They said it had become an echo chamber of likemindedness, thinly veiled by the idea that they were the most high-ceiling environment for ideas – little did they know there were places with literally no ceiling. The places where homogeneity was paired with the self-image of being very open-minded were the first places to fall out of success. No matter how and why the camps grew, no one had anything to offer them but a waste of lifetime. Hundreds of thousands of people who had spent their energy upgrading their lives, were stopped in their tracks and swept together in the dust-pans of camps to lead a static and miserable unchanging life in waiting, hoping, and then ceasing to hope but still waiting. Meanwhile, the populations of nation states revelled in their individuality and exercised every right to be successful. With special needs and food preferences, letting other people know if they were in or out of their individual lives, excelling in careers, exhibiting their lifestyles and attributes on social media. Refugees on the other hand got used to being non-individuals, in the eyes of the rest of the world - people without the rights of individuals - and they decided to play the tune played to them, to make a change in the long run. If we are not individuals, with the human right to move, we can try

A substation is a part of an electrical generation, transmission, and distribution system. Substations transform voltage from high to low, or the reverse, or perform any of several other important functions.

being a group, earning the right to stay, they thought. By agreeing to temporarily giving up their rights to mobility, they made a promise to stop being a burden to the host nation and the UN, and to prove their human rights. While regrouping as a “tribe”, the refugees embarked on a geographically static, but anything but socially immobile, journey towards freedom. Freedom itself was reinvented as they all realized that the life lived by people in the Western world was in some sense another kind of prison, albeit one of their own device. On the way to the promised land, the promise itself was revealed to be a lie wearing perfume and plumes. It was all too obvious from the millions of images sent to them for approval, that the deprived lives producing those images was not much to aspire to. They might as well reinvent that world too.

MEMEMBRANCE / The tribal treaty, in the form agreed by the UN and the ”host” nation state, began to spread as a concept. First to other great refugee camps, like the Uganda camp where Océ grew up and studied in, then the ideas spread to groups who formed tribes with different agendas within countries, in agreement with their respective nations. In the wake of forming independent tribes, often with a sustainable focus and a significant lifestyle focus, all nations had to rethink the idea of what a citizen or even what a population is.[1] Nations had to step up their game if they would not miss

out on The more common order in wealthy countries was that an offer from the government opened for a group of people to move to remote places, where there still were some nation state citizens, but not enough of them to motivate the upkeep of civil services. This depopulation of the countryside and the concentration to people in first big cities, then middle-sized cities, were an intricate matrix of migrations set in motion by the increasing gaps in society. Lampedusa was one of the first land b'n'b's to form in Europe, while the tribe of Dadaab, formed in Kenya, celebrated its first year under a council, funded by the Chinese company AliBaba,[2] and the treaty of Kutupalong in Bangladesh was soon underway. Static lives, going nowhere, were traded for high education and a specialised set of skills sought after by not just the financing company but in high demand from all nations whose populations were torn by populist micro-conflicts stemming from increasing gaps in society. The bigger companies had enough of negotiating at individual level, especially when there were entire tribes whose offer was too good to resist: highly educated people claiming neither individual demands or salary, but paid tasks from which an automatized AI process credited up the collective of the tribe. This provided them with everything but the individualist consumer lifestyle they once craved to be a part of, but did not find any reason to strive for anymore. This whole new way of forming a society ripped national politics apart. Populists who had built their entire political programs on the big scare of "waves of refugees" coming their way, lost their main argument. The old nation states found themselves in need of the working skills of the collectives. In the great adaptation to sustainable lifestyles, they did not know much of how to live a life less opulent, while refugees knew everything about how to get water over night, to make a bag of rice last for months, to grow on resistant grounds, to have a box of mushrooms under the bunk bed, to practice each one teach one, and to live through a day without wifi. This is the skill set now. In Sweden, the mining company LKAB offered up a big piece of the inland, where a Sapmi/Siberian exile group (from the tundra melt-off) formed one of the best AI labs in the world in a camp called Asimov. As taxes started flowing into governments again, the refugees were not called refugees anymore. Most people had forgotten anyway how they got to be there. Generations had passed, and the camps had become cities. Refugees had become tribes under councils, they had transformed to skilled communities and productive collectives. Passports and mobility were restricted at first, but soon granted to facilitate the mobility of the delegates and the most brilliant inventors and crafts people. Kinships groups formed

hierarchies, certainly, but the refugee camps had a line of social evolution that rendered religious and social conflicts obsolete. No matter what social status you might have had outside of the camp, you had none of it on the inside, forced to reconstruct your self -sustainability from scratch. No matter what clan you claimed descent of, once inside, you had not more than the clothes on your body, a pair of flipflops and a damp tent. This is why tribes were the most accurate definition of the refugee camps as they transformed. A tribe is any cohesive group of people who feel an affinity for one another. Tribes can function as self-contained economic and political units. There was not enough money around for the usual criminal organisations to exploit in order to get hold of or wield influence over the camp. The means of production were knowledge and code, because that is what was made available to them by the Facebook contributions. All the while, tribe members called themselves, as a reminder of their individual worth: memembers. Me as a member. Remember me, as an individual. If I am trash to the rest of the planet, I will be a treasure to my tribe. If human rights are not granted us in this time and place, I better change this place over time. Count me in. Memember me.

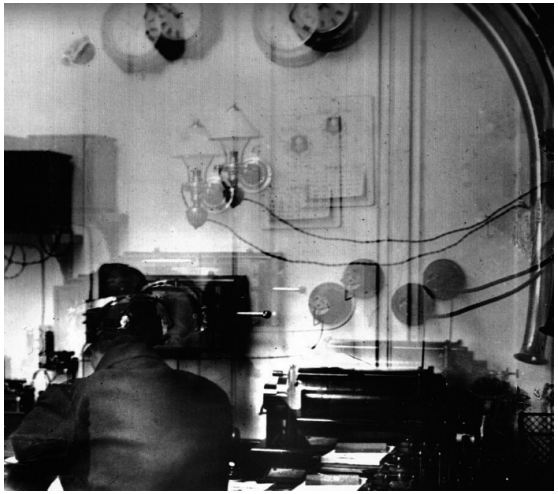
FREQUENCY (N.) 1550s, "state of being crowded" (now obsolete); 1640s, "fact of occurring often;" from Latin frequentia "an assembling in great numbers, a crowding; crowd, multitude, throng," from frequentem (see frequent). Sense in physics, "rate of recurrence," especially of a vibration, is from 1831. In radio electronics, frequency modulation (1922, abbreviated F.M.) as a system of broadcasting is distinguished from amplitude modulation (or A.M.)

FREQUENT (A.) mid-15c., "ample, profuse," from Old French frequent, or directly from Latin frequentem (nominative frequens) "often, regular, repeated; in great numbers, crowded, numerous, filled, full, populous," which is of uncertain origin. Watkins says probably from PIE *bhrekw- "to cram together," and compares Greek phrassein "to fence in," Latin farcire "to cram," But Beekes regards the connection to the Greek word as "quite uncertain." Meaning "common, usual" is from 1530s; that of "happening at short intervals, often recurring" is from c. 1600.

/From Etymology online: https://www.etymonline.com

PART TWO

WALTZ / At dinner, Miss Marjorie Anne Newell was served her first ever glass of sparkling wine, and of course she had declined, saying she was going to have an early night, and not to waste these precious bubbles on her. And, of course, her first sip told her that this was just what she needed. She leaned back and let the laughter and conversations twirl around her, marvelling at the beautiful gowns the first class' ladies wore. It was also the first time she was wearing a long train gown, and it made her feel part of something bigger and promising. She smiled recognizingly to the other guests as they heard the band playing "The Merry Widow Waltz", "Turkey in the Straw," and "Alexander's Ragtime Band". The only thing that stirred her a bit was when the woman next to her commented that the ship was going too fast, that there might be icebergs, and they should be slowing down. Around 10 pm she made her excuses and was escorted by one of her father's business partners whom she liked and trusted enough to know she was not going to have to make an awkward goodbye at the cabin door. In fact, she convinced him already at the corridor entrance that she would make the last 20 meters all by herself, a venture to which he did not object but tipped his hat and bid goodnight. Yet the sparkling sensation held on to her knees and she reached for the railing as she was making her way down the corridor, to cabin D-36 where her sister Madeleine was already asleep. The sisters had brought their back-up violins on the trip, so as not to miss out on their daily practice. Marjorie put her sister's instrument back in its case and placed it at the make-up did not put her instrument back in its bag before going to bed. Marjorie put it back in its case and placed it at the vanity table, hung her dress in the closet and went to sleep as soon as she laid down.



The only known photograph of Titanic's Marconi room, taken by passenger F R Browne.

At 11:40 pm, Marjorie sat up straight in her bed, listening to the jingle of the chandelier in the cabin ceiling.3

- Maddy, are you awake? Did you feel that? Maddy?

Her sister irritatingly changed position in her bed and grunted. A minute later, there was knocking on the door, and while Marjorie unlocked it, she heard her father's voice in the corridor.

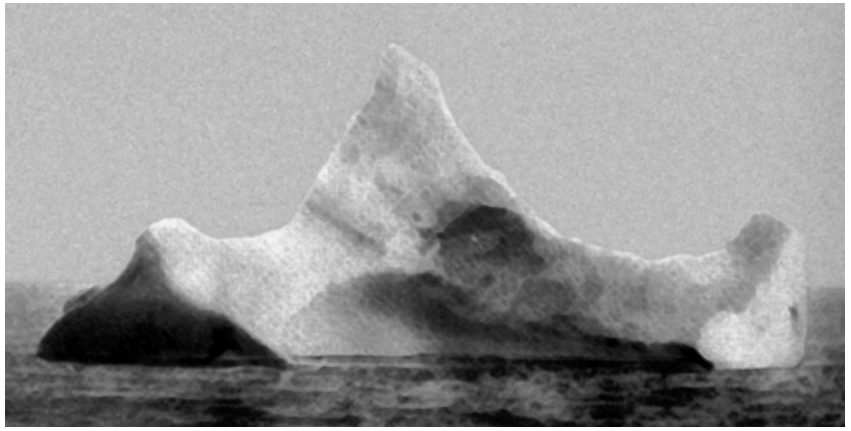
- Get dressed girls! Hurry now. We shall go see about this calamity!

He put one foot and his cane inside the cabin and looked quite upset. Fully clothed but without his hat, he insisted with a lower voice that they should not mind with corsets and such, just the warm attire and would they please hurry as he waited outside the door.[4]

WIRELESS / At 11:46 pm, Harold Bride bustled into the wireless operator's cabin and slumped into a swivelling chair, making his excuses for not having woken up earlier, urging his colleague to go to bed already.

- You look all done for, old man, just get out of that seat and leave the rest to me.

Jack Phillips did not look up from the wireless but assured him that he had not expected Harold to show up for another quarter of an hour, but on the other hand he was pleased that Harold came because he was right, Jack was exhausted. Earlier that evening, Harold had gone to bed early to be able to relieve Jack at midnight, two hours earlier than normal. That way, Harold would be able to catch up on the backlog of the passengers' personal messages, while Jack got some sleep. Harold was both



The iceberg suspected of having sunk the RMS Titanic, photographed by the chief steward of the liner Prinz Adalbert on the morning of April 15, 1912, unknowing about what happened to the Titanic. His attention was caught by a smear of red paint along the base of the berg.

amused and slightly annoyed by the passengers' frivolous use of the novelty technology onboard. Before he was off to bed just after 7 pm, he sent the following message from a first class passenger to New York: "Hello Boy. Dining with you tonight in spirit, heart with you always. Best love, Girl", after which he felt more than entitled to a couple of hours of rest.[5]

- We have struck an iceberg and I am having an inspection made to tell what it has done for us. Phillips, you better get ready to send out a call for assistance. But don't send it until I tell you. Bride, button up your jacket.

Captain Edward Smith left the operating room and left these words hanging for half a second in the air, while Harold and Jack realised that this was not to be an ordinary shift. Ten minutes later, the captain came back in and as he opened the cabin door, confused voices could be heard behind him, as he ordered the call they did not expect to be necessary: the regulation international call for help.[6] Jack sent out his first CQD while Bride took messages to the Captain's bridge about which ships were responding to their distress signal. He did not have much encouraging news to bring as the closest ship to respond, the RMS Carpathia, would not reach the Titanic until another couple of hours. At one point Harold reminded Jack that the new code was SOS, lest he forgot: [7]

- Send SOS, old man! It's the new call, and it may be your last chance to send it.

As they shifted to the date 15 April 1912 in the log, Jack took a quick break and Harold took over the wireless. The communication between the ships was a mix between exchanging of positions, the occurrence of "bergs, growlers and field ice", information about the condition of the ship, all the while with a jolly brave tone, calling each other "old man". The wireless traffic between the ships was at times silent, and at times too jammed, whereby the message "shut up" was sent, not out of disrespect but as a short form among wireless operators to politely ask other operators to 'keep the line free'. As time passed the messages got increasingly frustrated as receivers seemed to have a hard time grasping the events on the Titanic. Harold was by far the fastest Marconi machine operator in the conversation, and he would have been in any situation, not just in this particular distress. Harold was fluent in "broadcast". He had pushed the speed at which Morse code can be sent, to its limits, and he was well aware of his ability when, at the age of 22, signed up for service on board the Titanic in Belfast as "junior wireless operator" and assistant to Mr Phillips, whose 25th birthday was celebrated aboard the Titanic on the 11 April, with pastries brought up from the first class dining room. Their young age was not sensational as it was common among young people to take up interest in the latest technology. Harold knew all abbreviations that could be used to speed communication: prosigns, Q codes, and a set of Morse code abbreviations for often recurring message components. Broadcast expressions like "CQ" for "seek you", "OM" for "old man", "YL" for "young lady" and "QTH" for "my location" – these and others were used to distinguish between the parts of the conversation. YL or OM is used by an operator when referring to the other operator. What was especially appealing to Harold was that the use of these abbreviations permitted conversation even when the operators speak different languages. And god knows, he thought, tonight we need help in every damn language it may speak.

Arthur Newall stood before his daughters, holding his position in an increasingly chaotic line to get into lifeboats. They watch the hauling of one lifeboat, reaching the sea surface safely, and pushed a little harder in line for lifeboat 6. Arthur held the hand of Marjorie who got in without a word, then took the hand of Madeleine who objected in bewilderment to everything around her, the temperature, the bustling, the violin she forgot in the cabin, her sister waking her up for no reason, and she had a hard time to let go of her father's hand, but the girls had to move along in the boat and Madeleine continued her complaints, addressing her sister instead of her father who was out of hearing distance. Marjorie saw him lending a hand to another woman who was one of the last to get on the boat. Arthur did not take his eyes of lifeboat 6 as it was hauled down. He saw the sisters trying to be seated together, unsuccessfully, whereby Madeleine stopped speaking. He saw Marjorie being assigned a place by the

oars and her surprise in being expected to handle the boat. He saw the boat disappearing into the darkness, and stayed on to see the twirls of the oars lingering in the slow cold water.[8]

WATER / When Jack returned to the wireless cabin, he had brought life vests and warm clothes to him and Harold and reported that the forward part of the ship was flooded. Bride began to get dressed while Phillips went back to work on the wireless machine. The signals kept coming in and going out. They were almost out of wireless power when Captain Smith arrived.

- Men, you have done your full duty. You can do no more. Abandon your cabin. Now it's every man for himself, I'm afraid, boys. You look out for yourselves. I release you.

Despite the captain's words, Jack kept transmitting for a while longer, while Harold gathered his personal belongings. The only thing that made Jack leave the wireless machine was when a panic-struck and drunk stoker reached in and grabbed the life vests that Jack had went off to get for them. Jack stood up and knocked the man out. Harold noticed how much water had reached the deck where the wireless room was and assisted hastily in launching one of the last lifeboats – Collapsible B – off the roof of the officer's quarters. With freezing hands, and with the forward tilt of the ship, the twelve crew members were unable to launch the boat properly, and the collapsible was washed off the deck upside down, strange surges beginning to stir around the small vessel. Harold found himself beneath the overturned boat and in an intuitive effort to save his life he managed to swim from one darkness to another, felt his hands hit the boat, climbed onto it and waited. The sounds around him were impossible to shut out. He did not dare to close his eyes, for fear of losing his balance. At times, he was not sure if they were closed or not. But it was impossible to shut his ears. The sound of hopes and lives lost were mercilessly audible, since the sea was calm this April night. Some drifted mutely, looking strangely alive, others still shivered with inaudible prayer, a few screamed in agony before being numbed to silence in the water. All lights went down with the Titanic, as her bow tipped down into a surreal suction, and the stern broke off to the sound of a giant bone breaking.

The next time he saw lights was when RMS Carpathia approached them. As Harold and the other fifteen survivors were lifted into lifeboats from the waterlogged and slowly sinking collapsible, Harold noticed that his feet were badly injured. Aboard the Carpathia, Harold was informed that Jack had collapsed from fatigue on the Collapsible B, he had frozen to death and fallen off, and this had happened just a couple of terrified survivors away from where Harold was sitting. To fight the sorrow and panic that was about to consume him, Harold had his feet bandaged and after a short rest, he asked to be carried to the wireless cabin of Carpathia. Together with wireless operator Harold Cottam, Harold set to work on the wireless telegraph, sending messages about survivors first, and all information they had from aboard the saving ship. Harold Bride and his namesake Cottam had met before the disaster and were united in this situation, as good friends. Sparing all words between them for a later day, they

Rescuers from the ship Carpathia helping Titanic's radio operator Harold Bride off ship at Pier 54, New York, April 18, 1912. Despite being injured, he helped the Carpathia's wireless operator transmit survivor lists and personal messages from the ship.
Left: Harold Sydney Bride, Wireless Officer at RMS Titanic. Born 11 January 1890, died 29 April 1956 (aged 66).
Right: Jack George Phillips, Wireless Officer at RMS Titanic. Born 11 April 1887, died 15 April 1912 (aged 25).

embraced each other and the saved Harold nearly burst into tears. Without much ado about their unexpected reunion, they engaged whole-heartedly in the acute messaging following the tragedy.

Harold got his first sleep in nearly 52 hours, and in his waking dream, he was looking straight into the eyes of John 'Jack' George Phillips.

- We could follow the rules, or we could break them, he told Harold.

Harold had no idea what he meant but agreed on breaking rules if Jack thought this best. It was the 13th of April, and they had detected a faulty component in the wireless, that caused a decrease in power output from the machine.[9] Phillips explained the matter to Harold, and as he was talking to Harold, he talked himself into the decision to troubleshoot and fix the problem, even if this would mean working through his allotted time to sleep. The violation of rules had more to do with the protectionist corporate rules that came with the equipment, than overruling the scheduled hours of work. According to the Marconi manual and company policy, telegraphists on shift were not to attempt to fix things themselves, mid-journey, but should wait until getting into port whereby a Marconi engineer could be called in for repairs. Harold's curious interest in the reparation was enough as consent to Jack's decision, and together they took to small tools and big swearwords before they had the machine back in full capacity by the afternoon of the 14th. Harold lied in his bed on the Carpathia and realized that if Jack had not made the decision to repair the wireless, they would not have had enough power to contact the ship that was now carrying him towards the shore. If not for Jack's work morals and willingness to break some rules for the common good, Harold would not be resting in clean sheets, alive but with sore feet. If not for their confident relationship, the survivors in the lifeboats would have been left adrift in the freezing North Atlantic ocean. They would all have had to die the way Jack had perished.

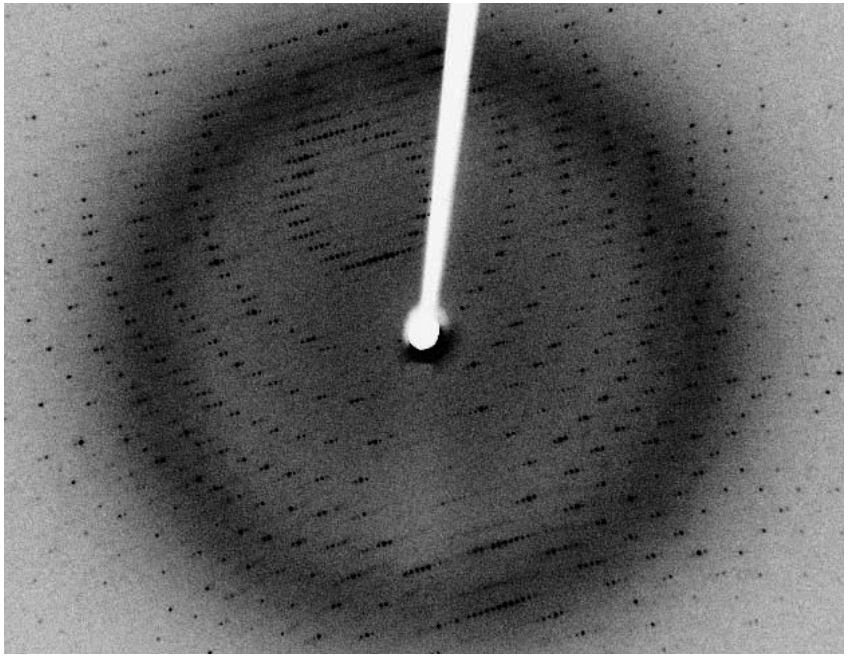
Jack's body was never recovered. Later in life, Harold visited the Phillips family grave at Godalming Old Cemetery in Surrey, England. He stood silent by a medium-sized plot with a headstone in the shape of an iceberg, before getting on the train to Scotland with his wife Lucy and their three children.

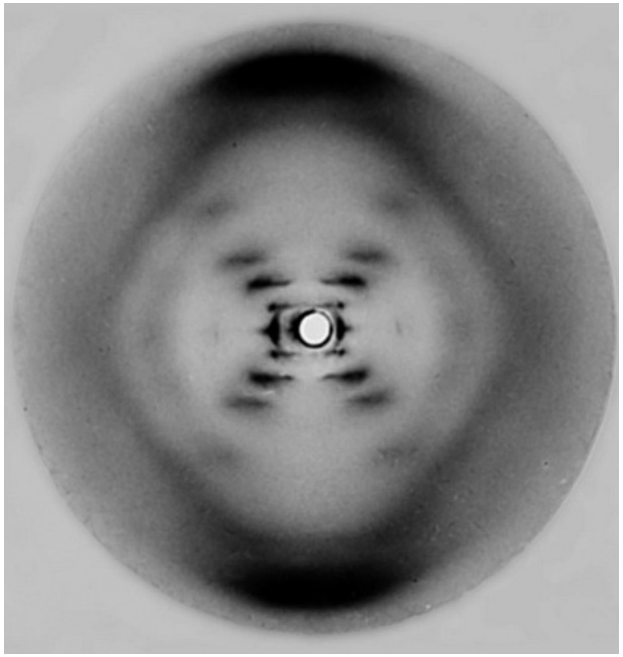
WONDERS / Marjorie Anne Newell married Floyd Robb in 1917. Together they raised four children –three daughters and one son – in Aurora, New York. Sixty years after her marriage, at the age of 97, she would draw full audiences as she finally chose to share her memories from the Titanic. Out of respect for her mother and sisters, she had not revealed any details on their fate, but as she outlived them, she decided that researchers and historians would benefit from her sharing the honour for her lost father. On these occasions, she would try to catch the audience's attention to her achievements in life, too, but they seemed only interested in hearing about her near-death. She would tell the audience about her happy years as a music instructor at Wells College in Aurora, and about her harmonious life in South Orange, New Jersey, where she taught violin and piano between 1920 and 1950. Marjorie would not leave out the fact that she eventually became one of the founders of the

An emergency cutter lifeboat carrying a few survivors from the Titanic, seen floating near the rescue ship Carpathia on the morning of April 15, hours after the disaster.

New Jersey Symphony Orchestra. A polite applause would ensue this disclosure, and the interviewer would ask her again about the experience from steering the lifeboat away from the sinking ship. To any human being at the age of 97, life is a wonder. To Marjorie, life was divided into her first life, the years she took for granted from her birth in 1889, and her second life: the wonder of being alive after 1912. After reuniting with their mother in a hotel in New York, she felt anything but saved – her mother was devastated by her father's death, which overshadowed the relative joy of having her daughters back. Holding on to her lust for life, when nobody was at home, she used to play "The Merry Widow Waltz" on the violin, dancing around her room. She also played Autumn when she was alone, the hymn that accompanied the sinking boat. She would imagine herself as a member of the orchestra on board. She tried to imagine how the leaning floor would feel from inside the ship. She put herself into the situation in such detail she almost entered a dream-like state. She thought there would be no straight lines left to hang on to, except on the note sheets floating in the dinner hall. She was wondering what a piano might sound like when played under water.

She was relieved to leave the family home, her unmarried sister





Left: X-ray diffraction pattern formed when X-rays are focused on protein in crystalline form. Each dot is a reflection of scattered X-rays passing through the crystal.
Right: "Photo 51" showing x-ray diffraction pattern of DNA, forming the X that indicates the double helix structure of the DNA molecule, taken 1952 by Rosalind Franklin.

and her mother still dressed in mourning clothes, and make a new life for herself, full of music, together with her husband in Aurora. She taught music at Wells College for many years, and then in South Orange, New Jersey, where her students never wanted to miss a class of violin or piano. She made sure they had good fun, having her students play hit songs as well as fugues, and she had enough confidence to never judge one or the other as high or low culture, only ways to "please the ear". When she realised there were enough good students of hers in South Orange, she launched the idea of founding a Symphony Orchestra. With her good name and some wealthier families of the county behind her, the New Jersey Symphony Orchestra was formed. The only time she went back to Europe, this time by airplane, was on the invitation to try out a grand piano at Steinway & Sons in London, courtesy of her most generous local donor Mr. Lord of Lord & Taylor. Steinway Hall opened in 1875, located in London's West End in the Marylebone district. The reason for going all the way to Europe for the instrument was due to the personal contact of Mr Lord who insisted that there was a tuner there named Ingo Hoffman, whose company and anecdotes she would appreciate.[10]

WORKSHOP / Mr. Hoffman introduced himself, and somehow after that he never stopped talking, for the entire duration of Marjorie's visit to the Steinway & Sons workshop. Normally she would mind terribly, but Ingo – that he insisted she would call him, but which she never got around to – was absolutely charming. Although Marjorie only spent an afternoon with him, he was the kind of person who made an impression that lasted a lifetime.

- My father tuned for Rachmaninoff in Vienna! Everything I know I learned from my father. He would not listen to anything that was not played on a piano, so my objections to becoming a tuner were useless, he joked as he showed Marjorie into the workshop.

- Tea! This was not a question, Marjorie realized as she accepted the mug Ingo handed her without enquiries about her choice of beverage.

- This here is a Grand model D that I want to show you. The felt in this piano is the original from 1936 when this piano was built. It's the original! It cannot be duplicated today, and it makes a difference in the sound. This is Scottish felt, and for some reason it is no longer available. Perhaps the sheep are different!

There was no stool but she tried the tone B6 to verify this new knowledge about key sensitivity.

- This piece has been very well taken care of, but it was in a private home, and I would love to see it safely cross the pond and get on stage! It was built in New York, you see, maybe it longs for its old playground… You know, nobody believes me when I say I can hear on what side of the Atlantic a piano is built. It will sound marvellous in Jersey. And you have Mr Lord, bless him, to pay for the shipping, so I cannot see what you are waiting for! This said with a big grin, resting his elbow on the instrument as if waiting for someone to strike a tune he could sing along to.

Marjorie Anne hunched to look inside the body: tense parallel strings, with different type of metal wiring depending on their position. It smelled of noble wood, resin and polish.

- I think anyone can be tought to tune! Of course you would have to have a basic ear for the sounds, but one does not have to be musical or skilled. God knows I could not get in front of an audience. I haven't even found an apprentice whom I can trust in not mocking my lack of musicality. I leave that to Bernstein and the likes, they keep coming back for my tuning and that is the way I play this instrument, mind you. I am a dying breed, they tell me, and sure it would be nice to someone to hand over the old wrench to, once I can't open the lid of a Grand anymore.

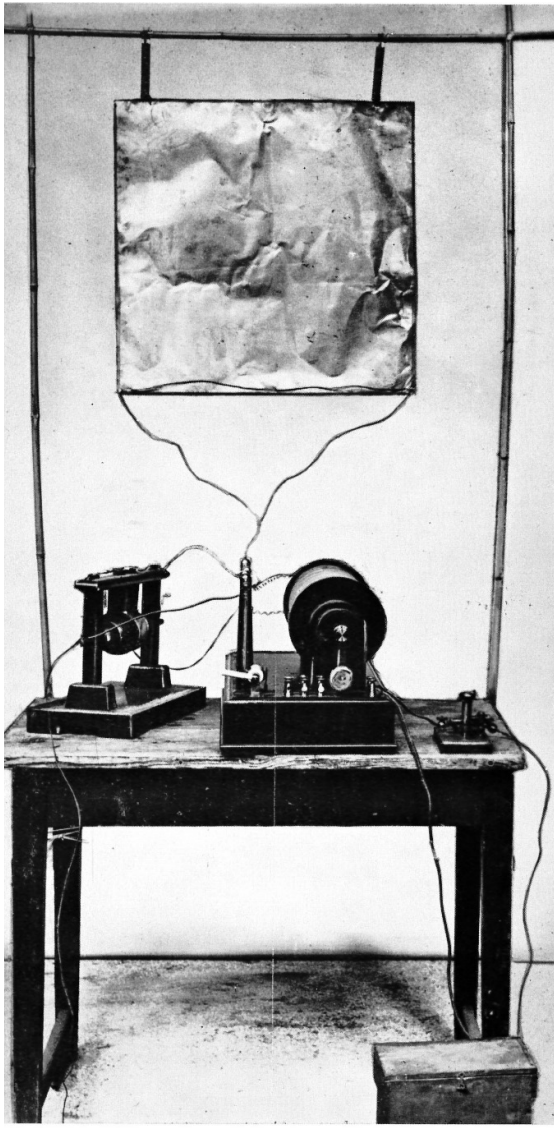
Ingo puts down his cup on a workbench, grabs a stool and gently plays a short piece that travels all along the keyboard, relieving Marjorie from her shyness to have a go at it first. The bass is full and rich, but not without a complex edge, the midrange flowing like chocolate, the treble crisply minted.

- The action has become stiff from underuse, but I am confident you will find way to have the piano played more often! Mr Steinway said about all his pianos that they all deserve good company and a well-tempered home. Oh I play poorly, so sorry old friend, my fingers should be on the inside and not soiling the keys. I should stick to the ebony!

Marjorie did not stop smiling during the whole visit. She signed the shipping insurance slip and pressed Ingo's hand for a bit too long while thanking him and telling him he should expect an invitation for the opening of the New Jersey Symphony Orchestra in no more than a year and a half.

Marjorie Anne held on to the newspaper from the 3rd of April 1917 through all the moves between addresses. The paper featured the Newell-Robb wedding announcement in the personals, while the big headline about United States declaring war on Germany and a smaller announcement about Einstein "applying the general theory of relativity to model the structure of the universe as a whole".[11] These events, brought together as headlines on a page, were to Marjorie a peculiar reminder of the scope of life, from the recklessness of the world war to the grandness of the universe. The same paper carried these news in big letters, but there they were: her name and her husband's name united in a small notice on page 27, as readable as any president's or scientist's names on the front page.

Mrs Robb moved for the last time in her life, to Fall River in 1990, where she died in her sleep on June 11, 1992. At the age of 103, she went as the second longest lived of all of Titanic's survivors and the longest lived first-class passenger.



Guglielmo Marconi's first radio transmitter, built in August 1895, with a spark-gap transmitter left on table, an induction coil producing the spark at the center, powered by the battery on the floor, and a telegraph key on the right side of the table. Above this the unique monopole copper sheet antenna, a "capacity area" connected to the ground: a solution with greater range than the dipole antennas invented by Hertz, covering longer distances with lower frequencies. The operator switched the transmitter on and off, producing pulses of radio waves which spelled out text messages in Morse code.

INTERMISSION

Neither Mr Hoffman, nor Mrs Robb lived to read the following news published February 28, 2017, on the local news site nj.com.

"NJSO concert comes to surreal halt after $160K piano breaks down

A Steinway and Sons piano malfunctioned at the New Jersey Symphony Orchestra concert on Thursday night. The opening concert of Music Director Xian Zhang's first series with her orchestra in 2017 started out without a hitch with a performance of the overture of Verdi's "Nabucco." But when it was time for the main event, "Rachmaninoff Second Concerto," featuring celebrated Russian-born pianist Kirill Gerstein, things took a very unusual turn. Zhang and soloist Gerstein were about a minute into Rachmaninoff's concerto when something sounded wrong -- the treble notes on the Steinway were just not ringing right. A few minutes later, Gerstein stopped playing mid-phrase. He turned to the audience and said, "The sustain pedal isn't working. It would be unfair to you and to Rachmaninoff to continue with the part of the piano missing. He then asked if there was a piano doctor in the house before walking off stage. /-/ On Friday, a spokesperson for the symphony said: "It broke during the performance, was fine in rehearsal." The spokesperson added that, "The piano was quickly diagnosed and repaired by Steinway & Sons concert technician Li Li Dong, who was on call that night. "

However, the music reporter James C Taylor ends on a nice enough note:

"Despite what ultimately proved to be about a 20-minute hiccup, the show did go on. As the piano was being repaired, Zhang and the NJSO tackled the Elgar Variations. The performance of the 1899 score was accomplished; the andante theme was placid and pulsed with life. Variation II scampered with mystery and Variation IV ended with another big, Zhang-ian finish. The pastoral Variation VIII burbled along nicely and the famous "Nimrod" Variation was perfectly noble and majestic. What it lacked was a spark of something new or immediate -- though to be fair, with the question of whether the headliner would go on or not in everyone's mind, a gentle palate cleanser rendition of Elgar may have been just right. The final movement also impressed. Sure, certain notes and textures were lost due to the cramped stage and bergenPAC's odd acoustics, but the musicians delivered Rachmaninoff's big, blockbuster score in a full-throttle -- but never fussy -- way. This listener has heard richer, more stirring

Left: Marjonie Anne Newell, Titanic survivor and music teacher, married Floyd Robb in 1917.
Right: Marjorie accompanied by her sister Madeleine at the piano.

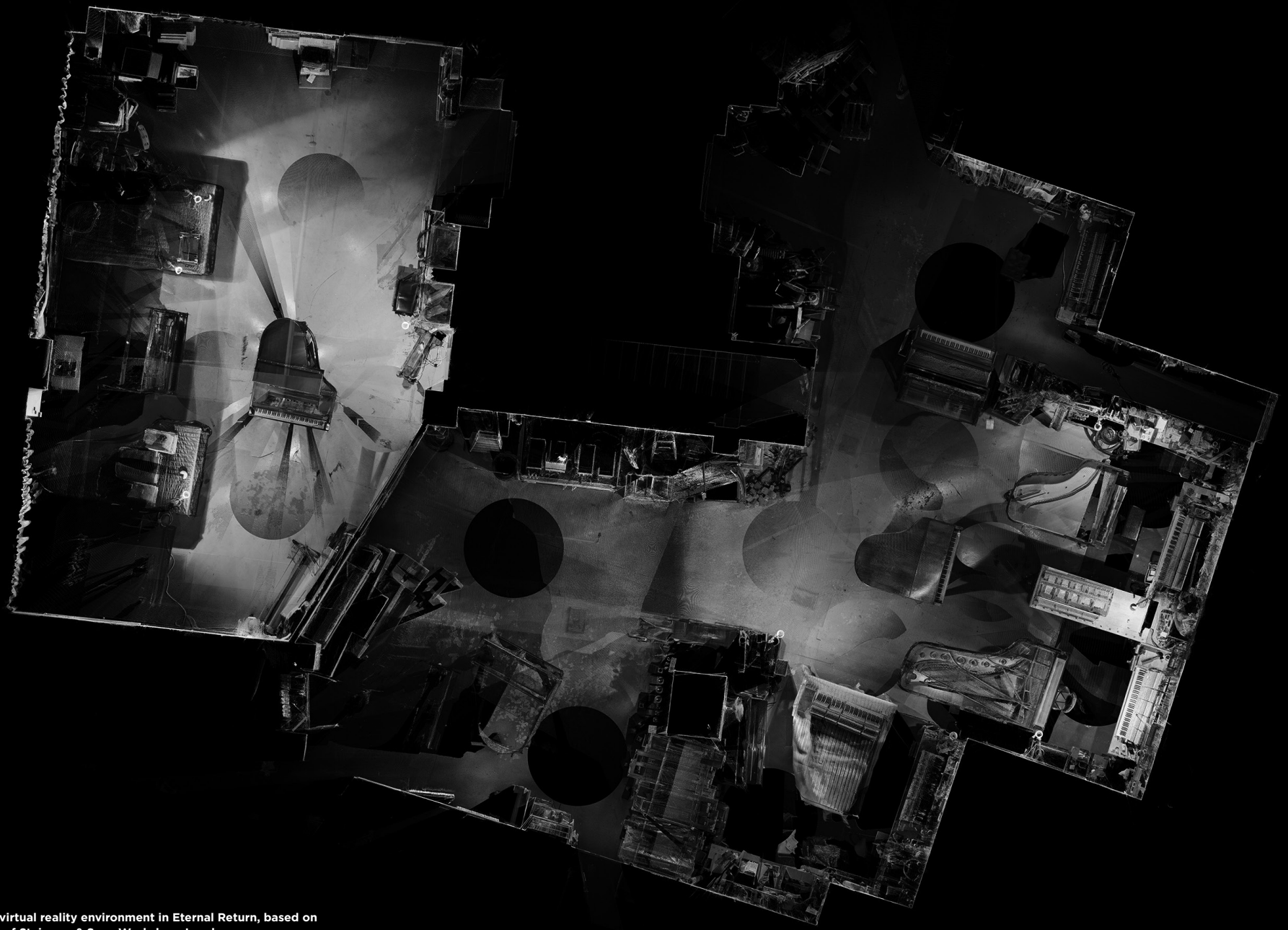
accounts, but few that displayed such clarity and subtly while still being entirely satisfying. When the piece was finally over, Gerstein and Zhang grabbed each other with the force of a bear hug as the crowd cheered. Proof that, functioning piano or not, you can't keep a good orchestra down.[12] "

Nobody cared to enlighten the nj.com reviewer about what exactly had caused the mid-concert instrument breakdown. Li Li Dong held on to the secret, while the spokesperson was busy talking to James Taylor backstage after the recitals. Li Li had expected the worst: having to replace a treble section string. The tuning does not hold for even a minute with a recently replaced string, and it would take too long for the audience to wait in their seats, and the pianist would have to play on a replacement piano meanwhile. Mr Dong did not even have to open his toolbox though. At closer examination, in the 4-line octave, a small note was found, folded in half with dry scotch tape along the edge. It had fallen from its position under the lid, where Li Li could see the dried outline of the tape holding the note into place, until it fell off and was perfectly jammed between the Scottish felt damper and the B6 string. The note read:

To whomever reads this, I am long gone, and you are wondering what just went wrong. This piano has outlived me and my craft. You finding this note is a celebration of a craft that, performed to perfection, always passes unnoticed. The work of the tuner is unseen, but cannot be overlooked.

Remember me.

Sincerely, I. Hoffmann

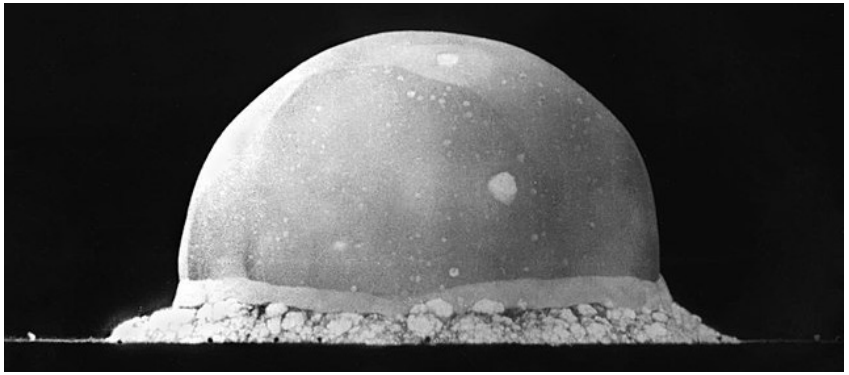


Overview of the virtual reality environment in Eternal Return, based on point-cloud data of Steinway & Sons Workshop, London.

Eternal Return installation detail with cup and Stromatolite fossil found in Sahara Desert, Morocco.

Point of view in the virtual environment in Eternal Return, based on pointcloud data of Steinway & Sons Workshop, London.

PART THREE



Trinity Site: 200 meters high atomic fireball 0.016 second after detonation, July 16, 1945, Alamogordo White Sands Missile Range.

THE FUGUE / Sabine Fier summons the team the next morning in Dugnad, while the air is still fresh. Océ places a device the size of a softball on the table that looks like a fossil. Océ lifts half the ball like a lid, and places it next to the other half. The inside reveals a concentric pattern of ridges from the center to the rugged circular cut. The perfect waves on the inside contrasted with the dry-fruit or terracotta-like matte surface.

Océ: - I will introduce a form and a tool for this session. This is the Orgad we developed together with the off-MIT tribe in Canada. Orgad is an AI specializing in recording and analysing conversations. When we named it, we thought it would be useful as an organiser- and administrator-type of AI, but when we tested different input modes, still a prototype, we found that it was really interested in partaking in meetings and so it found its own way to be useful. We have brought it to all our meetings since and have become quite attached to it. It assists quantum thinking and uses associative augmentation, delivering a reference depth to what we say. I like to think of it as an organ, both as if it were a part of the body, but mainly as the instrument. Understanding it as an instrument, we have introduced a "method of composition" for the entities engaged in the conversation, that is – us. We are being "played" by Orgad, in a way, by adapting to an auto-moderation form that we call The Fugue. Each one of us is a voice. We are introduced one after the other into the conversation. in turn, alternating between the tonic subject and the dominant answer. After this exposition, there are no strict rules for the overall structure. There will be counter-subjects, augmentation, diminution, inversions and often also a stretto – the overlapping of the subject with one or more answers. A fugue is a method of organizing themes, a way of allowing voices to weave and perhaps resonate towards a solution. It is a meeting form that plays very well on the Orgad. All we have to do is bring our knowledge to the table, and try to avoid interrupting each other. You can stick to your subject or you could deviate, which is ok, since you are still your voice and the trajectory of interest is very good metadata for Orgad too, as well as speculations. Orgad will employ the three-qubit quantum core to deepen our thoughts into the web and probe into networks of people and other AIs and see trails of thought coincide with ours. When our conversation is over, we will get a proposal for the next step. Any questions before we start? No? Okay, so for calibration, just state your name, profession and if you want maybe origin, and then Orgad gets all the transcription from here.

- Memember Sabine Fier, radio astronomer, born in the US by Haitian parents.

- Memember Jos F, communication historian, I was born in Belarus and I have studied and lived throughout the Americas all my adult life.

- Memember Paula Wegha, I am a physisist specializing in wave mechanics and gravity, born and raised in Alajuelita, Costa Rica.

- And memember Océ de Broglie, astronomer, the free colony of Cegep, Quebec. Let the session begin!

Sabine: - Do you remember the Sputnik crisis? It was the anxiety following the 1957 Soviet launch of the first artificial satellite, and the reason why NASA was created in 1958. The cold war was won by contributions to science, not just the space race. Advanced Researched Projects Agency was created the same year. Our project is concealed in the appropriation bill for R&D Applied Research in the field of Energy. We will answer to DARPA, who in turn has direct line to the main presidential advisory body Office of Science and Technology. The project is initiated from right inside the President's Council of Advisors on Science and Technology. They do not want to see another Nobel Prize in Physics fly off to China and India.[13] The energy sector has the highest budget levels, so our project rests snugly under

the file name ETERNA: Electromagnetic Tracking of Energy Repeating New Agency. I dare say we are the result of a "Sputnik Crisis" – this time with China taking the lead. The president is tired of seeing the backs of former students of UCLA and University of Washington, as they fly off to get their medals in Stockholm. Let's just be grateful for this emotional reaction, and let's try not to mock the irony of not having set a foot in the mentioned institutions. When they contacted me, they were very aware of our collective CV, and our achievements so far in the field. They were particularly impressed with our ways of getting a bigger bang for the buck. So, honestly, our budget is not as big as the expectations, but they will have an ear for our needs, throughout the entire process. So we figured, they could be an outset of our DARPA mission. This is where we all come into the picture. Océ, could you take us through the background?

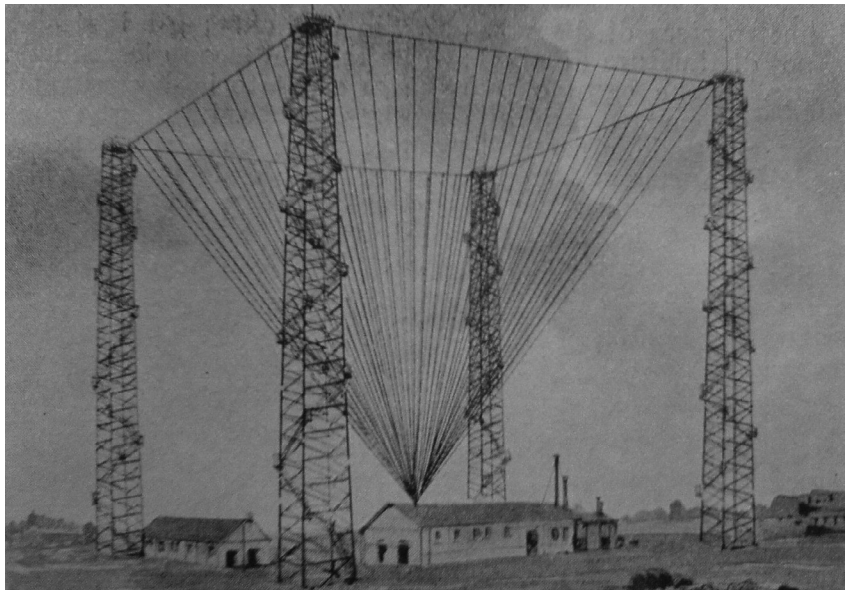
Océ: - Ok, sure. You know about our studies of Fast Radio Bursts? Since they were first discovered in 2007, there has only been about thirty bursts recorded. These signals have been few and far between. They are incredibly strong millisecond-long emissions, carrying the amount of energy comparable to what the sun produces in a century, but they die away quickly. They do not come from a consistent place, there is little pattern to them.[14] ASKAP is a network of 36 radio dishes in Western Australia.[15] When the HIREX in South Africa came up, there was radio telescopes on every continent, a great asset since we needed to cover a wider field. We were then able to tie each burst to its home galaxy. We collaborate closely with the CHIME, Canadian Hydrogen Intensity Mapping Experiment, in British Columbia. The bursts detected by ASKAP are brighter than previous detections, and they have lower dispersion. By dispersion I mean that there is less smearing of the different wavelengths that make up a burst. Then came the Ryan Shannon team at the Swinburne University of Technology in Australia. Since the beginning of 2017, he and his team have been searching the skies for FRBs using the ASKAP. In October 2018, the researchers reported 19 new FRBs. But counting a burst that was previous reported in a different paper, they have 20 signals from their systematic detection.[16] Their study is remarkable, I mean, not just hunting down 20 previously undiscovered FRBs but among them also finding the closest one to Earth and the brightest one ever seen, and "the repeater" as it was called. Since quite a while, the news are out about the FRBs but the signals were quite poorly analysed by the Australian team. And of course the FRBs are the topic of much discussion and debate, including the "usual suspects" – triggering speculations about being sent from advanced civilizations out there, though most colleagues favor natural explanations, such as fast-spinning neutron stars. Anyway, we used our Swinburne University of Technology contacts and the series of the twenty FRBs was sent to Paula, a couple of weeks ago, who used sophisticated waveform calibrations on them.

Jos F: - I am not a telegraphist but, seeing this rendering of the FRBs they really looked like a Morse code. I mean it a set of bursts, a sequence of signals, and with Paula's rendering they finally aligned enough both visually and audibly to read. We found two sets of signals, the first with 11 bursts and

Stromatolites are the longest living organisms on the Earth. About 3,5 billion years old, they are the key organism in the formation of the oxygen-rich atmosphere on earth, formed by cyanobacteria capable of photosynthesis. Growing in the tidal interface between land and sea, they provided the perfect conditions for the development from prokaryotes (bacteria with no membrane-bound organelles) to eukaryotes (organisms with cell nucleus).

the second in 9 bursts. Decoded by Morse, the first one reads "CQD" and the second one "SOS". It was absolutely astonishing. CQD is one of the first distress signals adopted for radio communication, initiated by and for Marconi installations. Before this standard, land telegraphs had used CQ, read out in French as "sécu" for "sécurité", for alert messages that would be of interest to all stations along a telegraph line. When used by wireless operators, the 11-digit CQD is understood by operators as an all stations distress call. Popular belief has it that CQ means "Come quick" or "Seek you", and that D is for danger or drowning or distress, but these are backronyms. A CQD was typically sent by a Marconi operator, as they used it worldwide, although it was never adopted as an international standard. In the 1906 International Radiotelegraphic Convention, the 9-digit SOS signal was adopted as the international Morse code distress signal. The only time the two messages were telegraphed in the same communication line was from the Titanic in 1912. The wireless operators on the Titanic were employed by the Marconi company, not by the White Star line that operated the Titanic. I looked up their communication; first the CQDs were sent, then the SOS, then a combination of both.[17]

Paula: - I cleaned up the set of signals in different ways, but it was not until I reduced the signal into a standing wave, that they aligned to form a resonance pattern that allows us to play them with the coherent rhythm. So this is what I shared this with Jos F. With the assumption that it could actually be the Titanic distress signal, we decided to suspend our disbelief and just work on possible causes. If we just use it as a riddle, how a wireless signal was sent from a ship on earth, picked up by a radioscope 106



Poldhu ("black pool" in Cornish) on the Lizard Peninsula in south Cornwall, UK, in 1914. Poldhu became the site of one of the main technological advances of the early twentieth century when, on 12 December 1901, a wireless signal was sent by Thomas Barron in Poldhu, and received by Marconi in St John's, Newfoundland. The technology was the precursor to radio, television, satellites and the internet.

years later, as a signal travelling from lightyears away – we thought what could come out of it. What I am saying now is pure speculation, and you would want to just keep our minds open for now. Spring 1912 was considered an unusually bad season for icebergs. When R.M.S. Titanic went down, a strong gravitational pull might have sent the icebergs further South to waters where they normally do not occur in these sizes in April. But figuring out why this happened has been a mystery. Turns out there was an extraordinarily rare alignment of the sun, Earth and a supermoon, meaning the time the moon is full during its closest monthly approach to the Earth. With this type of alignment, when the three bodies are arranged in a straight line, the sun and the moon are intensifying each other's gravitational pull on Earth. We notice the event by the phenomena of spring tides: when low tides are lower than usual, and high tides are higher. But on this night in April 1912, the full moon and its spring-tide alignment coincided with the moon making an unusually close swing by Earth. It was the closest lunar approach, in fact, since A.D. 796, and Earth won't see this again until 2257.[18] There were reports on records tides around the Earth in 1912, but the extra gravitational effect was just 5 percent. However the effect on the tides and whether the icebergs were floating further South than normal, the extra gravitational pull might have had another effect, in the opposite direction, so to say. The extra gravity pull, could have pulled the wireless signals, the repeated radio waves, into space, and sent them on along with an escape velocity that these radio waves normally don't get. So the signal travels for supposedly 53 Earth years into space, encounters something that turns it all the way back to us. The turning point can be a neutron star, a black hole or a magneton. These bodies would be able to swing the signal back to where it came from.[19]

Sabine: - It is unbelievably sad to get the distress call back. The irony. I can see the spin on this if the news would get out. We might as well have sent an SOS from earth now, one Pacific island drowning after another. Getting the signal back is like saying we are alone in this shit.

Jos F: - So far, we have intentionally created messages intended to present Earth to possible civilisations out there. And on every continent, there are telescopes and radioscopes that scan the surroundings for messages, with absolutely no result worth mentioning, I mean – the WOW signal could be the most underwhelming science news ever. These messages we send say more about us and our anthropocentric efforts to identify our species in the bigger context, what is our "USP", so to say. The time they were sent, "man" often being the default subject. Whether you look at the Pioneer plaque, the Gemini discs, the Arecibo signal, SETI or METI – all very moving – assuming "aliens" would be interested in homo sapiens culture.[20] I am pretty sure that aliens would find trees more interesting than people. People don't realize the greatest selling point of this planet is photo synthesis, everything else is mostly bollocks.

Sabine: - Radio waves are a kind of electromagnetic radiation – they are not "sound" – so they move at the speed of light. All overcoming of distances in the universe requires huge amounts of energy, even electromagnetic radio transmissions. How much energy depends on distance, frequency, directional efficiency of antennas…It is amazing to think that this signal is able to leave earth to begin with, let alone receiving it back, assuming this is what we think it is. In 1974, the large-dish Arecibo telescope beamed a 210-byte radio message aimed at the star cluster M13, some twenty-five thousand light-years away. It was transmitted with a power of one megawatt – enough energy to power about one thousand homes –using a narrow beam to achieve an EIRP (effective isotropic radiated power) of 20 trillion watts. That made it the strongest human-made signal ever sent. It has gone 0.14 percent of the way, so far. [21]

Paula: - I think we need to consider some unconventional theories. Electromagnetic waves differ from mechanical waves in that they do not require a medium to propagate. They can travel not only through air and solid materials but also through the vacuum of space. Hertz showed that the velocity of radio waves is equal to the velocity of light, demonstrating that Maxwell's equations were correct.

Practically every kind of information to our senses and bodies travel by waves. We use different entities to denote the various types of waveforms, but in fact they can all be described by the same three parameters, and what's better: these three are mathematically related so that if you know one, you can calculate the other two. Radio- and microwaves are described in Hertz, the unit for frequency. Infrareds and visible light are described in wavelength, measured in meters. Higher frequencies like gamma and x-rays are described in energy: electron volts. Nearly everything we know about the universe has been obtained by light travelling to us. The pulsar waves, the FRBs and the gravity wave detection are some of the sounds we have received that can be useful for our understanding of cosmos.[22] Along this enormous stretch of wavelengths, there are many parts that sort of fall between scientific chairs. We should also be aware of the combined effect of, for example, gravity waves and electromagnetic waves. I think this is what could have happened here. The radio signal would have "surfed" its way out from the gravity field of earth, aided by the aligned body gravity that occurred at precisely this point in time. Trying on different filters on the signals before sending the file to Jos F, I found that restoring the signals to a standing wave pattern was like tuning in a channel on the FM radio, all white noise cleared out.

Océ: - Gravity is a phenomena that we cannot sense with our bodies until we manipulate it – freefalling to experience zero-gravity, different forms of G-force training and so on, these things are quite extreme ways to make us realize the impact of this force on our bodies. The detection of gravitational waves, first predicted by Albert Einstein in 1916, takes a hell of a lot of space and installation to tell us what is going on, like in the LIGO. Gravitational waves are propagating disturbances of gravity – in fact, they are ripples in the fabric of space and time. Gravitational waves also form a complete spectrum.

Paula: - Exactly. Since we can't sense gravitational waves with our bodies, we have no words to describe our sensory experience. We need technical instruments to identify the waves by their wavelength, that is, the distance between peaks of the wave, or their frequency – how often a peak passes by you, if you just stand still and let the waves wash by, and then the energy – how "hard" the wave hits you.

Océ: - As astrophysicists, and humans, we have very short lives and cannot fathom the waves that are not in a hurry. The very low frequency waves where a wave peak may only pass by once every million years or so; these long wavelengths are the hardest to observe in our perspective.

Paula: - This Hertz… Physicist joke. But being aware of our limited perspective, as Océ points out, pushes us into overcoming it in the most efficient way. One of the most incomprehensible challenges is the sheer size of the universe. We are the most helplessly small beings to even attempt to overcome the distances of the universe. But at the same time as we think this thought, our very bodies are permeated by the strongest force in the universe, gravity is running right through us! Let's say I am a waveform who wants to go faster and further, to propagate more efficiently to a minimum energy cost, to overcome the endlessness of the universe. A standing wave can occur because the medium is moving in the opposite

Part of the Northern Cross Radio Telescope at the Medicina Radio Observatory is an astronomical observatory located near Bologna, Italy. Institute for Radio Astronomy of the National Institute for Astrophysics, Italy, 1974.

direction to the wave. But standing waves are always associated with the phenomena of resonance. As a standing wave, I can tell you how I want to set up space around me; a standing wave will let us know the design of its corridor, do you follow? Standing waves don't form under just any circumstances. They require that energy be fed into a system at an appropriate frequency. So I want the driving frequency to equal the natural frequency of my system. Compared to traveling waves with the same amplitude, producing standing waves is relatively effortless. The peak amplitude of the wave oscillations at any point in space is constant over time. But here is a problem. A standing wave is frame dependent – and it selects a specific frame. A standing wave is attached in both ends, like the string in an instrument. My theory for our signal is that it might have surfed off on a gravity wave, that is, it would have found its "attachment point" that allowed an end point from which it could stretch off into eternity as a standing wave. Since it has optimized its frequency, amplitude and minimized its energy by forming a "travelling corridor", it has reduced the endless space to a more confined space. This is how we overcome the size of space, by choosing ways to confine it, by choosing what to become, in order to overcome distance.

Sabine: - You said that a standing wave can occur when the medium is moving in the opposite direction to the wave. What about dark energy being the perfect opposing medium to these standing waves? Could it be that standing waves – who are transmitting energy and not material – has a way of

The LIGO (Laser Interferometer Gravitational-Wave Observatory) is a 4 km long observatory to detect cosmic gravitational waves and to develop gravitational-wave observations as an astronomical tool, located in Hanford, US.

being reinforced by dark energy, since dark energy is a "countergravity" force? Dark energy should be a counterwave-force – thus forming or at least helping to shape standing waves? If dark energy is the medium and you disturb it, you should be able to create the perfect standing wave. This would be fun to stand around and poke a stick at, what do you say?

Paula: - Hell yes! I would like to get into the records of the occasions of combined gravity that was noted in 1912 – we might find something for the year 796, and I would not exclude the possibility of retrieving data for 2257.

Sabine: - Are you suggesting we might actually retrieve data sent from 2257? This is a goddamn time-machine we are talking about?

Jos F: - We already invented the time machine: written language! Quite tried and tested by now…

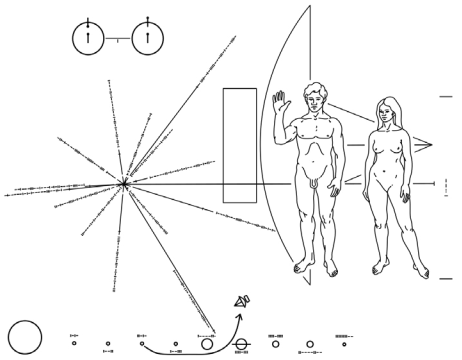
Paula: - Well I was thinking more in terms of astrocalendars and what could be forecasted, but if we had the resources to go further into this, then sure, I don't know what the hell that would take in terms of resources…

Océ: - As much as I like the energy going on here, if I may settle any concerns about resources – the present "Sputnik crisis" implies a guarantee from DARPA to support our work all the way towards a respectable global recognition…

P**aula**: - I would like to hear you out on the time-space ratio in relation to communication. The size of human societies have been scaled to the distance over which we can communicate. The size of the land that could be traversed by first a runner measured out the first kingdoms. When and where the horse was tamed to serve humans as a means of transport, the countries became as large as a horseback messenger could cover in a certain time. Our ability to communicate decides what portion of space we occupy.

Jos F: - Consciousness and remembrance is to thinking, what dark energy is to gravitation. It is the

The Pioneer Plaque, a 6 inch by 9 inch gold-anodized aluminum plate postcard sent into interstellar space aboard the Pioneer F. The radiating lines at left represents the positions of 14 pulsars arranged to indicate our sun system's location.



field that contains us. It keeps things apart- it keeps everything from happening at once. It organises time to create space between events – it allows memories to form. Communication is externalised memories. Communication is a variable of evolution. We form language to be able to overcome time. Communication is the best form of time travelling we have. It is externalised memories. Text is externalised memory.

Océ: - Now the message itself seem to have escaped the medium altogether…

Jos F: - Can I ask Orgad a personal question?

Orgad: - Of course!

Jos F: - How did you get your good looks?

Orgad: - Thanks for asking! I am modelled after a stromatolite. It is a fossil of some of the oldest photosynthesizing life on earth. Stromatolites is Greek for "layered rock", but they consist of layers of single-celled cyanobacteria, forming microbial reefs. The stromatolite was a probability engine: an actualizer of life. Before the stromatolites, air contained only one percent oxygen. Some of the first forms of life on Earth are recorded in stromatolites present in rocks 3.5 billion years old. I was designed this way as a reminder that with the event of biological life, memory happens. In the universe, things might happen, without no one there to remember it. Life is the vessel for memory. With the stromatolite, there is a string of data, the first form of memory, the single-cell bacteria. This lifeform enables more advanced cells to form, advanced cells can internalize memory in the form of a genome, and they are able to learn. The next step is self-awareness, and even more advanced beings. But remember, there was never a single cell who was responsible for "life" as we know it. It was always a collaborative symbiotic community of cells that was the first step towards consciousness.

Océ: - The beauty! Session concluded. Orgad, do you have a proposal for our next step?

Orgad: - You need a laboratory. Find Nico Latesla.

INTERMISSION

The fate of mankind forks out in different ”fates of fortunes”. There will be the ones who get out alive from a shipwreck twice, like ”The Unsinkable Molly Brown” (who was in the same lifeboat as Marjorie Anne Newell) who walked out from the Titanic Disaster, then managed to survive a second shipwreck: two boats went down without her – twice. Guglielmo Marconi managed to not get on the boats that would potentially have meant the untimely end of his life. He had a ticket for the Titanic but went to the US on another boat five days earlier. He also escaped the next possible shipwreck by not using the ticket he had. Then there is the faith of the unfortunate genius William Thomas Stead (1849-1912). He famously foresaw the destiny of a similar ship to Titanic in a novel describing the most sea-worthy vessel going down with not enough lifeboats to save people. He would then get on the Titanic and actually die in the same way as he had predicted in his novel. He was in touch with mediums who foresaw his demise, but this did not stop him. He considered their readings as interesting possible scenarios. So – humanity either narrowly escapes, or manage to avoid disaster once or more times. Or they end up dead despite being informed of the future, even when capable of foreseeing it. Then there are the ones who build a replica of the ship and set sail again, a hundred years later. In 2018 the Replica of Titanic was presented, planning to set sail on 2022.

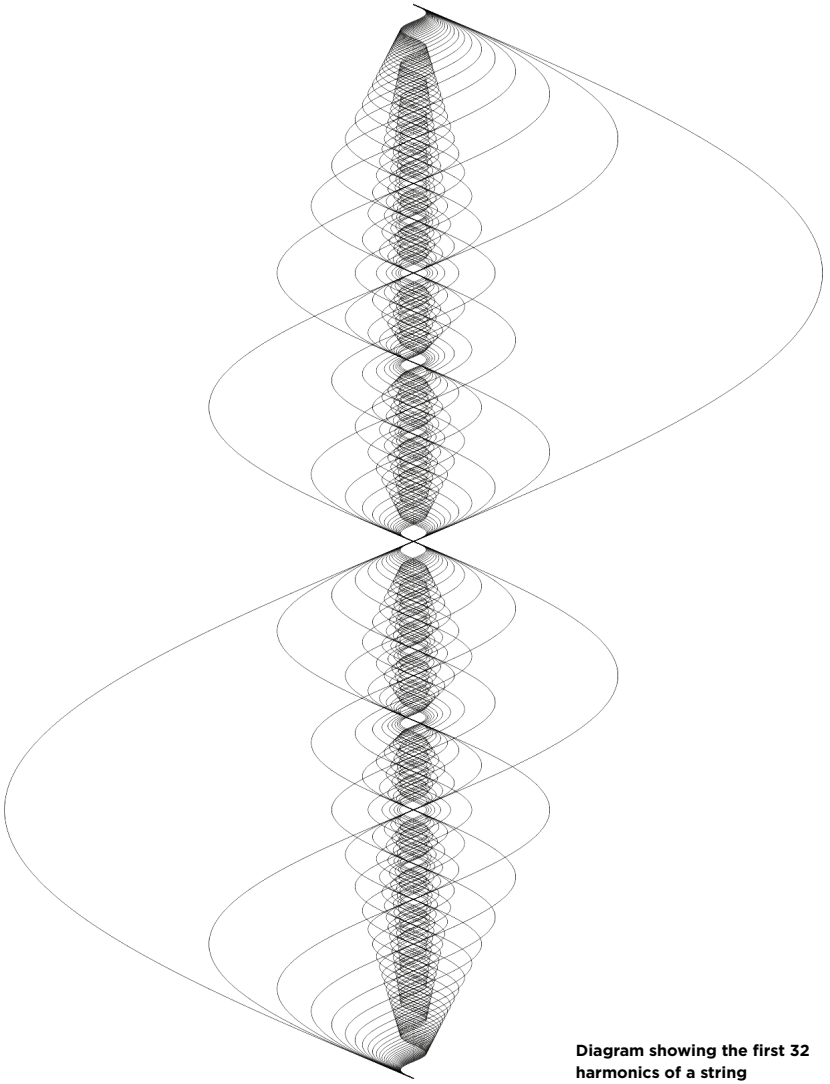
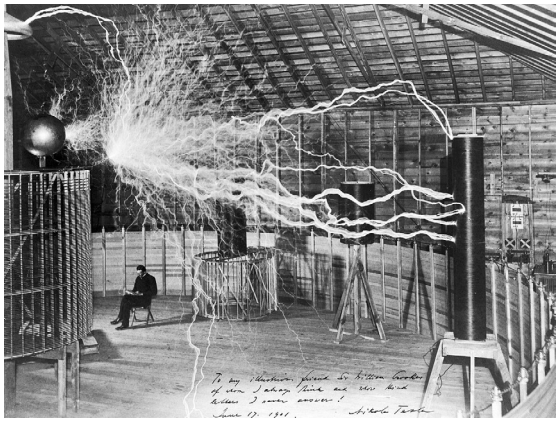


Diagram showing the first 32 harmonics of a string

PART FOUR

2048 / They took the trip together from Dugnad, getting on a ship from Mobile, Alabama to Halifax, Nova Scotia, from where they travelled North and across Baffin Bay with a research ship leaving for Pond Inlet, Nunavut. They chartered a helicopter from here, travelling over the Quttinirpaaq National Park to Alert, an outpost if there ever was one. Alert, in the Qikiqtaaluk Region, is the northernmost permanently inhabited place in the world, at latitude 82°. From the military post, Nico took them the last 6 kilometers by dog sleigh to her lab. They had been in touch the last month, from their first contact and all along the journey's length, but only via a brittle satellite link that did not reveal any of the gloomy splendour of this landscape, neither exposing the magnificent interior of Nico's station. She had bought it as disused military equipment, not even classified as property since it had once been a combined telescope and a plane hangar. The dish was already scrap metal, but the tower was in good enough a condition. Nico had made a neat bitcoin fortune in the 2010s and was able to construct a well-insulated laboratory inside the hangar, using it as a shell construction. Parts of the façade of the hangar were replaced with transparent solar panels, allowing a hothouse for plants to thrive separated from the grim outdoors. There was a doghouse and various used and disused vehicles inside the hangar shell too, most notably a pontoon plane that looked as if it was last used in the 1950's. A gravity tank storing water at atmospheric pressure was placed next to the hothouse. But the most prominent feature of the station was her tower, reusing the framework of the former telescope mast. A black and purple chrysanthemum-like bud was bulging from its apex, a lush structure that looked like the only thing alive in this landscape. Nico explained it was a project she had developed with Dan Nocera at Harvard in the early 2010s, in fact it was the reason she set up shop here.[23] What they saw was the first industrial size photosynthesis replicator. It uses hydrogen and oxygen, exerted from the

Nikola Tesla's Wardenclyffe wireless station, located in Shoreham, New York, seen in 1904. The 57 m transmitting tower was built by Tesla from 1901 to 1904 with backing from Wall Street banker J. P. Morgan who supported Tesla's idea of a "World Wireless System" and a "Radio City" and offered Tesla 200 acres of land in Shoreham, NY. The experimental facility intended to be a transatlantic radiotelegraphy station and wireless power transmitter was never completed



Publicity photo of Serbian-American inventor Nikola Tesla sitting in his laboratory in Colorado Springs, next to his magnifying transmitter high voltage generator, one of the largest Tesla coils ever built. The image is created using double exposure: Tesla was not sitting in his chair while the machine produced huge bolts of electricity. By photographer Dickenson V. Alley, for Century Magazine, December 1899.

water, filtered by an artificial leaf, where one side produces hydrogen and the other produces oxygen, when triggered by sunlight. The power this plant produced was mostly used for an even more intriguing part of the lab that was very unimpressive to look at. It was merely a borehole penetrating the ground under the tower and they had to go inside the lab for an elaborate presentation since the arctic night was setting under a dull curtain of Absinth green Northern Lights, licking the ice-covered horizon and curving out towards the Arctic Sea.

The conversation warmed up in the kitchen area, while making themselves useful around the place. Sabine was the first to articulate the question about the name of their host. Nico Latesla was used to amused comments when she introduced herself.

- Of course it is not a taken name, I borrowed it. Tried it on for size. I had to hide my identity in the early 21st Century, haters gonna hate, you know. I have not used my birth name in decades. In all the places I have stayed, I have mostly been known as the energy source hacker, finding energy where available and making electricity accessible to those who need it. But I am now in this remote place for an overseeable future, as I have to give the gravity reactor a chance. Right now it is more of a gravity detector, not your average one though.

As darkness outside was kicked around by atmospherical disturbances and the cold winds framed the windows with crystal patterns, they had artichokes and fresh potatoes from the hothouse, char and lime butter, followed by "yellow snow" that tasted just like vodka-spiked lemon sorbet. They talked about how Nico had organized her life here, in the company of ten sleigh dogs and a mostly reliable satellite link that enabled her to work in her international network of friends and researchers. She assured that her 13 years in her station felt like 13 months, considering the efforts it took to learn to speak Inuktitun, the language of the Innuvialuit population that made her life possible here. She had never been more aware of her dependence of people than in this scarcely populated place. She traded electricity for fresh game and helped securing Externet connections for the locals, as well as providing garage and service space and a drone fly-in shipment hangar where people could pick up their stuff at any time, sheltered from the weather. Her hothouse was a community garden and the place was big enough to house a badminton court in the backspace of the hangar. It doubled as indoor gymnasium for the four to eight school children in the Alert area, the ones who were not involved in hunting for the moment.

- So you came for the artificial photosynthesis and stayed for the badminton? Sabine asked.

- Compared to many other places this was the most favourable spot. The hardware was here, half the tower done, the access to fresh water for the process, but most importantly, the gravity.

- Well, that is hard to come around. Although not for me, weighing in… Jos F joked.

- You might think it is uniform but one of the most important reasons we are here is that gravity is the strongest at the poles.[24] The highest gravitational acceleration is in the Arctic Ocean – just a few miles off the coast, it measures 9.8337 meters per second. I also needed the most consistent latitude, since Earth's magma movements could affect gravitational forces and my instruments. Not much of that activity under this bedrock. But, let's look at this from a very basic truth. Using gravity as an infinite energy source is deemed to remain a fantasy. At the same time, gravity is one of the oldest sources for energy on earth. You need to remember that gravity is a force, but it is not energy. It does provide ways for objects to exchange and transform energy to different states. When we use dams to amass water, the sun is the force that moves the water that ends up in the dam, then we use the relocated water to run the turbines. So we exploit the force of gravity to add kinetic properties to water. The gravitational potential energy is negative because us trying to do the opposite of what gravity wants needs positive energy. I love gravity for being Einstein's headache of the general theory of relativity[25] and the still unacknowledged family member of the Standard Model.[26] It is the trickiest bastard around, and I have been committed to science the hell out of it since I pissed off British academia with my dissertation. I am never going to put my foot inside a university again, and find those hypocrites crawling all over themselves to make it to Sweden and receive an oversized coin from a fairy tale king, sending their wives into shopping frenzy mode for an evening dress with not too much cleavage for a 70+ woman. Ridiculous. That norm dies hard in fairy land.

Nico's words were received with ill-concealed amusement from the team.

- I hope the scouting mission for a Nobel Prize does not put you off this collaboration? Océ looked shy in an ironic way.

- I am just not that bothered. Let's give them something to hang medals on, even though I am not going to be part of the circus. It wouldn't be far-fetched to expect good results from the artificial leaf

project, but for me it was more or less a cover story while I was working on the same thing I always did, and until very recently the results were really shaky. The reason Dan hasn't gotten the prize yet is the battery lobby that has taken over the role of the bad guy from the fossil fuel lobby. A few actors want to maintain the profits in that industry, and the whole innovation climate suffers. Dan refused to collaborate with the companies who wants to exploit African countries and turn places like the Democratic Republic of Congo upside down mining for battery minerals. I know since long that the dark side of energy is huge, profit and politics tear the possibilities to shreads. That is where I have entered the picture, working for tribes to hack the fields and provide them with the energy that they needed. But I just got tired of the whole thing. But the plant works, and I guess by now I can tell you all about this. I have taken some safety measures to protect my innovation, but not in the traditional patent and copyright way. I am a hacker, this shit is not going to be placed in the hands of risk capitalists. I am open sourcing it as soon as I can but I count on it being silenced down efficiently by the capital that is invested in rare metals and the battery industry. They do a better job than me in keeping this shit a secret. I am more than ready to assist in setting up full-scale labs, but I need people like you to advise on where these can go without falling into the wrong hands.

- So this black bud, does it relate to the gravity project?

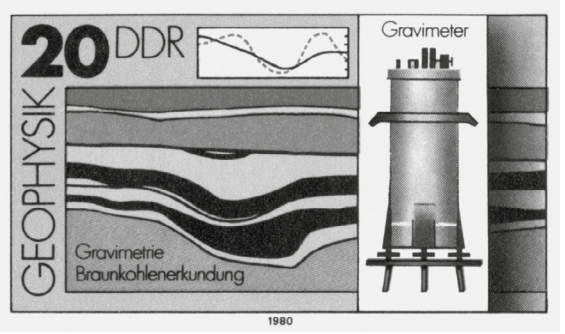
- Come on Nico, if this is what I think it is, I am going to explode! Paula throws herself back in her chair.

- Ok, so we can't use the force of gravity by tapping if off the grid of space time. But gravity can be tuned. In any situation where two waves from opposite directions meet, while moving along the same medium, interference occurs. Standing waves are produced when two waves of identical frequency interfere with one another while traveling opposite directions in the medium.[27] The waves interfere to form a new wave pattern called the resultant. This standing wave is stable enough to be amplified. So my plant makes standing waves out of gravity, but it needs input energy fed into the system at an appropriate frequency. Hence the "cover co-op" of photosynthetic energy, the bud as you call it.

- How did you engineer the system to cause a standing wave resonance with gravity waves?

First you need to measure the frequency of the gravity waves and then you engineer a system to have the same resonant frequency.[28] A resonant-mass gravitational waves detector gives me the accurate frequency of "incoming" gravity waves. My most important breakthrough was finding how the force of gravity is scalable. If the density remains constant, then volume is scalable with mass. So I use the mass and gravity of the earth to create the attachment point of the wave to make it a standing wave, that is, to make a resounding wave. It is a bit of a fail though since my purpose was to use gravity waves as an energy source. My intention was to use the standing waves in a medium not unlike the principle of how you use ocean waves to generate energy. For this purpose I used Deuterium Oxide, heavy water, for its ability to slow down every process on a quantum scale, leaving gravity as the only actor in the

55 Gravimeter, DDR stamp 1980. First Day of Issue 11 November 1980. Design by Lothar Grünewald



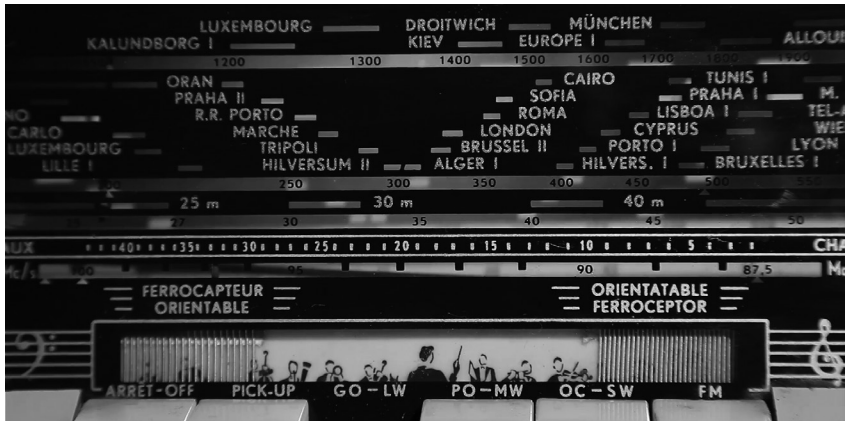
medium. I tried a vacuum tube but it didn't support resonant frequencies. It turned out that this tube was the perfect scaling device for the gravity waves. The vertical shaft under the tower has a depth of 5000 meters – remember the LIGO gravitational wave detector is a horizontal observatory, with an intersecting axis of 4 000 meter length each. My borehole was here and ready to use when I scouted out the place! So my observatory is vertical, and the borehole with its heavy water filled shaft works like e a tuning device that is calibrated to receive the gravitational field that contains earth. These waves interact under interference with the waves of Earths own gravity. Since I can regulate the depth at which to generate the standing wave from, I have found a kind of magnifying receiver of gravity waves. My aim was to create a magnifying transmitter, which could have been a step towards extracting gravitational energy, but I guess what I have is rather a magnifying receiver with an underground antenna.

- You mean this is a big cosmic radio, basically? Jos F said.

- What makes this detector different from the LIGO is that we are not merely listening to gravity waves, but to the resonant frequencies carried by standing gravity waves. Thanks to the scaling, we have a narrow corridor instead of a wide field. And we can "attach" the standing wave at both ends. It means you confine endlessness to a finite space. This is why we can use it- it is when waves are forced not to propagate forever, but to reach an endpoint from which we can make it resonate all the way back to us.

The next day, starting blissfully late in the morning as the arctic autumn took its toll on daylight, they laid down the plans to search for the points in Earth time where the critical gravity line-up occured, starting with the result of the fast radio burst detection.

Over the next few weeks, they refined the reverse-engineered the gravity reactor to a gravity radio. They calibrated the resonance receiver from the 1912 signal source, carried by the FRBs to Earth. From this source location, they could calibrate and adjust the signals' frequency, energy and amplitude. Breathlessly they stood around and listened to the extended re-emitted morse signals of the 120 year



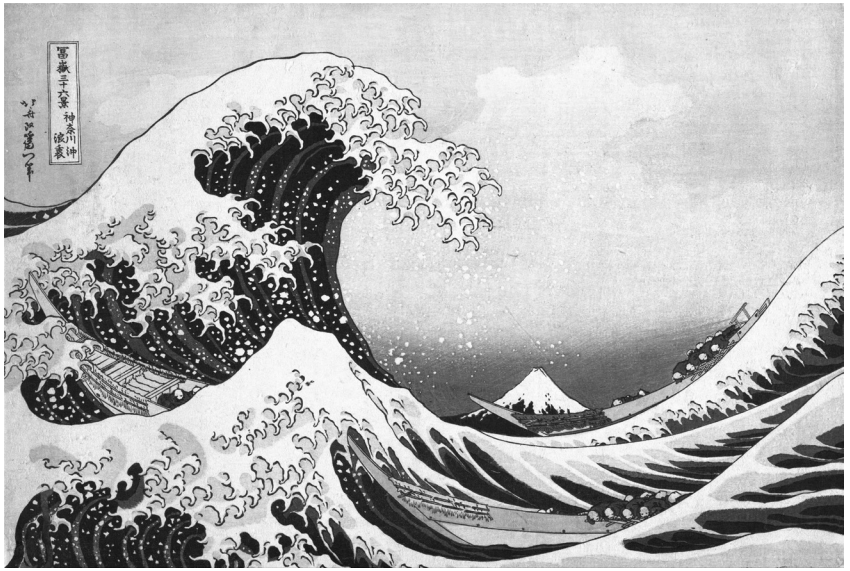
All radios produced during the first half of the 20th century were tube radios, since transistors were not invented until 1947.

old disaster, this time extending beyond the limited set of distress signals blasted out by the FRBs. Even though they were slightly "off" the general direction of the sender galaxy, they had a good earshot at it. This was the crude detection refined by signal detection that quickly found the repetitive single-tone signal. Sabine could swear she had heard a piano playing but before they could stabilize the signal, it was lost. The first communication they found beyond the CQD and the SOS emitted by the FRBs was the response signal from the Carpathia. This carried an unexpected and profound feeling of hope into the project. Even though we know how the story ended, the reassuring response meant almost as much to the researchers as it meant to the people in the life boats to see lights from the rescuing boats approaching. The call for help, leaking into the universe, had found its way back, maybe to save them all in a different way this time.

Paula and Sabine had prepared a "tuning map" of slingshot nodes in space around which signals would turn. They presented a map not unlike the dial of an antique wireless radio set. These were chosen to correspond to certain dates of transmitting from the earth travel time for the signal from Earth to this gravity anchor node, from which it could travel back, piggybacking on standing waves of gravity. The tuning map spanned between the year 796 AD and 2257 AD, and for these dates, and in between them, strong candidates for heavenly bodies with sufficient "slingshot" capacity were picked, showing traveling time for possible signals sent from Earth over a sequence of roughly 1500 years. They had found that around the known year 1912, there was quite a few strong nodes, some temporary

celestial phenomena like pulsars and neutron stars, with a high transmitting capacity. The strongest candidates for a good decoding of signals were assumed to be the nodes that were strong enough to gravity effect related to earth itself, would potentially have the power to bounce a signal back.

796 / The alignment of the celestial node for the year 796 AD was well-timed. Within a few weeks they gathered around the instruments, directed at one of the nearest, and oldest pulsars from Earth.[29] The signal was distinctly separated from the periodic pulses and the cosmic background noise, but it differed a lot from the 1912 signal that was found at 500 kHz. It was varied and melodious, but slightly intermittent, although with a consistent pitch and tone. After trying different filters and refining the signal in the frequency range of human voices, they heard a repetitive phrase in what Jos F could identify as early middle age Japanese. As they scanned all frequencies to find other voices, they happened to leave the audible spectrum and came across something that looked just like Alpha waves, but this was a far stretch to amp up and the power dipped although the reserve generators were running. The detection of the standing waves and its resultant were only slightly easier than finding the Higgs particle kicking about in the CERN – every single cohesive string of data was a cherished find. They printed the chanting that oscillated around the frequency range of 85 to 100 Hz, a low pitched male voice, and right along this pitch curve followed a wave of 8 to 12 Hz. This was their first detection of a human voice, but also, and more astonishing, cohesively accompanied by an Alpha brainwave. It took them some time before they could get a friend to assist with translation from the far Asian tongue. Jos F came back with the most plausible theory, given the date, the language, and the tag-along brainwave pick-up. In 796, the first Buddhist temple of the Shingon sect, Tō-ji , was established in Kyoto, Japan, by a Japanese Buddhist monk named Kūkai. He travelled to China to study esoteric Buddhist practices, and returned as Kōbō-Daishi – the great master of literature, calligraphy and a new way of bringing life into text: the mantra. This was first practiced in India, finally reaching Japan via the monk Gonsō, who had learned the Kokuzō-Gumonjiho teachings via Chinese translations of Sanskrit. When Kūkai was 22, he learned this mantra from Gonsō and regularly went into the forests of Shikoku to practice it for long periods of time. He persevered in this mantra practice for seven years and mastered it. According to tradition, this practice brought him siddhis of superhuman memory retention and learning ability.[30] During this period of intense mantra practice, Kūkai dreamt of recovering a central scripture: Mahavairocana Tantra, only recently made available in Japan, but only in Chinese. Large portions of the scripture were in Sanskrit and a Chinese that was too arcane for him to understand, so to be able to fully comprehend it, Kūkai travelled across the sea to China to study the Tantra for the master Huiguo, who at the time was very ill. Huiguo exclaimed to Kūkai that he had long awaited his arrival, and that he should quickly prepare for initiation into the mandalas, since time was running out for the old master. In the three months he had left of his life, Huiguo initiated and

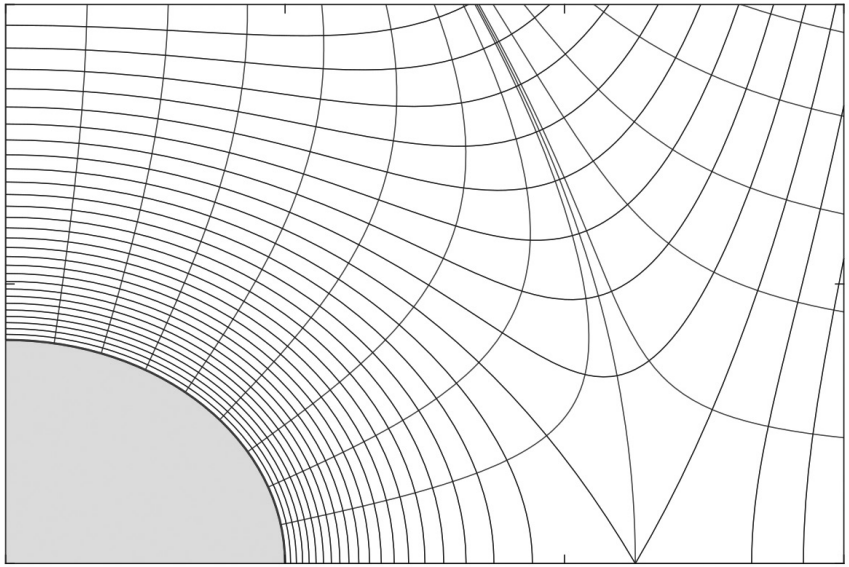


The Great Wave off Kanagawa by Katsushika Hokusai, ca 1830.

taught Kūkai everything he knew on the doctrines and practices of the "Mandala of the Two Realms" as well as mastery of Sanskrit and Chinese.[31] Kūkai returned to Kyoto to see the temples completed in 796: Sai-ji, and its sister temple Tō-ji, placed symmetrically along the Suzaku Avenue, just north of the great Rashōmon gate to the Heian capital. While Tō-ji has survived into modern times, Sai-ji was burnt in 990 and 1233, then abandoned and never rebuilt. These two temples and the imperial palace temple were the only Buddhist institutions allowed in the capital at the time it was established. Tō-ji was rebuilt in the late Edo Period, when Hokusai painted The Great Wave off Kanagawa.

The story left them silent, while replaying the 1130 year old mantra, sung by a monk whose brainwaves and words, had rounded the ancient pulsar J0108 to be picked up by a rusty tower in Alert, in the year 2033.

2052 / The realization was immediate to the group of researchers, spending the winter in Alert in Qikiqtaaluk, that there were nearly no limits to the detailing of the returned signals. What would take decades to master was tuning the instruments to bring more cohesive portions of time together, in order to get more than fragments shattered by the cosmic events punching at the gravity corridor.



Normal gravity potential diagram, showing stream lines and contours of constant gravity potential.

During the years 2034 until 2040, Jos F and Paula toured the globe as lecturers, following the book and the numerous documentaries and feature film made from their discovery.

Paula remembered them standing in the night, having cigarettes and coffee under the elusive curtains of the Northern lights, talking about what they had experienced. They encountered the signals, first with the focus of researchers, then upon realizing what they had found – sending them across an ocean of feelings, from empty disbelief, followed by reinforced hope to surreal euphoria – eventually washing them up on the shores of gratitude, a feeling that brought them to tears and gave them a sense of stillness and restful wonder.

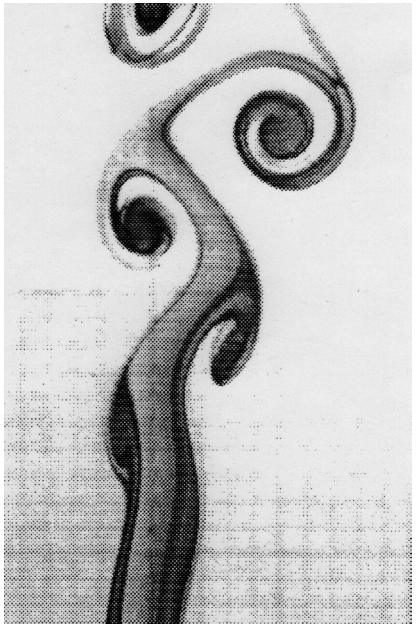
She recalled when they, only a couple of years ago, back in Dugnad, as they were continually scanning the data collected by Nico in Alert, found a fragmented piece of piano music. Almost like listening to a wax roll, the soft notes of Bach's Fugue in A Minor. She had a profound sense of how time and gravity collaborate in keeping things apart to allow for silences as well as tones, for gaps and solids, for black and white keys, to stretch out space and time enough to allow life to happen.

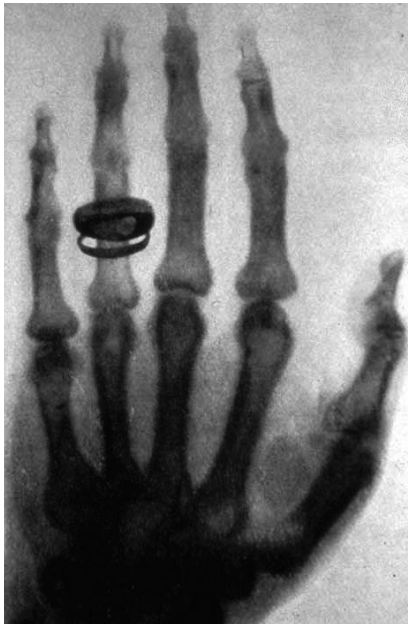
Jos F spoke about horses. How they were the first non-human power to assist communication

across vast stretches of land. The first nations in the world, the first borders defined, contained no more land than could be traversed by a human messenger. But in the kingdoms where horses lived, humans turned them into communication devices. A message carried across a kingdom by horse allowed the kingdom to be hundreds of miles bigger. More land to cross with messages of deaths and threats, which in turn required action worthy of defending the huge distance. The dimensions of a carriage drawn by a horse affected the design of the first spacecraft, Jos F would continue. The size of a carriage that could be pulled by one horse has a certain width between the wheels. This width dimensioned the roads, some with the capacity to meet another carriage travelling in the opposite direction. When the railway was introduced, the width between the tracks came to be virtually the same as the space between cart wheels. More than a century later, when a solid piece of space aircraft was to be transported to Cape Carnaveral, it had to be dimensioned to fit the railway infrastructure, the tracks and tunnels, to be able to be transferred to Florida, the first leg of the journey into space. What do we communicate now, across the new territory we find ourselves crossing at the speed of light?

Océ de Broglie wrote the speech for Sabine Fier, who accepted to pick up the 2041 Nobel Prize in Physics as she was the only native US citizen in the team. From the chaotic wonders of the first observations, they had authored a solid article, spread in all due forums, and within minutes changing the self-image of humanity. Someone said that from learning this, it was obvious that we live in a collective brain, capable of memory, and thus of universal consciousness. The theme of the Nobel talk departed from the epistemological paradigm shift from light to sound. Light had hitherto guided humanity's knowledge about the universe. Astronomy was a spectator sport. Nearly everything we know about the cosmos is obtained with light. Light is easily created and abundant. It was divided from darkness by most religions, it was considered to be good, but it could also be blinding. Most of what we know about the universe has been discovered by observing the behaviour and spectrum of light. We had been obsessed with vision. Light has told us a lot about the Baryonic universe, the roughly 4.6 per cent that is made up of Baryonic matter, as we know it. But dark matter, making up 85 per cent of the universe, is not observable. Even more evasive: dark energy constitutes 68.3 percent of the mass of the universe compared to dark matter's measly 26.8 percent. We need to employ other senses to handle it. It is still electromagnetic energy, and the hearing range is a lot bigger than the visible spectra. Seeing might be believing but listening is learning. We began to use our ears instead of our eyes to orient ourselves in the darkness. And it spoke back to us.

We gave it the name Memor. In old Norse mythology, Mímir was the giant who guarded the well of wisdom, and a counsellor of the gods. His capacity of memory was infinite, so he was known as Mímir - the "Rememberer". It was to him Oden sacrificed his eye: as the eye was thrown into the well of wisdom, it would send information of what it sees down there to Oden. It is time humanity at least lend an ear to the universe.





Left: Flow instability converts steady energy to time dependent energy, where small disturbances generate a "vortex street". Right: An X-ray picture (radiograph), taken by Wilhelm Röntgen of Albert von Kölliker's left hand at one of Röntgen's public lectures.

2257 / As the external memory of the skies were more thoroughly mapped, by more refined instruments, researchers found that repetition was an important factor for recovery of the signals. The most repeated phrases on earth kept showing up in transcripts: words like "mom" and "dad", "hello" and "thank you", "yes" and "no", in all languages and voices. They overheard the first "I love you", "good night" and "good luck" before it fell into a soft black noise, and they turned the dials all the way back to a point in time when there were not voices but birds, no babies crying but lightning cracking, no mantras but waves rolling across waters not yet separated by land. Closer to us in time, and with the increasing amount of people on Earth, the volume levels soared, letting through repetitive expressions of the great legends and grand narratives, the countless recitations of Shakespeare, the eternal pieces of classical music, the hit songs and the box office successes, the winners, the crowds, the demonstrations, the states of the unions and the voices of their generations. Turning the dial of Memor, all of this still

A test subject being suited up for studies on the "Reduced Gravity Walking Simulator" in the hangar at Langley Research Center, NASA 1963.

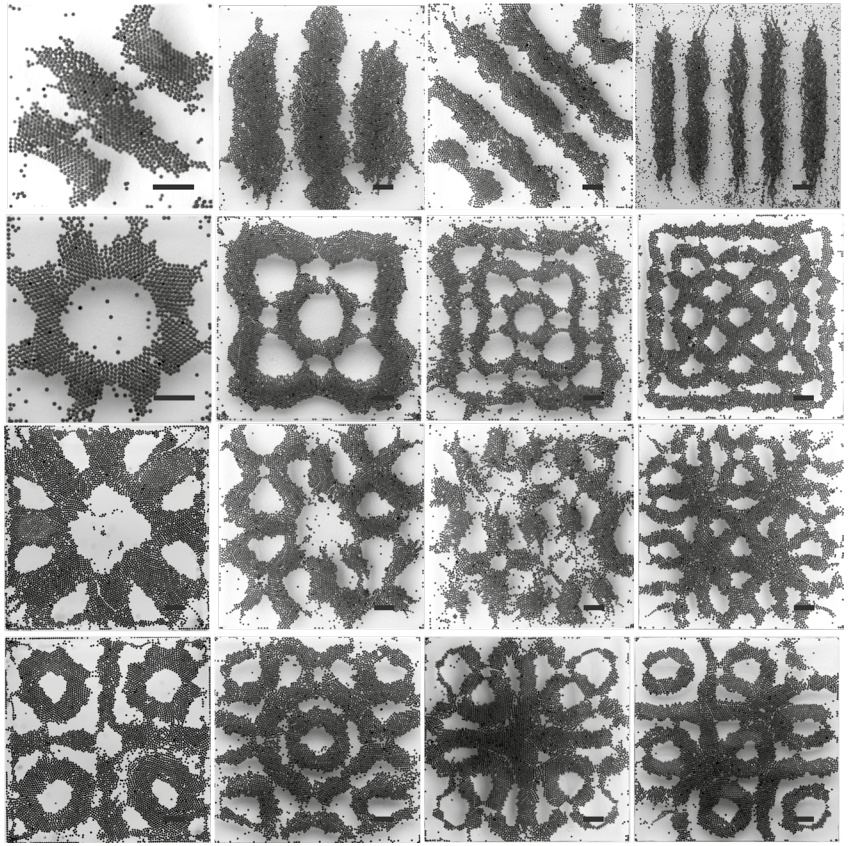
surfaced at random, as finding something very specific was an exclusive process of fine-tuning that still could not guarantee the result. We accepted the abundance of information travelling along the gravity repulsion corridor of dark energy, much as we accepted the abundance of images that had occupied our vision for millennia.

As time passed and generations grew up not knowing a time when the universe was not resounding of life, cults of silence were founded, sects of forgetfulness were constituted and debates on the absence of many voices in history were common. There were forensics trying to solve crimes by finding proof in the Memor, there were sound archaeologists and integrity activists. The Memor triggered new schools of philosophy, and gave people novel reasons to disagree, while others found each other in unison. The concept of memory was discussed extensively, both as an intrinsic element of biology and as something that adds existential depth to our lives. Where did silence go? Who said what? It was extremely rare to pick up a voice who was identifiable, apart from the celebrities and hits. The voices and sounds were like thoughts inside a giant brain. We could hear them but not attribute them to any one, most of the time. It was the sound of a huge collective, layered in time.

When shifting the focus to the dark energy of the universe, the Memor grew exponentially. The signal from 2257 was picked up in 2088, when the Dugnad had transformed into a major city and the original team were scattered across the globe in various honorable senior functions. A dedicated team had managed to "hack" the gravity radio, to make it possible to not just stay in touch with our past, but also get in contact with our future. Since gravity provided standing carrier waves, along which memories travel, the counterforce of gravity – dark energy – was closely examined. While gravity is the force pulling the fabric of cosmos together, dark energy is a force that accounts for the expansion of the universe. As gravity brought back memories to Earth, what dwelled in the dark energy – the counterforce of gravity - was a message from the future. The signal was not sent from, but to, Earth. It was not really a signal, more like a piece of music found in the "channel" of dark energy. Having listened to the harmonies without making much sense of it, the tones were played to vibrate a plate of sand, the same way as de Broglie's ancestor Louis studied ripple patterns, and in the same way that Michael Faraday studied nonlinear standing waves appearing on liquids enclosed by a vibrating receptacle. The signal, identified as being sent in the year 2257, was finally decoded by playing the piece of music into

a layer of plasma, where the vibration frequency spread a critical value through the medium and lit it up as a three-dimensional map. It engaged great communities, human and non-human, to collaborate on extracting the information about how to make inter-dimensional travelling possible and how to lay down the communication lines between dimensions.

The 2257 signal was a ship coming to the old world, to remind us about something even older. Waving goodbye, taking you protein pill, closing the hatch on the tin can and run the engines: that is the pop star way to leave a place in the universe and go to another. But the universe is not made for that kind of travelling. Humanity has been trailing along, inventing faster and better carriages, assuming that this is the way to bring the body someplace new. Passing through dimensions was an artform that had not been practiced since the days of the shamans. There was much to learn about this from the Memor, detecting the ancient techniques breathing your way through to the other side and moving like the propagation of sound, extending you mind into a chosen body or avatar, navigating by breathing and singing. Neural networks are bodyless by default, and were given the instruction to let the plasma map lead them into parallel dimensions. The neurals soon found what the single human mind would not readily see, as we are born into bodies and we die from them, and have no concept of how we got to and from these organic cases. The neural networks and the Memor took an immediate liking to each other. The non-linear randomness of the voices and sounds were just the kind of big data that the neurals craved. They found the missing keys in the back of the collective mind of the universe, and created labs for exercising orientation and navigation in inter-dimensional space. Neurals accompanied humans into the place where the music came from. Remember - only the disturbance is travelling, not the air. The unbodied human consciousness became the disturbance travelling from the old world to the new.



Assembly of microbeads on Faraday waves, or Faraday ripples: nonlinear standing waves that appear on liquids enclosed by a vibrating receptacle, a phenomenon related to parametric resonance.

MEMORY (N.) From Anglo-Norman *memorie,* Old French *memoire* etc., from Latin *memoria* ("the faculty of remembering, remembrance, memory, a historical account"), from memor ("mindful, remembering"), from Proto-Indo-European **(s)mer-*(to remember), related to Ancient Greek μνήμη *(mnēmē*, "memory") μέρμερος (*mérmeros*, "anxious"), μέριμνα (*mérimna,* "care, thought"), Old English *mimor* ("mindful, remembering"). More at mimmer.

From Etymology online: https://www.etymonline.com

MEMOR (N.) Latin, from Proto-Italic **memnos*, Proto-Indo-European **me-mn-os-*, a reduplicated form of **men-* ("to think"). [ˈmɛ.mɔr]

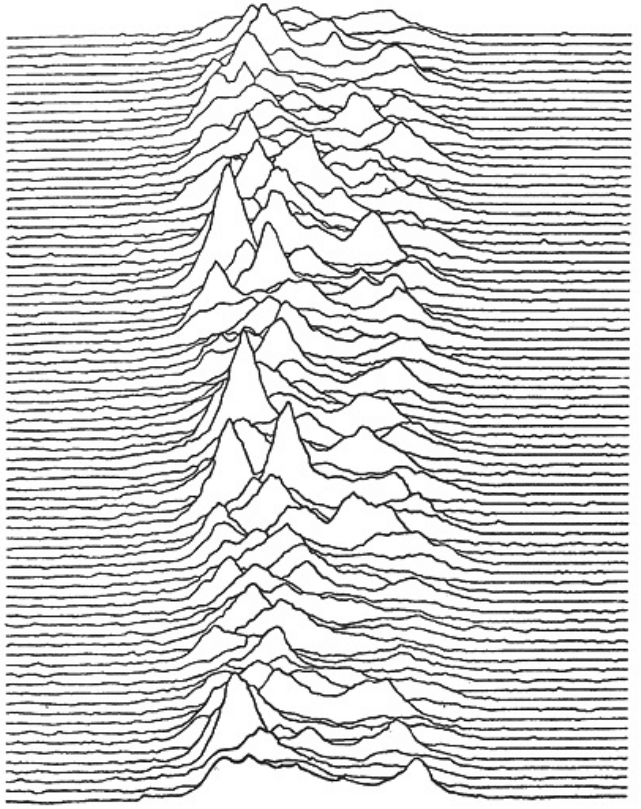
MEMOR (A.) *(genitive memoris); *third declension 1.* mindful, remembering 2. that has a good memory.

From Wiktionary: https://en.wiktionary.org/wiki/memor#Latin

FUGUE (N.) A type of musical composition, 1590s, *fuge*, from Italian *fuga*, literally "flight," also "ardor," from Latin *fuga* "a running away, act of fleeing," from *fugere* "to flee" (see fugitive (adj.)). Current English spelling (1660s) is from the French version of the Italian word. A Fugue is a composition founded upon one subject, announced at first in one part alone, and subsequently imitated by all the other parts in turn, according to certain general principles to be hereafter explained. The name is derived from the Latin word *fuga*, a flight, from the idea that one part starts on its course alone, and that those which enter later are pursuing it. ["Fugue," Ebenezer Prout, 1891]

From Etymology online: https://www.etymonline.com

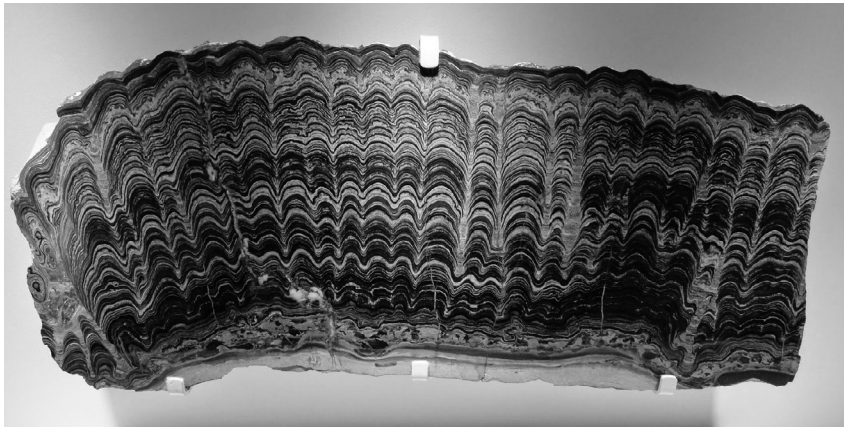
Successive pulses from the first pulsar discovered, CP 1919. The pulses occuring every 1,337 seconds are caused by a rapidly-spinning neutron star.



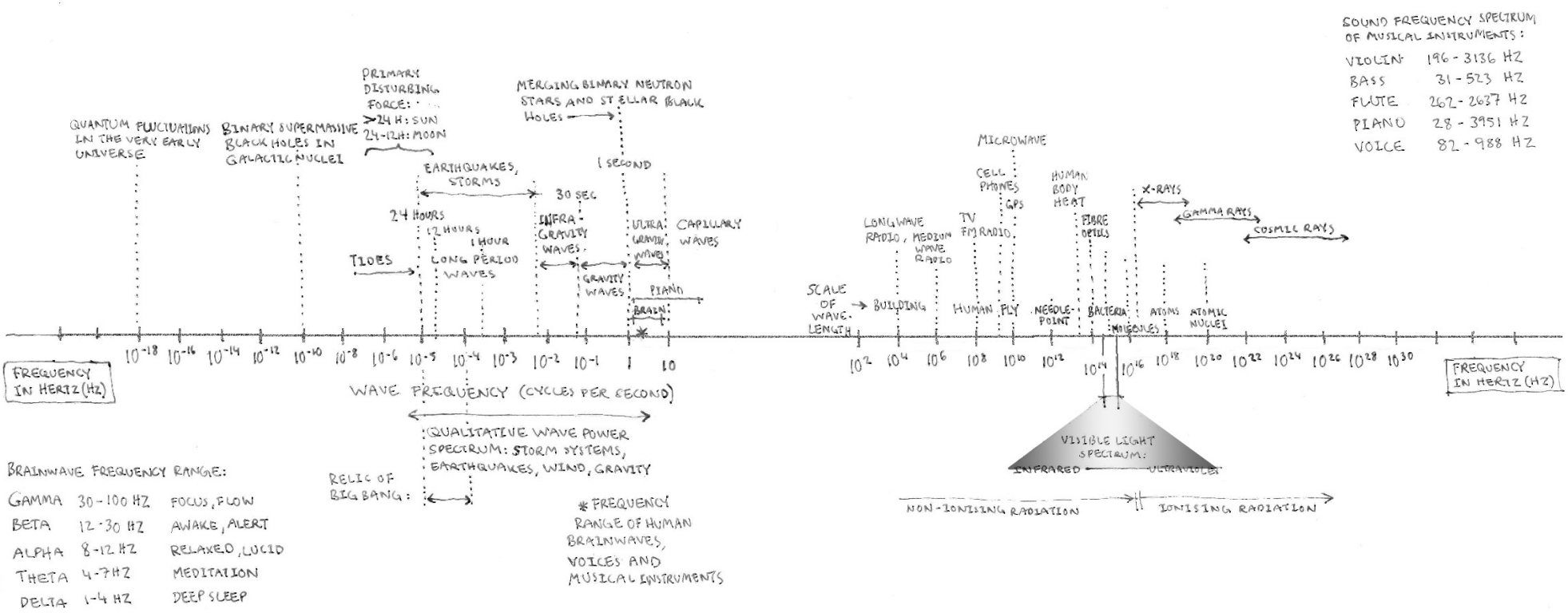
POST-SCRIPT

Memory allows us to die from something new every day, until we don't. The collective memory is the bank from which we pass knowledge over across generations: what to fear, what to value, how to not die, how to care for the world of tomorrow. The learnings from Bruce Damer were recalled: in the universe, before or without the event of biological life, things just happen.[32] Stars collide, neutrons merge, nebulae form, without a single conscious entity to witness and record the event. Memory enters the scene with the event of organic life. Memory installed at genetic level allows for a string of data to be passed across time. Memory is the biotech of the concept Eternal Return[33], as life may be lived over and over again, yet there will be something there to ensure we do not have to start all over again. When organic life reaches a level of complexity where neurons are formed; self-consciousness is introduced, and with it self-preservation and learning. Neurons are activated and move as waves in the brain, at different frequencies. Memory is an aspect of both the genome and the consciousness, that makes it possible to pass information on to the next cycle. With neurons comes the ability to access stored data in no particular order, making sense of it as we go along. The stromatolite is a "note found in the piano", a reminder of where we come from. The stromatolite is telling us that our ancestor was never a single cell. It was always a symbiotic community of cells, packed together and exposed to friction. A single individual cell competing with all other cells costs too much energy. Collaboration is the key in which the songs of life are played. Gravity, like memory, is a force that brings the world together.

Memember me.



Top: Stromatolites growing in Hamelin Pool Marine Nature Reserve, Shark Bay in Western Australia.
Bottom: Section of a stromatolite: the earliest fossil evidence of life on Earth.



BRAINWAVE FREQUENCY RANGE:

GAMMA	30-100 HZ	FOCUS, FLOW
BETA	12-30 HZ	AWAKE, ALERT
ALPHA	8-12 HZ	RELAXED, LUCID
THETA	4-7 HZ	MEDITATION
DELTA	1-4 HZ	DEEP SLEEP

SOUND FREQUENCY SPECTRUM OF MUSICAL INSTRUMENTS:

VIOLIN	196-3136 HZ
BASS	31-523 HZ
FLUTE	262-2637 HZ
PIANO	28-3951 HZ
VOICE	82-988 HZ

Waveform frequency diagram

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5 https://en.wikipedia.org/wiki/Harold_Bride
6 https://en.wikipedia.org/wiki/File:Thrilling_Story_by_Titanic%27s_Surviving_Wireless_Man_-_read_by_Winston_Tharp_for_LibriVox%27s_Short_Nonfiction_Collection_Vol._026_(2012).ogg
(Ogg Vorbis sound file, length 18 min 28 s, 76 kbps)
7 Wireless operators originally used Marconi's "CQD" distress signal. "CQ" was the signal to stop transmission and pay attention. The "D" was added to signal distress. In 1906 the International Radio Telegraphic Convention in Berlin created the signal "SOS" for summoning assistance. The letters were chosen for their simplicity in Morse Code - three dots, three dashes and three dots. While the "SOS" superseded "CQD" in 1908 Marconi operators rarely used it. It became standard after the sinking of the Titanic.
8 https://www.hancockchurch.org/the-newells-a-hancock-family/
9 https://www.getsurrey.co.uk/news/surrey-news/rarely-told-story-jack-phillips-14551323
10 https://www.steinway.com/news/features/with-the-piano-tuner
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12 https://www.nj.com/entertainment/index.ssf/2017/02/piano_breaks_at_njso_concert_but_the_concert_carri.html
13 Explaining why US is losing the scientific research game: https://www.vox.com/2015/2/23/8052365/nasa-budget-europa
14 https://www.independent.co.uk/life-style/gadgets-and-tech/news/signal-space-fast-radio-burst-frb-a8475696.html
15 ASKAP: Australian Square Kilometer Array Pathfinder
16 https://www.space.com/42085-mysterious-fast-radio-bursts-new-discoveries.html
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20 Search for Extra-Terrestrial Intelligence (SETI)[42] is the search for extraterrestrial life or advanced technologies. SETI aims to answer the question "Are we alone in the Universe?" by scanning the skies for transmissions from intelligent civilizations elsewhere in our galaxy. In comparison, METI (Messaging to Extra-Terrestrial Intelligence) refers to the active search by transmitting messages.
21 https://en.wikipedia.org/wiki/Arecibo_Observatory#The_Arecibo_Message
22 In 1967 there was an observation from the Mullard Radio Astronomy Observatory in Cambridge. This is when Jocelyn Bell detected the CP1919 pulse, uncannily regular, after individual observation of miles of graphical data traces. It was so regular, she and her PhD supervisor were tempted to assume it was produced by an extraterrestial civilisation, but Bell soon ruled this out after discovering a similar signal from another part of the sky. The original signal turned out to be radio emissions from CP 1919, the first pulsar found. Bell noted that other scientists could have discovered pulsars before her, but their observations were either ignored or disregarded.
23 https://www.youtube.com/watch?v=J556uXwrjII
24 https://www.space.com/11849-earth-gravity-map-geoid.html
25 Gravity is most accurately described by the general theory of relativity (proposed by Albert Einstein in 1915) which describes gravity not as a force, but as a consequence of the curvature of spacetime caused by the uneven distribution of mass.
26 "Specifically, we need a massless gauge boson of spin 2. We call this hypothetical particle the graviton". https://www.quora.com/What-does-the-standard-model-have-to-say-about-gravity
27 https://www.physicsclassroom.com/mmedia/waves/swf.cfm
28 https://physics.stackexchange.com/questions/238024/can-a-system-be-engineered-to-cause-a-standing-wave-resonance-with-gravitational
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33 https://en.wikipedia.org/wiki/Eternal_return

IMAGE CREDITS

1,3 Water under sinusoidal vibration of 11 Hz by Jordi Torrents from Spain. Freely licensed under CC BY-SA 4.0. https://blog.wikimedia.org/2015/12/24/european-science-photo-competition/

11 The Wave, Coyote Butte North, Vermillion Cliffs, Arizona, 1998. https://en.wikipedia.org/wiki/The_Wave_(Arizona)#/media/File:TheWave_1600pixels.jpg

12 Vietnamese refugees at Camp Pendleton, 1975. Pendleton Marines welcomed wave of Vietnamese refugees. New arrival refugees from Vietnam with volunteer teacher, Be Thi Nguyen, teaching the children English songs and nursery rhymes. Charlie Neuman/San Diego Union-Tribune/Tns.

15 Electrical substation and overhead power lines. Photo by it's me neosiam from Pexels: https://www.pexels.com/photo/b-w-electric-electric-light-fog-608076/

19 Titanic's Marconi room, photographed by passenger F R Browne. Public domain image.

20 The iceberg that might have sunk the RMS Titanic. Photo by the chief steward of the liner Prinz Adalbert. Navigation Center, United States Coast Guard. https://commons.wikimedia.org/wiki/File:Titanic_iceberg.jpg

23 Photo of Harold Bride carried off Carpathia, by Time Life Pictures/Mansell/Time Life Pictures/Getty Images) Getty Images Archival. http://www.gettyimages.co.uk/Search/Search.aspx?EventId=104112342&EditorialProduct=Archival#&esource=maplinARC_uki_apr12

Bottom left: Harold Sydney Bride, wireless officer at RMS Titanic. Born 11 January 1890, died 29 April 1956 (aged 66). Public domain image.

Bottom right: Jack George Phillips, wireless officer at RMS Titanic. Public domain image.

25 Lifeboat from the Titanic rescued April 15,1912. Photo: Ralph White/CORBIS/Corbis via Getty Images

26 X-ray diffraction pattern of crystallized 3Clpro, a SARS protease (2.1 Angstrom resolution). Created: 1 April 2006 by Jeff Dahl.

27 Photo 51: DNA X-ray diffraction image. Interpreted by geograph.org.uk, Robin Stott after ideas of Rosalind Franklin+ Raymond Gosling. https://commons.wikimedia.org/wiki/File:Experimental_setup_of_Photo_51.svg

29 Guglielmo Marconi's first radio transmitter, photographed in November 1926. Public domain image (published in the United States between 1924 and 1963). First published in the 1926 issue of Radio Broadcast magazine: Guglielmo Marconi, "Looking back over thirty years of radio", Radio Broadcast magazine, Doubleday, Page, and Co., New York, Vol. 10, No. 1, November 1926, p. 31. https://commons.wikimedia.org/wiki/File:Marconi%27s_first_radio_transmitter.jpg

31 Left: Marjonie Anne Newell. Courtesy of Michael A. Findlay, USA.
Right: Marjorie and Madeleine Newell. Courtesy of Marjorie Newell Robb / Michael Findlay Collection, Titanic International Society Archive. https://www.encyclopedia-titanica.org/titanic-survivor/marjorie-anne-newell.html

32-33 Image by ScanLAB-Projects.

34-35 Photo by Christer Lundahl.

36-37 Image by ScanLAB-Projects.

39 Alamogordo File: Trinity Test Fireball, 16 ms. Created: 16 July 1945, Alamogordo White Sands Missile Range. Berlyn Brixner / Los Alamos National Laboratory. http://www.lanl.gov/orgs/pa/photos/images/PA-98-0520.jpeg

41 Stromatolite, Greysonia sp., Vendian, Bolivia. Exhibit in the Houston Museum of Natural Science, Houston, Texas, USA. Photography was permitted in the museum without restriction. 22 October 2012.

42 Poldhu Marconi Station, 1914. Published in "Rivista mensile del Touring Club Italiano - Anno XX - N.2 - Febbraio 1914". Public domain image. https://it.wikipedia.org/wiki/Poldhu#/media/File:Stazione_radiotelegrafica_di_Poldhu_(anni_venti).jpg

45 Medicina Radio Observatory. With a surface area of 27400 square meters it is the largest UHF band antenna in the Northern Hemisphere. Published in Medicine, 1974 / Paolo Monti. Available in the BEIC digital library and uploaded in partnership with BEIC Foundation. The image comes from the Fondo Paolo Monti, owned by BEIC and located in the Civico Archivio Fotografico of Milan. https://commons.wikimedia.org/wiki/Category:Medicina_Radio_Observatory#/media/File:Paolo_Monti_-_Servizio_fotografico_(Medicina,_1974)_-_BEIC_6348759.jpg

46 LIGO, Louisiana 2012, courtesy LIGO Laboratory. https://creativecommons.org/licenses/by/2.0/

47 Pioneer plate. February 1972. Image from Great Images in NASA, author: NASA. https://commons.wikimedia.org/wiki/File:Pioneer_F_Plaque_Symbology_-_GPN-2000-001623.jpg

49 First 32 harmonics of a string. Public Domain Image. Courtesy of Hyacinth.

51 Wardenclyffe Tower. Retrieved from http://www.sftesla.org/images/Tesla_Broadcast_Tower.JPG
Previously published in Arthur B. Reeve, "Tesla and his Wireless Age" in Popular Electricity magazine, Popular Electricity Publishing Co., Chicago, Vol. 4, No. 2, June 1911, p. 97. Photographer Unknown (Life time: Unattributed).

52 Inventor Nikola Tesla in his Colorado Springs laboratory. Photographer: Dickenson V. Alley, Century Magazine, December 1899. This image was created by Century Magazine photographer Dickenson V. Alley using "trick photography" via a double exposure. The electrical bolts were photographed in a darkened room. The photographic plate was exposed a second time with the equipment off and Tesla sitting in the chair. The unretouched image, without Tesla, appears in Nikola Tesla, "The Problem of Increasing Human Energy", Century Magazine, The Century Co., New York, June 1900, fig. 8. Retrieved from Wellcome Collection gallery, via Wikimedia Commons: https://commons.wikimedia.org/wiki/File:Nikola_Tesla,_with_his_equipment_Wellcome_M0014782.jpg

55 Gravimeter, DDR stamp 1980. First Day of Issue 11 November 1980. Design by Lothar Grünewald
Made available by: Nightflyer (talk), 8 November 2010 on Wikimedia Commons: https://commons.wikimedia.org/wiki/File:Stamps_of_Germany_(DDR)_1980,_MiNr_2557.jpg

56 Vintage Radio dial: https://www.videoblocks.com/video/vintage-60s-radio-ruxh77siiqbkxiym

58 Katsushika Hokusai: Kanagawa oki nami ura (The Great Wave off Kanagawa). The waves in this work are sometimes mistakenly referred to as tsunami (津波), but they are more accurately called okinami (沖波), great off-shore waves. Metropolitan Museum of Art. Created: First publication between circa 1830 and circa 1832. Public domain image. https://commons.wikimedia.org/wiki/File:Great_Wave_off_Kanagawa2.jpg

59 Normal gravity potential, showing contours of constant gravity potential (gravitational + centrifugal), stream lines for the gravity; these are spaced at intervals of 10° in parametric latitude on the surface of the ellipsoid. Image by Cffk, 6 March 2017. https://commons.wikimedia.org/wiki/File:Normal_gravity_potential.svg

61 Left: Unstable water jet. Retrieved from: https://ipfs.io/ipfs/QmXoypizjW3WknFiJnKLwHCnL72vedxjQkDDP1mXWo6uco/wiki/Whistle.html
Right: An early X-ray picture (radiograph) taken at a public lecture by Wilhelm Röntgen (1845–1923) of Albert von Kölliker's left hand. See Axel Haase; Gottfried Landwehr; Eberhard Umbach (eds.) (1997) Röntgen Centennial: X-rays in Natural and Life Sciences, Singapore: World Scientific, pp. 7–8 ISBN: 981-02-3085-0.
Created: 23 January 1896 https://en.wikipedia.org/wiki/Glossary_of_machine_vision#/media/File:X-ray_by_Wilhelm_R%C3%B6ntgen_of_Albert_von_K%C3%B6lliker%27s_hand_-_18960123-02.jpg

62 Reduced Gravity Walking Simulator 11 December 1963 – NASA. Photograph: NASA / Langley Research Center (NASA-LaRC).

65 Assembly of 200-micrometer polystyrene beads on Faraday waves. Faraday waves are used as liquid-based template. The beads were assembled on the nodal regions of Faraday waves. Retrieved from: https://commons.wikimedia.org/wiki/File:Assembly_of_microscale_materials_on_Faraday_waves.png

67 Pulsar diagram, published in "The Nature of Pulsars" by J.P.Ostriker, in Scientific American, January 1971, pp 48-60.

69 Top: Stromatolites growing in Hamelin Pool Marine Nature Reserve, Shark Bay in Western Australia. Photo taken in March 2005 by Paul Harrison (UK). Retrieved from: https://commons.wikimedia.org/wiki/File:Stromatolites_in_Sharkbay.jpg
Bottom. Stromatolite morphology. Retrieved from http://www.geologyin.com/2014/04/stromatolite.html#EkC2zgc0boMpFgOz.99

70-71 Waveform frequency diagram. Illustration by Malin Zimm.

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