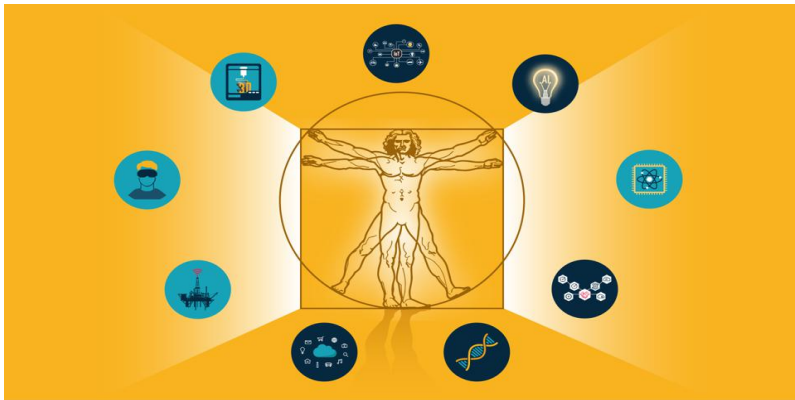


# Middle School Scholars' Newsletter

Summer Term 2021

## A New Renaissance?



### Introduction

Leon Battista Alberti, a leading figure of the Renaissance, famously said that 'a man can do all things if he will.' This idea of embracing new knowledge and showing a curiosity for the world is one that characterises the writers and their articles in this issue. This bumper edition is a combined effort from the 3rd and 4th years, and is one of the most eclectic editions of the newsletter we've published. This group show themselves to be critical thinkers and eloquent writers, unafraid to grapple with the big ideas of the modern world. Science, Literature, History, and Creative Writing are all represented here and show the many interests and talents of the scholars. I'm sure Alberti would have approved, and we hope you do, too.

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## HISTORY, POLITICS & GLOBAL AFFAIRS

### The Politics of World Maps by Philip Kimber

For most people, a map is a fairly simple instrument in navigating and understanding the geography around us. But some would argue that the complex and exacting science of cartography and map projection has a much greater impact on our perception of the world than we might think.

That was the view of the German historian Arno Peters, best known for his development of the 'Peters World Map'. He attributed some aspects of historical Eurocentric biases in worldviews to the wide use of the 400-year old Mercator projection, which (unlike his new projection) enlarges the sizes of regions close to the poles - leading Greenland to look bigger than the whole continent of Africa.

To understand the difference between these two projections, it can be helpful to look at the mathematics of it. It's quite well known that it is impossible to accurately plot a sphere on a flat plane, and so every 'projection' of the globe distorts it in some way.

The Peters and Mercator maps are both rectangular - which is the way we have come to expect most world maps to be. This means that all lines of latitude are the same length on the map. This isn't the case on a globe: the equator is the largest circle of latitude, and as you get

closer to the poles, the circumference of circles of latitude is much shorter. But on the map, these all get stretched out to the same size.



Different projections deal with this in different ways. The Mercator projection, designed to be 'conformal' - preserving direction by keeping direct bearings on the earth as straight lines on the map - applies an equivalent stretching factor to the map's height in the polar regions, which keeps the direction accurate in countries like Greenland and Sweden which would otherwise be distorted.

But this has the side effect that the size of these northern countries is massively exaggerated because these correction factors multiply to make a greater area on the map.

In an effort to combat this unfairness, the Peters projection applies an opposite correction factor, instead stretching out the height of the equatorial regions. This ensures that all countries' sizes on the map are proportional to their size in real life, but at the cost of losing the 'conformality' of the Mercator.

The result is that many have criticised the Peters Map for its strange shapes of continents. Russia and other northern countries no longer have massively inflated areas, but their shapes are stretched sideways more, leading to Scandinavia looking quite different.

What is most problematic (and arguably hypocritical), however, is the effect that the Peters projection has on Africa and South America, the two key continents Peters believed were let down by the Mercator map. Whilst the USA and most of Europe look roughly accurate, the shapes of the African and South American continents are stretched vertically the most, no longer resembling the actual landmass as much.

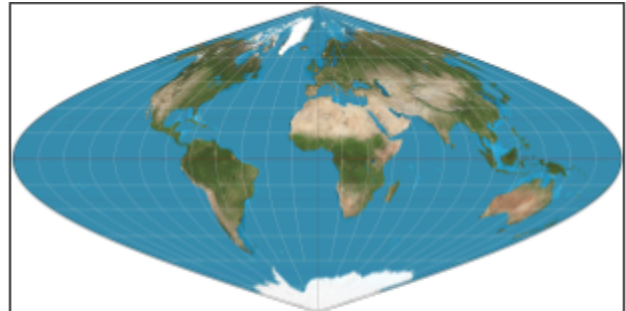


An early version of Peters' map, which aimed to show countries more fairly. The projection is 'equal-area', which means that countries' sizes are accurate to the scale of the map - but at the cost of distorting shapes, particularly in Africa and South America.

Peters did acknowledge this criticism when first demonstrating the map in the late 1960s, indeed pointing out that it's more accurate portrayal of Europe might see it more willingly adopted by Europeans. But we should also consider that there are lots of other equal-area projections.

Take the 'sinusoidal projection' for example, which was developed by 16th Century French

mapmaker Jean Cossin at around the same time as Mercator. It rather neatly shows the world in equal-area proportions by drawing all lines of longitude as half sine waves of differing amplitude.



The sinusoidal projection. Dating from the 16th Century, it is sometimes called the 'equal-area Mercator' projection. Africa and other central regions are shown reasonably accurately, but the US and China have almost unworkable distortion.

Why didn't proponents of equal-area cartography like Peter's turn to this kind of map? There are ultimately lots of reasons why individual projections don't catch on, but perhaps we should also look at it more cynically.

On the sinusoidal map, the areas away from the central meridian are most distorted. Therefore, whilst Africa and the Middle East are reasonably accurately shown, the severe distortion of the US would make it unacceptable for the American audience.

There are lots of equal-area map projections, but the Peters was acceptable for its growing audience of politically-aware Europeans and Americans perhaps only because it shows the US and Europe reasonably accurately in direction too.

The real test of whether we can overcome the Eurocentric bias Peters was criticising, would be whether we could accept a projection like

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the sinusoidal, that distorts our countries and portrays Africa and South America accurately.

In the end, the criticism of the Peters World Map shouldn't aim to discredit it and its motivations, nor should the intention be to blindly preserve maps (like the Mercator) that we have traditionally used.

Instead, it's important to understand that there is no one 'correct' way of projecting the globe onto a flat plane, and that world maps, like a lot of things, are a compromise.

## A Case Study on Japanese Airlines, Flight 351 by Sam Ramsey



On March 31, 1970 Japanese airlines flight 351, travelling from Tokyo to Fukuoka was hijacked. There were 122 passengers and 7 crew members on board the flight, of which there were some high profile people such as the lead bass player in one of Japan's most up and coming rock bands and a Roman Catholic Priest from New York.

About a third of the way into the flight, when the plane was reaching cruising altitude, a 27 year old, recent graduate, Takamara Tamiya got up from his seat to announce that he was hijacking the plane. Surprisingly, he started to draw a samurai sword and used it to threaten the passengers. 7 more hijackers wielding samurai swords made themselves known, the youngest of which was just a 16 year old student. They did not only have the swords - some held pistols and even small bombs. As they began to tie down the passengers and force their way into the cockpit, the final hijacker got up from his seat. This hijacker was Moriaki Wakabayashi and he was the bass player of the up and coming Japanese rock band.

Once they forced their way into the cockpit, the young hijackers had full control of the aircraft. They demanded that the plane should be flown to Havana, Cuba across the Pacific ocean since in their eyes it was a communist stronghold in which they could make a political statement to Japan, and the rest of the world. The hijackers were members of the Japanese Communist League Red Army Faction, predecessor to the Japanese Red Army, and were extremely driven on taking down their own government and giving rise to the proletariat.

However, it was not possible for the plane to fly that long a distance to Cuba since it had been designed for the short one hour flight from Tokyo to Fukuoka and only had enough fuel for the original destination.



The hijackers decided that they would land in Fukuoka and demand more fuel so that they could reach a new location, North Korea, another communist state. When they landed in Fukuoka, authorities surrounded the plane and the hostage negotiations began. Eventually a deal was met that meant that the hijackers would release 23 passengers in exchange for more fuel, enough fuel to get them to their new destination Pyongyang, North Korea. However there was another problem. It was 1970 and flying planes was not as automatic as it is now, and the pilots had never flown to Korea. They

were handed a basic map of the Korean peninsula, but it was very rudimentary and was really no better than a student's atlas map.

When they were flying over the DMZ, the pilots were justly concerned since they had no way to contact the North Korean officials and it was common knowledge among pilots that any unauthorized planes in the DMZ could be shot down at sight. However they had no choice except to carry on since the hijackers continued to threaten them and the remaining passengers on board.

Moments after entering the DMZ, fighter jets began to fire at the passenger plane, however it was short lived, and the pilots concluded that it must have been warning fire. Finally, the pilots managed to get a hold of the North Korean airspace officials and after some back and forth, they were permitted to land in Pyongyang.

The flight touched down in Mirim Airport, located in East Pyongyang and the hijackers were met with many high ranking military personnel, but also sympathetic civilians and even a choir of young school children singing North Korean songs. A Korean military official approached the plane and tried to lure the hijackers away from it.

However the hijackers noticed something was wrong. In fact, the whole flight to 'Pyongyang' was a ruse and the pilots had instead landed in the South Korean capital, Seoul. All South Korean flags had been replaced with North Korean ones, and the entire welcome party had been faked in an attempt to divert the hijackers. Nonetheless, the rescue failed and another series of negotiations took place.

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This time, the hijackers agreed to give up all their hostages, in return for the Japanese minister of transport as insurance that the plane would not be taken down, and for promise of safe passage to North Korea. Kim Il Sung, president of North Korea, ordered that the hijackers be taken care of and they safely landed in Pyongyang, for real this time. The crew and transport minister were allowed to fly back to Japan.

When they arrived they were housed in a luxurious hotel in the capital and they were eventually moved into a residence for foreign officials. However the 'revolutionaries' still desired to travel to Cuba to carry out their communist take over, but their host nation, North Korea, had no intention of letting them do so. Instead the hijackers were heavily politically trained and were used in propaganda messages spreading their ideals. Not all members of the hijacking were happy with this situation and one was reported dead a few years later, thought to have tried to escape North Korea, despite their favourable position by North Korean standards.

Other members of the group were not radically opposed to their situation but all expressed desire to return to Japan. The fate of these hijackers remains relatively unknown although it has been reported that at least 3 have died.

## **The Reichstag Fire: Coincidence or Conspiracy?** by Toby Pinnington



Adolf Hitler was made Chancellor of Germany in January 1933, but the Nazi Party (NSDAP) only had 190 seats in the Reichstag (German parliament). Hitler wanted to reverse the Weimar (German) Constitution, which he could only do with a  $\frac{2}{3}$  majority, and so he decided to hold another election on 5th March. Suddenly, the Nazis gained 98 more seats, the most any party had won since free elections were instituted. Considering that the Great Depression had been easing since 1932 and so people were looking for less extreme parties, how exactly did this happen? A lot can be said about voter intimidation and the cult of Hitler, but the answer almost certainly lies in what happened on the evening of 27th February 1933, and the mysterious conspiracies that later surrounded it.

Marinus van der Lubbe was a Dutch communist member, with a criminal record for several attempted arson attacks. He went to Germany in 1933, saying at his trial that, 'I decided to go to Germany to see for myself what Hitler was doing. ... The government of Germany is bad.' At roughly 8.45pm on 27th February, he entered the Reichstag building through the



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restaurant window. Fire department photos show that many small fires were started, and all self-extinguished, except for the main fire in the debating chamber. The old wooden chamber was burning fiercely by 9.00pm, but 50 fire-engines put out most of the fire by 9.30pm. Little remained of the chamber, but the stone structure around it was left largely undamaged.



Hitler, as always, immediately jumped on the anti-communist bandwagon. When he first heard of the fire, he told a Daily Express reporter: 'I hope it's the work of the communists. If it is I will destroy them completely.' In public, he said that, 'We have seized hundred-weights of material ... these fires were to be the beacon signals for a nation-wide campaign of dynamiting and mass murder.' 4,000 communist leaders were arrested that night and President Hindenburg passed an emergency decree allowing the police to search and imprison people without fair trial. But most importantly, Hitler got a Reichstag majority in the election, allowing him to pass the Enabling Act, effectively ending the Weimar Republic and beginning his tyrannical reign in Germany.

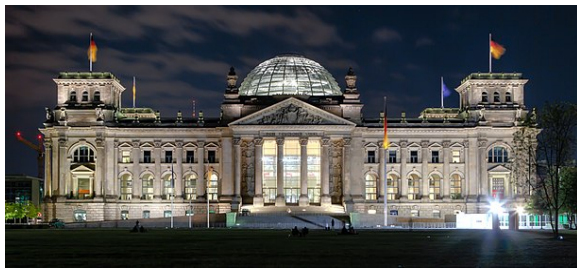
However, there has been controversy about what actually happened ever since. The idea that the communists were closely involved was soon disproved; Georgi Dimitrov, a leader of the USSR's Comintern, was acquitted at a trial in Leipzig. They found that Goering, a Nazi minister, had lied when he claimed that a communist membership card was found on van der Lubbe. William Shirer, an American journalist in Berlin at the time, believed vehemently that the Nazis did it, referencing the findings of the trial when he said that, 'two and a half minutes after he entered, the great central hall was fiercely burning. He had only his shirt for tinder. ... according to the testimony of experts at the trial, [the largest fire] had been set with considerable quantities of chemicals and gasoline' concluding that, 'he was a dupe of the Nazis.' But despite this speculation, van der Lubbe admitted at the trial that he had done it.

Another theory is that members of the Sturmabteilung (SA) - the Nazi's paramilitary group - snuck in through an underground tunnel. At the Nuremberg Trials, a member of the SS said that, 'ten SA men equipped with highly flammable liquid set fire to the Reichstag ... under the orders of Karl Ernst [Berlin leader].' Ernst himself admitted in 1934 that he led the SA through a tunnel, scattering gasoline and self-igniting chemicals. However, was van der Lubbe paid by the Nazis in advance, or there coincidentally? Goering said at a lunch in 1942, 'I set it on fire.' This is noteworthy because the tunnels Ernst referred to linked directly with Goering's ministerial palace.

Van der Lubbe was executed in 1934, but was pardoned in 2008 under a law pardoning those

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who committed crimes in Nazi Germany. Hitler later chose to hold treason trials in the new 'People's Court', bypassing normal legal rules. Whilst the majority of historians think that van der Lubbe burnt the Reichstag, there will always be a fierce and divisive debate about what actually happened on 27th February 1933, and how it changed the Nazi's fortunes forever.



## The History of Chernobyl by Harry Martin



On February 4 1970, Ukraine founded Pripyat as the ninth 'atomgrad' (a restricted settlement that requires authorised travel), only 100 kilometres from the capital Kiev, to house the Chernobyl Nuclear Power Plant. August 15 1972 the power plant (originally named the Vladimir Lenin Nuclear Power Plant) began construction, within 5 years the first reactor was erected; after a further six years (1977-1983) all four reactors were completed. As a result of its population growth, by 1979, it was officially declared a city and accommodated nearly 50,000 people. At this moment the travel restrictions had been lifted and the city was permitted to commence regular activity, this motion was approved as the Soviet Union saw nuclear power as a safer alternative to other power plants; the slogan 'peaceful atom' had been branded by the local government. During the early 1980s the city was beginning to develop as the infrastructure improved and it saw a surge of residency from young couples

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and families, the average age was only 26, due to the 15 elementary and 5 secondary schools accompanied by a range of leisure facilities including: 10 gyms, 3 indoor swimming pools and a stadium. Regardless of these the main pull to the city was the search for work as it occupied four factories and the new plant.

The nuclear plant itself had four RBMK-1000 (graphite moderated and using Uranium-235 as fission fuel) reactors each capable of producing 1,000 megawatts of electrical power. Together these four reactors were responsible for powering 10% of Ukraine's electricity. The population of Ukraine in the 1980s was around 50 million therefore approximately 5 million people along with various factories were dependent on it for power generation. Furthermore 6,000 workers relied on it for their wages and their families' livelihood.



A less infamous disaster had occurred at the plant even before the construction was complete. On September 9 1982, there was a partial core meltdown in reactor 1 as a consequence of a defective cooling valve that had remained closed after maintenance. When the reactor was turned on the uranium in the tank overheated and ruptured. No one was directly killed by the accident, however the hazard had gone unnoticed by the operators for several hours, during this time spools of

uranium oxide, and other radioactive isotopes, were being released into the atmosphere. The public were not made aware of this until several years later. Cleanups occurred around the plant and the reactor was repaired and running again within eight months.

Then on April 26 1986 the infamous disaster took place which to this day is considered the worst nuclear catastrophe in history, it is one of two nuclear disasters that were rated a seven, maximum severity, on the International Nuclear Event Scale (the second being the 2011 Fukushima disaster in Japan). The accident occurred as a result of a safety test in reactor 4 performed by unprepared workers due to a 10 hour delay that caused a shift change. The test was a simulation of an electrical power outage to assist the creation of a safety procedure for maintaining reactor cooling water circulation until the back-up electrical generators could provide power, three similar tests had been conducted previously but had proved inconclusive. During the test the workers were ordered to decrease the reactor power, however the power unexpectedly dropped to a dangerously low level. In a panic they rapidly increased it but were still unable to reinstate the exact test conditions, consequently the reactor became unstable. The workers were not aware of this and proceeded with the test. Upon completion the operators shutdown the reactor, however a combination of unstable conditions and a flawed reactor caused an uncontrolled nuclear chain reaction instead. These reactions released a large amount of energy in a minute time frame resulting in two explosions destroying the reactor core and building. In an instant the reactor core set on fire initiating the release of radioactive



contamination. Fifty of the operating staff were killed by the explosion.

In the immediate response 134 firemen were sent to the scene to put out the fire, they were all hospitalized due to absorbing high levels of ionizing radiation, of which 28 died within a few weeks and 14 others died due to radiation related cancers after several years. The fire gradually released about the same amount of contamination as the initial explosion. As a result of rising radiation levels, a 10-kilometre radius exclusion zone was created 36 hours after the accident, the 50,000 residents of Pripyat were all evacuated. The exclusion zone was later increased to a 30 kilometre radius when a further 70,000 people were evacuated (eventually 350,000 were displaced). The fire continued to burn until 10 May and only ceased after 600 pilots had poured over 5,000 tonnes of sand and lead across the reactor. Approximately 185 million radionuclides escaped into the atmosphere, 400 times more than the Hiroshima bomb, and radiation levels were reported to be 20,000 roentgens/hour (a lethal dose lies at 500 roentgens over 5 hours). The contamination cloud travelled across 77,000 square miles affecting the majority of European and western Asian countries. It mixed with rain clouds and contaminated water sources as well as livestock, even animals in the UK had to undergo testing before they were allowed to be sold for public consumption. Some restrictions on Welsh and Cumbrian sheep farms were only finally lifted in 2011. 100 tons of radioactive debris had formulated around the site and needed to be removed for the safe construction of the sarcophagus, therefore 5,000 soldiers were sent to clear it.

As a solution to the desperate need to reduce the effects of explosion the government decided on building a 'Sarcophagus', a lead and concrete shelter that would enclose the destroyed reactor to prevent the spread of gamma radiation. The plan was quickly approved and construction lasted from June to November. The area also underwent a seven month decontamination process and within 15 months 75% of land was back under cultivation and a third of the evacuated area was reinhabited. The disaster caused financial strain on Ukraine and the surrounding countries as the Soviet Union spent over £3.8 billion and Belarus had spent £170 billion by 2005 having drained 22% of their national budget in 1991 alone (partially as a result of a fire that broke out in reactor 2 that year). Furthermore it is estimated that there were between 93,000 and 200,000 deaths (the majority through radiation related cancers) directly caused by the radiation released from the disaster.



Reactor 1 was decommissioned in November 1996 and on the 15 December 2000 reactor 3 was shut down therefore the whole plant was completely deactivated. Finally in February 2013 a 600m<sup>2</sup> section of the sarcophagus caved in, the damage was immediately repaired after Ukraine received £810 million from the European Bank of Reconstruction and

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Development. The New Safe Confinement was finished in 2016. As of today Pripyat is still responsible for some of the most radioactive locations on the planet, however on average the city gives exposure to only 2,500 microsieverts/hour, roughly one-thousandth of the lethal dose, consequently short guided tours are now available to the public for £100.

## Greenham Common: A Short Guide

by Liam Engall



### *Top Facts about Greenham Common:*

- Situated southeast of Newbury, Greenham Common was a piece of common land before the runway and airfield was built
- It is a former Royal Air Force station, used by the RAF and the USAAF in the 2nd world war
- It held nuclear missiles in the Cold War
- In 1943, Greenham Common became a base for the USAAF
- Beyoncé filmed a music video at the bunkers
- Topgear filmed an episode there - Series 12, Episode 6 (also, Boris Johnson is the star in the reasonably priced car)
- A 'near nuclear accident' occurred there in 1958
- It was used as a film set for Fast and Furious 9

Over the Easter holidays, I was given the brief to write an article about an interesting place I've visited over the holidays. How do I do that when we are in a lockdown? Nothing is open

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for visiting, my house certainly isn't special, and neither is the local supermarket. I had a long think and finally came up with an answer that might be good enough. You weren't allowed to do much over lockdown, but outdoor exercise was one of the few freedoms that were possible. Before the pandemic, I was subject to forced torture of the Saturday 5K Park Run at Greenham Common. Lockdown was no exception, and I often was dragged up there for 'fresh air and healthy exercise' because it is supposedly 'good for me' (I really don't think that aching muscles and a chronic stitch is good for me though). But having said that, Greenham Common has a very interesting history.

Before the 2nd World War, Greenham Common was a piece of common land. It was used as a military base for the RAF (Royal Air Force) and the USAAF (United States Army Air Forces) and during the cold war, it was used as an air base. It was redesigned in June 1951 and a new runway was built, over 10 000 ft. (3.48km) long runway that pointed east to west. During the Cold War, missiles were kept in the silos at Greenham and contributed to around 60% of the entire UK's nuclear missiles, which is rather concerning as I live quite close to Greenham.

In 1981, there was a protest against the government keeping cruise missiles in the bunkers at Greenham Common. It was a women's only protest that lasted a total of 19 years. The women set up camps outside of the bunkers and would often cut through the wire of the fence. I recently visited Greenham Common on a bike ride and cycled to the Greenham Peace Garden. It's a memorial that shows where the Greenham Common Women's Peace Camp was and shows where the old boundary of the airfield was. In September

1992, Greenham Common was given back to the RAF and, shortly after, closed and no longer used as a military base. It has since been renovated back into a common for the public to enjoy.

The Common has since been used for lots of things, including a public common for walking, biking and running. The old military bases used in the 20th century have been made into new buildings for smaller companies, with most of the hangars converted into storage facilities, some used for the English Provence Company, who make pickles and chutneys. The old control tower is now a cafe.

In early 1958, a bomber plane took off from Greenham Common, developed problems and dumped its fuel tanks onto the airfield below. They missed the safe zone and struck a hangar and a nearby plane, which had a 1.1 megaton nuclear warhead on it. The parked plane went up in flames and the blaze took over 16 hours to extinguish. It was rumored that the nuclear bomb exploded, throwing bits of its radioactive core across the airfield, but an investigation found no traces of uranium or plutonium isotopes anywhere.

The Common has also been used multiple times for different TV series and films, including Top Gear, in series 12, episode 6, if you want to watch it, where Jeremy Clarkson and Richard Hammond drove Eastern European cars around the airfield, Fast and Furious 9 (or what we can see in the trailer, at 2:12 until 2:26 on youtube), and most famously in Star Wars: The Force Awakens and Star Wars: The Last Jedi, where the old missile silos were featured as a large part of a Resistance base. It was also used as a backdrop to one of Beyoncé's music videos. She reportedly had

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the bunker swept for radiation signs to ensure that it was completely safe before filming.

So, for a disused, destroyed military base, Greenham Common has some surprising history and uses. From war bunkers to movie sets, missile silos to a space for the public, Greenham Common has changed a lot since its construction in 1942 and is a great experience for everyone to enjoy.

## Miseno: A Brief History by Archie Leishman



Since Covid we have all been stuck at home, unable to go anywhere or visit anything. Instead we have been dreaming about the places which we would like to visit when Covid travel restrictions are lifted. Most people have been yearning for beaches or ski slopes but I would love to have the opportunity to visit Miseno, Italy, a place that is not frequently found on people's bucket lists.

Miseno is located on the north part of the Gulf of Naples and is probably most famous for being the site of an ancient Roman naval station. In 31 BC Agrippa, Augustus' right hand man, converted the natural harbour into the main naval station of the Mediterranean fleet. The fleet housed there was called the Classis Misenensis, the most prized fleet in the Roman navy. It is most famous for being the fleet that Pliny the Elder was the commander of when he died whilst attempting to rescue those fleeing the eruption of Vesuvius in AD 79.

However in my opinion Miseno has had a far more significant impact on world history even before Aggripa converted it into the main naval station of the Roman Empire.



It was there in 39 BC that the pact of Misenum was 'signed' (more likely verbally agreed) between Sextus Pompeius, the son of Pompey the great, and two of the Triumvirs, Mark Antony and Octavian.

At that time Antony and Octavian had just returned victorious from the battles of Philippi against Marcus Brutus and Gaius Cassius. Octavian had returned to Italy but owed the soldiers who had fought for him vast sums of money. With the Roman treasury empty, in order to raise the sums required, Octavian decided to confiscate land from farmers and give this land to the retiring veteran soldiers. The problem with this is that he displaced huge numbers of poor people and caused the country to rely on inexperienced farmers for their source of food. Soldiers who were expecting a relaxing retirement and knew nothing about farming unsurprisingly didn't make great farmers; resulting in huge grain shortages and famine. This hit the poor the worst and so the displaced farmers started to lay siege to small cities in southern Italy in order to access the grain stores. While Octavian was worrying about that crisis, Sextus had taken control over Sicily and Sardinia and had decided to blockade Italy which exacerbated the famine. In order to try and remedy the

situation and improve his public image with the starving populous Octavian finally decided to deal with Sextus. Octavian sent a series of fleets resulting in a series of skirmishes however Sextus prevailed and tightened his grip on the region.

The meeting depended on the fact that each party wanted to achieve something that required a peace agreement. The pact of Misenum was a bid by Octavian to gain more time to prepare a better fleet to deal with Sextus and also bring an end to the blockade and famine, in order to release strain on Rome. Sextus wanted to meet as he intended to replace Lepidus as the third member of the triumvirate, but this was never agreed. Antony needed Sextus to remove the blockade and for there to be peace in the western half of the Roman Empire as he needed more soldiers from Octavian for his planned conquest of the Parthians. Thus in 39 BC they met to reach an agreement.

It is claimed by some, including Cassius Dio who was a Roman consul and historian two centuries later, that Sextus refused to meet on land as he wanted to avoid the same fate that befell his father Pompey, who had been assassinated in Egypt when he landed to negotiate with the Egyptians. Instead they met on individual mounds constructed in the sea, which meant that Sextus was in sight of his fleet and an ambush was near impossible. They agreed that Sextus, in return for stopping the blockade and supplying grain, would be allowed to maintain his control over Sicily, Sardinia and Corsica, as well as giving him control over the province of Greece and a promised consulship in 35 BC. Proscription, where the Triumvirs would support the murder of their political enemies, was ended, likely at

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Sextus's request as many of these enemies were Pompeians, the supporters of Sextus' father.

Peace however was short-lived. Octavian and Sextus both accused each other of violating the agreement which resulted in another battle, this time at Messina, Sicily in 37 BC where Octavian was again defeated. He then enlisted the help of his close friend Marcus Agrippa and also Titus Taurus who were both formidable generals. That winter Marcus Agrippa both trained and built a new fleet in Lake Avernus which is just inland from Misenum. Agrippa and Sextus clashed at the battle of Mylae and then again a month later at the battle of Naulochus where Agrippa destroyed the remainder of Sextus' fleet. At the same time Lepidus, the Triumvir who Sextus had intended to replace, managed to raise 14 legions from his African provinces and was invading Sicily with Taurus.

In my opinion these victories, which would not have occurred without the time Octavian gained from the pact of Misenum, were crucial to Octavian stabilising his power base and improving the public image of the Triumvirs. If the pact hadn't improved public opinion of Octavian and allowed him to raise a new fleet to defeat Sextus, I believe that it is likely that there would have been an uprising against Octavian and the Triumvirs. Therefore Miseno was globally significant long before it became the primary naval station of Rome's Mediterranean fleet as without the pact of Misenum Octavian may never have been the first Emperor of Rome and thus history would have played out very differently.

If I ever do manage to visit Miseno, it will be amazing to stand in the centre of such an

unassuming yet globally significant place, where such a key part of its history occurred. It's amazing to think there is no spectacular monument to mark its historical significance.



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## The Churchill War Rooms by Monty Bowles



### *History*

The war rooms are the underground housing where the British government directed World War 2. They were known as the cabinet war rooms. Following World War 1, military strategists feared that there could be up to 200,000 casualties from bombing raids within the first week of a future war. This led to plans to evacuate the prime minister, the cabinet and essential staff being created as early as the 1920's should another war break out, however there was also the belief that the citizens of London would feel abandoned if the Prime minister was to leave London to a safe place. The speed an evacuation could occur was unknown, so they created the emergency bunkers underneath London, the cabinet war rooms. Despite being layered with 3 metre thick concrete above the rooms, a direct hit from a bomb heavier than 227KG could penetrate the building and destroy the war rooms, meaning the most important defence was secrecy.

Finally in June 1938, the new public offices were, as they were near parliament, fitted with

a strong steel frame and a large bunker. The basement was adapted to provide a meeting place for ministers, the Prime minister and king George VI. It also housed the map room, which is where information was collected. 27th August 1939, the war rooms finally became fully functional, just one week before Britain declared war with Germany. In total, Churchill's war cabinet met here 115 times, and were open 24/7 for 6 years, until finally the lights were turned off in the map room for the first time in 6 years. Finally, in 1984, the rooms opened again for visits, and in 2005 the Winston Churchill museums were opened.

### *The Map Room*



The map room was one room that remained the same all through the war. A week before the war broke out, handpicked officers entered the map room, turned the lights on for the only time in 6 years, and familiarised themselves with the components in the room. During each shift, five men sat on the long desk in the middle of the room, an officer from the army, navy and airforce, as well as an official from the ministry of home of security and then a fifth man from each of the different services in turn, acting as the duty officer. Their job was to gather intelligence on the situation in every

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aspect of the war. Most of this information was collected by the central, colour coded telephones. White phones connected to the war rooms for the 3 armed services, green to the intelligence services and black to the outside world via a private telephone exchange.

Now, the map is almost exactly as it was left at the end of the war, reflecting the occupied lands of the allies in the final days of the war. You can see the progress of Britain and America in the far East and the Pacific. Thousands of tiny holes have been left behind, where the pins have been placed, and taken down, illustrating the routes of the convoys that relayed information of the Germany and Italian submarines.

### *The Churchill Suite*

In early 1941, to allow easy access to the war rooms, they were expanded to fit a bedroom for Churchill's wife Clementine, a kitchen and dining room of the couple's private use, office bedrooms for the prime minister's private staff and a reserve meeting room for the chiefs of staff. However, these rooms were rarely used as they only became available after the heaviest bombing raids of the Blitz came to an end. After the war, this section of the cabinet war rooms were stripped and fell into ruin. They were used as office stores, and one was even turned into a gym. They were still being used in this way long after they opened the war rooms to public visit, and finally in 2001 they were available for restoration, due to a series of detailed photographs that had been taken of the rooms just after the end of the war.

### *Main Corridor*

The steps down to the dock sit at one end along the corridor, which in wartime linked many of the underground rooms. Staff recall Churchill prowling along the passage in the evening, cigar in hand. Back then the corridor would not have been as empty as it is nowadays, with its widest sections housing typists squeezed up against little desks, and close to the map room you would have had to stay clear of administrative staff fetching maps from their storage chests. Girders and buttresses along the corridor portrayed the fear of bombings, the girders to support the ceiling and the latter to limit the damage done by the blast waves.



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## The UK Space Agency by Sam Corbett



Even though many haven't heard of it, the UK has a space agency, however it is different to the common ones that you hear about such as NASA, the ESA, and JAXA. Even though it has been inactive, it has still made some steps forward in bringing space within reach of an everyday person.

The exact beginning of what could be considered a UK space agency was officially in 1985 as the British National Space Centre, however there was significant interest in the benefits and abilities of space travel prior to this, however this was mostly concerning the military ability of space and was run by the Ministry of Defense. As with other nations, much of their original knowledge was gained from German scientists after world war II when they were persuaded to work for the British. Further even though many countries focused on Human spaceflight, the British government had a policy against it, this means that to this day only one person, Tim Peake, has gone to space funded by the British government. However, the selection of Tim Peake as an astronaut had a fortunate effect on government thoughts about space, and the exploration of space. In 2010 this led to the incorporation of an official UK Space Agency (UKSA). However you can tell really how little they do by just searching up their acronym, you get a sailing academy before the space

agency turns up. After Brexit the UK government has been increasing pressure on lowering contributions to the ESA, which has slowly been happening, however maybe not with the desired consequences.



The UK space agency hasn't done much. Their purchase of Oneweb is the most influential thing that they have done in the past 5 years. They have had lots of plans, however most have fallen through due to budgetary constraints. Frequently it seems to be attempting to imitate the satellite quantity of NASA, an entity with a budget approximately 50 times the size of that of the UKSA. One case of this happening is after the government announced that ties would be dropped with the ESA's Old Galileo navigation system. The plan for replacing it was the United Kingdom Global Navigation Satellite System, the price of which was estimated at around £5 billion. However, of course, it would take over 10 years of complete inactivity for the UKSA to save up this much money on their current budget, so

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the project was dropped. This has led to a lack of satellite navigation globally for certain military purposes, and has meant that there is an even greater dependency on gps. Originally it was believed that the government had bought Oneweb in order to patch this gap, however information has later arisen that they had previously been told that it was not suitable for this purpose.

Even though some launch providers are based in the UK, most notably Orbex and Skyrora, many others are moving to the more funding rich US, where NASA is willing to spend lots of money on them. These include Virgin Orbit, a small sat and space plane launch provider. As Boris Johnson has said, space and orbital capability is incredibly important in the future of the UK, however companies are needing to leave due to the lack of funding that you can get from the UKSA. The UK really needs companies that are thinking of creating space planes, or just flying launches. This is because for most launches there is a need to launch going east, because this gives a greater boost due to the existing rotation of the planet. Traditional rockets can't launch over land due to the risk of things going wrong and parts falling down on countries below. This means that there is a need for investment in these technologies to stop our growing space industry from being stunted by the need for sun synchronous orbits, the only useful kind that the UK is correctly positioned for.

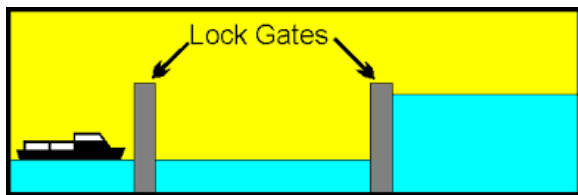
I think that even though the UKSA has not been the most influential space agency in the past it can grow into an important part of the future of the country. However this will only happen if it is given the correct funding and not put under too much pressure to do what the government wants.

## The Importance of Canals by Takumi Parker



The very first canal was built in 4000BC, in modern-day Iran and Iraq, and to this day canals still have great importance. The most famous being the Panama and Suez canals which both connect the east and west in their respective areas. However, do these canals actually have an impact on modern society and if so how greatly?

Canals, in this case, are artificial waterways built to service water transport vehicles inland. For example, the Suez Canal allows ships to cross from the Mediterranean Sea to the Red Sea and into the Indian Ocean. This significantly reduces operation times and costs for ships wishing to travel between Asia and Europe. Canals are also used in cities for general transport, most notably in Venice, and irrigation. I will be looking into the Suez and Panama canal, the two most valuable canals in the world.



Canals work in a relatively simple way, they are essentially rivers with slight modifications. A canal is an artificial waterway made between two water sources, however differing water levels between the water sources cause a problem. To solve this issue, structures called locks are built along the canal. A lock is comprised of two dam-like structures and a valve system underneath it. A lock works by changing the water level in a section of the canal so that a ship can change the water level it is on. In between the two dams is a section of water that can change its water level using a valve system. A ship can move past one dam, into the middle, change its water level and carry on past the second dam where the water level is higher or lower. This clever system allows canals to go up and down hills, thus allowing ships to travel whatever the water level.

The Suez Canal was built in 1869 between the Mediterranean and Red Sea with a length of nearly 200km. Every year, the canal sees around 1.2 billion tonnes of cargo pass through it representing around 13% of the entire world's trade. This gateway between Asia and Europe is undoubtedly one of the most influential canals on world trade. Travelling all the way round the bottom of Africa from Asia takes an extra nine days than passing through the canal. In addition, it is estimated that carbon emissions have been reduced by 44% due to the reduced operation time. Another alternative to the canal would be offloading the goods and carrying them overland

between the Mediterranean and Red Sea. This will increase operation cost so is not a very appealing option. These alternatives clearly show that the Suez canal is extremely beneficial to world trade.

However, there is an alternative that is in some cases quicker than through the Suez canal. Due to global warming, the Arctic sea ice has been shrinking, allowing ships to pass without needing an icebreaker. This northern sea route is much shorter than the route through the Suez canal and has the potential of reducing operation times by 8 days for some journeys. However, this route is only an option for the summer, and so when global trade is very high (around Christmas) the route can't be used which is a major limitation.



The Panama Canal is located in Panama, which is in Central America, and stretches for 82km connecting the Atlantic to the Pacific Ocean. The Panama canal allows 235 million tonnes of cargo through every year, only around a fifth of what the Suez canal allows, but is still as important. The Panama Canal, after it was built in 1914, permitted ships to go between the Pacific and Atlantic waters quicker than ever before. Instead of sailing around Cape Horn, the southernmost tip of South America, travelling through Panama removed around 13,000km from the journey between the two

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oceans. Just with one canal, several routes had around 15 days of travel eliminated. This canal revolutionised trade for the west and especially for the United States who were able to trade between the East and West coasts.

The Suez and Panama canal are two strategic canals both with the aim of making sea transport easier, which they succeed in doing. With 90% of all products transported by ship, there is no doubt that canals play a key role in allowing ships to travel efficiently. The Suez canal is vital for trade between Europe and Asia while the Panama canal connects America with Europe. These two canals alone not only connected the world together, but have changed the economy and environment of the modern world.

## **Six Days When Global Trade Ran Aground** by Rupert Mathieson

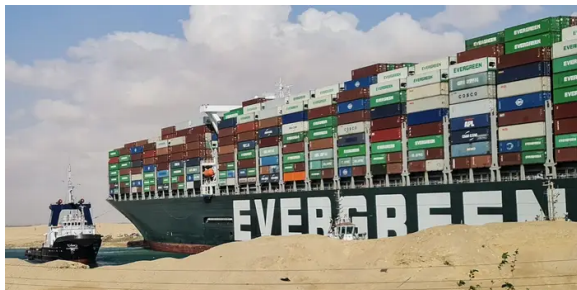


From the 23rd to the 29th of March, the global tap of world trade was turned off as the Suez canal was blocked by a 400m long ship Ever Given. Weighing 220,000 tons, Ever Given is one of the largest ships of its kind. Its extreme size caused the ancient canal to grind to a halt. According to the Suez Canal Authority, the canal has been shut four times prior to this year. Understandably a closure on this scale will have a high level of impact that echoes around the world. Although most people will understand what the Suez canal is, few will actually realise the profound impacts of its closure, over a relatively short six day period we have just experienced, to a potentially longer closure in the future.

It is very clear and obvious that the Suez canal is extremely important. A key example of this is that in 2020 12% of the world's trade (by volume) went through the canal and 10% of the world's oil went through it. A key reason why this happened is that it connects the predominantly manufacturing countries to the consumer countries. As the population rises over the next few years and decades, passages



such as the Suez canal will become increasingly important as they increase global-interconnectivity. Another reason why the Suez canal is so useful is that it is much cheaper than the other realistic option. It has been known for a long time that shipping is the cheapest and, in most cases, the most environmentally friendly to do the job that it needs to do. Shipping allows items to be carried in bulk long distances at a relatively low cost. This also fits the production style that we live in today. This is 'just in time manufacturing'. In this style of manufacturing, factories are supplying just enough at just the right time to be able to keep the market going. However, this does mean that at any slight delay, such as the closure of the Suez canal, there is very little stock for companies to fall back on.



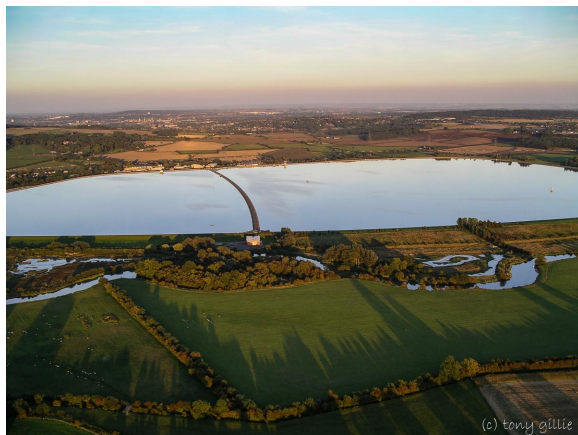
For six days in 2021, the Suez canal was blocked by the ship Ever Given. This blockage caused an estimated \$8 billion loss in trade per day (BBC) as well as causing damage to the canal. The distance for a ship to go through the canal to Rotterdam is 25.5 days<sup>(1)</sup> whilst to go round the Cape of Good Hope takes 34 days<sup>(1)</sup>. Even though the canal has been closed before, these closures are predicted to get more frequent as ship sizes are increasing due to the increase in demand but the ports, canals etc.. These key places in the manufacturing and supply web are working at as close to maximum speed as possible. This is similar to

planes, as airports are running at maximum so the only way to transport more people (in parallel the ships are transporting goods) is to make the planes (or ships) larger. As well as affecting world trade, the blockage of the Suez canal also leads to a large decrease to the local economy. Last year the Suez Canal Company had a revenue of approximately \$5.6 bn (over \$15.3 million per day) last year. This understandably decreases every moment the canal is blocked. At peak blockage time there were over 160 ships waiting on either side of the canal to get through (according to tracking data from Lloyd's List). As well as effecting large companies, states and co-operations, this blockage has a profound effect on many businesses and consumers in the UK. Items such as perishable foods can be delayed, causing increased cost to companies if they cannot be sold and increased inconvenience to customers if the products they want are not available to buy.

The ways of global trade are fickle at the best of times, but with the combination of COVID-19 and the blocking of the Suez canal, it is even easier to appreciate how important it is. With even the basic makeup of the shipping trade changing continuously, the world is trying to adapt to suit the economical and environmental needs. The only way that we will be able to do this is through fully understanding what is going on around us. Only then we will be able to make change happen.

(1) - Based on an average speed of 16.43 knots (approx. 18.8 mph)

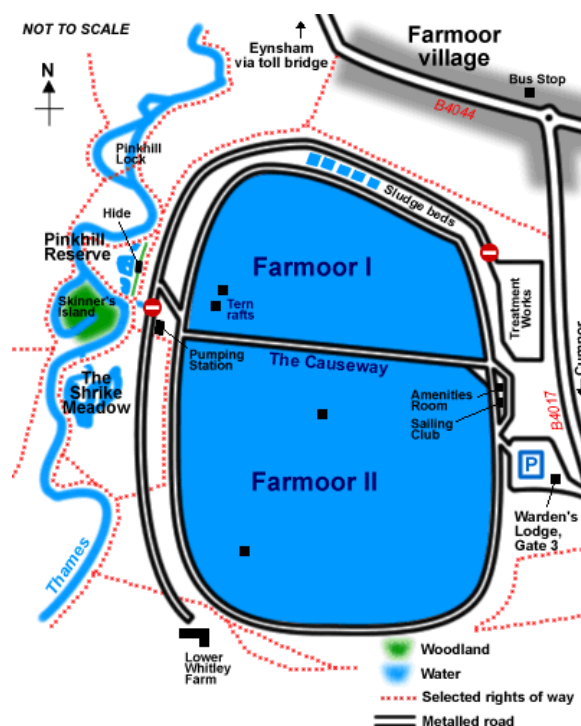
## On Farmoor Reservoir by Nikhil Tennant



During the holidays I visited Farmoor reservoir many times with various members of my family, in order to do a variety of different things, and previous to these holidays I have attended many water courses available, such as sailing. Some of these activities are photography, a countryside walk and all whilst admiring the various fishermen pulling in quite sizable trout from the lively ecosystem beneath the water. These repeated visits sparked my interest, so I decided to research Farmoor a little more.

The first information I found was that unlike many other reservoirs in the Oxfordshire area, the reservoir was not formed by damming a valley. In this case the banks were raised above the local ground level using material excavated from within the bowl of the reservoir. This is formed by damming a valley. In this case the banks were raised above the local ground level using material excavated from within the bowl of the reservoir. This explained the almost reflective symmetry but then I began to wonder how such a developed ecosystem, home to fishable trout, could come of an

entirely man-made reservoir. I found that because of the reservoir's rich underwater plant matter, and large area, it was chosen to have brown trout but also the rare blue and rainbow trout introduced, which is highly valued by seasonal fishermen not only due to the fact that it has prime meat, but also because the sport and experience is better. To catch one of these elusive fish is harder, because they are quicker, and stay further away from the bank, which all adds to the fun. In the words of a local fisherman there, 'They swim faster and jump a lot more than the normal rainbow trout and are very exciting to catch. They're also very pretty and look like a streak of aquamarine swimming.' Clearly the repopulation of these rare fish is beneficial to the subspecies as a whole, yet also adds to the fishing experience.



The other main wildlife found in Farmoor is the birds. There are many types of birds that live around this area, some being: the

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Black-headed gull, Eurasian coot, Great cormorant, Greylag goose, Mute swans, Tufted duck, White wagtails, and Mallards. Having done some research, I found that Farmoor was voted the country's best industrial and commercial site for birds in the British Trust for Ornithology's Business Bird Challenge competition. A strong reason for why Farmoor was given such an award was the fact that a total of 155 different species were found at the reservoir. In the words of Matt Prior, Thames Water's access and recreation coordinator for the Thames Valley, 'Farmoor itself is fantastic because it's such a large, open stretch of water and it acts as a magnet for birds. We have done a lot of work in helping birds on the reserve, such as creating shallow lakes, and we have also got two nature areas called Shrike Meadow and Pink Hill.' He also added: 'We have also put in place some public bird-watching hides so members of the public can see these nature reserves we have created and record a far greater variety of birds.' As can be seen by these comments, the birdwatching community clearly show great interest in the wildlife surrounding this inland haven.

The reservoir was constructed in 1976, and is filled by purified water from the Thames, hence the treatment facilities nearby. The whole process including the lake, the raised grounds and the nearby treating facilities cost a considerable sum of £32m in modern day value. This seems like an extensive sum of money to spend on a sole reservoir, but to put it in context, the 2021/22 the council has set an overall gross budget of £856.2m to spend. A project like Farmoor reservoir has benefitted many people in the 45 years it has been around and is unarguably a worthwhile investment.

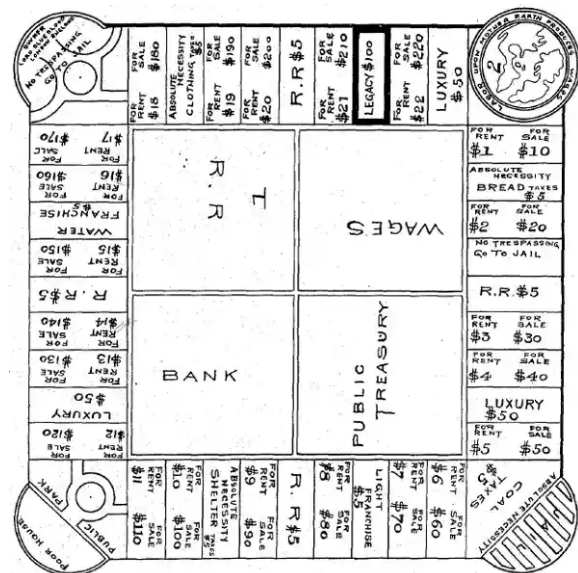
## **Monopoly and its Georgist Roots** by Torsten Ayerst

Monopoly is one of the most popular and successful games of all time. A truly iconic, multi-generational game enjoyed by young and old alike. It is published in 47 different languages and sold in 114 countries. In all there are 1144 versions of the game which include The Simpsons, The Godfather, The Olympics and multiple city specific versions. McDonalds has run frequent global marketing campaigns centred on the game which is set to return this summer. Monopoly causes frequent, heated arguments and turning the board over mid game is not uncommon. The shortest game lasted 21 seconds and the longest 70 days. The game is often seen as a demonstration of the strength of Capitalism, but its origins are much more left wing in nature and the true identity of the original creator has only in recent years been given full credit for inventing the game that can make or break many a Christmas party.

Historically the games company Parker Brothers gave all the credit for the creation of 'Monopoly' to Charles Darrow who made millions from the game and lived off the royalties his entire life. In fact, he had been introduced to the game by some friends, Charles and Olive Todd, in 1932. The game they played was a version of 'The Landlord's Game' which had been invented nearly 30 years earlier in 1903 by a progressive and deeply politically driven woman named Elizabeth Magie. The true origins of the game and its political message was lost for decades as the Charles Darrow story was a compulsive one to

In 1903, Elizabeth J. Magie, an American game designer, writer and political activist living in Washington D.C had created and patented a game called 'The Landlord's Game' to teach people about land ownership and the risks that accompanied it. To Magie the problems of the new 20th Century were so vast, and inequalities so massive and monopolists had so much power she wanted to get her message across and thought a board game a good device to do so. In her words the game, 'is a practical demonstration of the present system of land-grabbing with its usual outcomes and consequences' going on to say, 'It might well have been called the 'Game of Life' as it contains all the elements of success and failure in the real world, and the object is the same as the human race in general seem(s) to have, i.e., the accumulation of wealth.' In fact, originally, she created two sets of rules, an anti-monopolist set in which all would benefit when wealth was created, and a monopolist set in which the aim was to create monopolies and crush opponents. Unfortunately for her, the latter caught on with people.

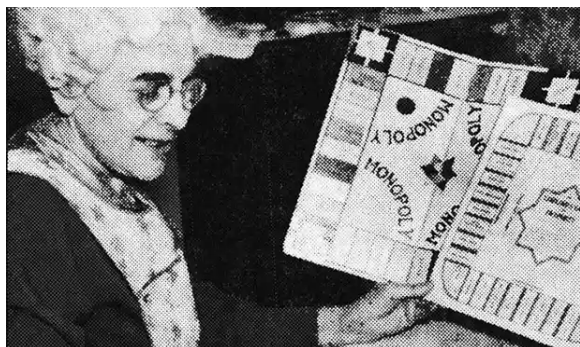
labour. His thoughts were outlined in his book 'Progress and Poverty' published in 1879. The concepts had their roots in early thinkers such as John Locke and Thomas Paine. Indeed, economists such as Adam Smith also argued that a tax on land value does not cause economic inefficiency unlike other taxes. Lizzie Magie was a staunch Georgist, and she developed the original game to publicise and try and spread the word about what she saw as the inequalities and unfairness of the capitalist system. Her game became popular with left-wing intellectuals and on college campuses. Its popularity grew over the next three decades. It caught on with a community of Quakers in Atlantic City who customised it with the names of their neighbourhood and this is how Darrow was introduced to the game and subsequently re-wrote its history.



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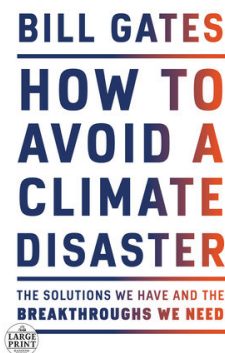
Lizzie Magie in some ways became a victim of the forces and negative aspects of modern 20th Century life on the individual that her creation was trying to highlight. When the game started to really take off in the 1930's a representative from Parker games visited Lizzie and bought the rights to Lizzies games for \$500 and no royalties. Charles Darrow was rewarded with millions of dollars after his game's night at his friends the Todd's. Magie is thought to have spent more on lawyers than she was paid by Parker Games. It's also true to say that her Anti-Monopoly version of the game might make Christmas get-togethers less fractious, but it would be far less fun. At least now we know the true roots of the game and it's real message.



Lizzie Magie in 1936 – 33 years after creating The Landlord's Game.

## BOOK REVIEWS

### How To Avoid A Climate Disaster - Bill Gates by Oliver Matthews



Recently, Bill Gates published a book on one of the most important and pivotal crises. Climate Change. The book is called 'How To Avoid A Climate Disaster' and in this book, he portrays the solutions we have and the breakthroughs we need. Reading this opened my eyes to the situation we have at hand, and since reading it, my carbon footprint has dramatically slowed down its speed of increase. I believe that everyone must read this book, and as humans have caused these chains of events, we are responsible for reversing the trend and its effects.

I believe the phrase 'Climate Change' is used in the wrong situations. It is often misunderstood and muddled with another term 'Global Warming'. Climate change is a long-term change in the average weather patterns that have come to define Earth's local, regional and global climates. However, global warming is the unusually rapid increase in Earth's average surface temperature over the past century

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primarily due to the greenhouse gases released as people burn fossil fuels. So, in a few words, global warming is a factor in climate change.

In Chapter One of this book, Gates often refers to two numbers and he opens this page-turner with the lines ‘There are two numbers you need to know about climate change. The first is 51 billion. The other is zero.’ Why are these two numbers so important to the way we must change our patterns of life? Fifty-one billion is how many tons of greenhouse gases (GHG) the world typically adds to the Earth’s atmosphere per annum. Although this figure isn’t exact from year to year, it’s generally increasing. The importance is that this is where we are today. What we must strive for is to get to zero. To stop global warming and calm down the radical climate changes, humans will need to stop adding GHG to the atmosphere. This chapter was the sucker punch in the book; knowing that we have to do something and being told this by a figure as important and pioneering as Bill Gates can really be a game-changer for a lot of people.

Much later in his book, Gates explains his version of a plan to get to zero in Chapter Eleven. Science tells us that in order to avoid a climate catastrophe, highly economically developed countries (HEDCs) should reach net-zero emissions by 2050. This is one of the few reasonable propositions. Of a list of 22 different schemes Gates describes, the most important way is that ‘We have to lower the Green Premiums’. I wouldn’t be surprised if you didn’t know what this was, but as I read the book, I researched this as I wasn’t very sure myself. The Green Premium is simply the extra cost put on items which would be less of a detriment to the environment. For instance, if you were to run an airplane on jet fuel, you

would have to pay about \$2.22 per gallon. In contrast, if you were to buy clean biofuels instead, you would pay about \$5.35 a gallon. This is the only way to make it easier for middle and low income countries to reduce emissions and eventually get to that important number zero.

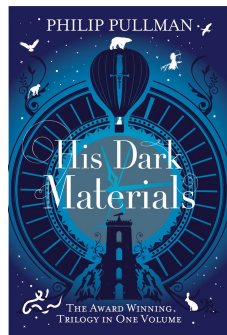
In the final chapter, Gates concludes with a title of ‘What Each of Us Can Do’. The most important phrase of text I took from this chapter was the opening paragraph. He wrote ‘It’s easy to feel powerless in the face of a problem as big as climate change. But you’re not powerless. And you don’t have to be a politician or a philanthropist to make a difference. You have influence as a citizen, a consumer, and an employee or employer’. Throughout this chapter, Gates describes the ways in which everyone can help with the climate emergency on our hands. Although, I can’t cover all of the different ways we can help in this short essay, reading this book can dramatically change the way we live and for the better. Although Bill Gates didn’t express this as a method to reduce climate change, I acquired some knowledge after researching the subject. One of the main contributors to climate change is food waste. When we waste food, we also waste all the energy and water it takes for it to grow, harvest, transport, and package it. And if food goes to the landfill and rots, it produces methane - a greenhouse gas even more potent than carbon dioxide.

To conclude, I recommend this book as a must-read for everyone, whether you’re interested in the subject or not, this book may be pivotal to the way we live in the future, and the way we conduct ourselves for eternity.

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## His Dark Materials - Philip Pullman

by Oliver Veal



Philip Pullman is considered by many to be one of the greatest fantasy authors of all time, not only due to the nature of his books being like our wildest fantasies, but also due to the realism of the characters, and the great portrayal of their emotions. The Telegraph said, “For sheer inventiveness, he has no equal”. Arguably his most famous series, “His Dark Materials”, really shows his skill off, and the storytelling is remarkable. It has even been made into a very successful TV series now, which I have also watched, and does the books great justice. His Dark Materials was an astonishing piece of work, which left me breathless by the end, and wanting more.

There were many things that I really enjoyed about this book. First of all, the progression of Lyra’s character was something to behold, and done so well and subtly over the course of the book, you could really see her confidence and braveness shining through by the end of the series. She started off as a little girl, with not a worry in the world. She lived in Jordan College, a fictional college based on Exeter College, Oxford (where Pullman was an undergraduate) in an Oxford of a parallel world. She and her friend Roger would explore around the city and

the college, getting in trouble many times along the way. She seemed arrogant and confident for most of the start of the book. But then, when Roger got kidnapped, you could really see how out of her depth she was in this new and scary situation. She was frightened, she didn’t know what to do. She was helpless. But as the series and her journey progressed, Lyra became more sure of who she was and found out a lot more about her past as well. By the end, she had turned from a small child who knew little about the outside world, into a young woman who probably knew more about the world(s) than anyone else. This change from childhood to adulthood was one of the key ideas in the series.

Another thing I really liked about the series was the setting of it. The books were set in a world where religion was still prominent, and ‘The Church’ was controlling, wealthy and corrupt. It was everywhere. People in the series were always very careful about what they said in front of the church, and people were severely punished for heresy. The Church, and the way it worked, reminded me greatly not only of 1984 by George Orwell, where Big Brother and Thought Crime oppressed Winston’s society, but also of late-medieval / 16th century England. Back in those times, people were often punished for heresy, or even just for practising the ‘wrong’ religion. The way that Pullman has combined our modern-day world (more or less) with something that occurred quite long ago according to us really makes Lyra’s world familiar, but also alien at the same time.

The final thing that I really liked about His Dark Materials, is the concept of Dust. Dust - also known as Dark Matter - is a key part of the storyline of the series and comes up so many

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times throughout. However, it's not Dust itself that was the most interesting to me, but the debate and constant tension behind it. All throughout the series, Scientists and Churchmen alike wanted to know what Dust was. However, the people of the Church claimed they already knew what it was; original sin. Therefore it was a very awkward topic of discussion, and people researching it had to be exceptionally careful not to get caught by the Church, otherwise they would have to pay the price. Dust was only one example of the tensions between Science and the Church. In our world, the choice between believing in science, or religion, or in some cases both, is widely accepted. But not in Lyra's world, where the Church is very controlling. The reason the Church hated science so much, is because if people saw that the Church wasn't always right, the Church's power over the population would diminish. This is why many of Lyra's problems occur. Lyra commits 'heresy' almost every time she breathes, in the opinion of the Church. Lyra's destiny is well known by the Church, so they try to stop her as much as they can, and by the end, they want to kill her.

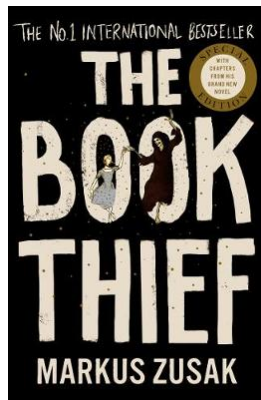
The one thing that I didn't particularly like about the series was at times, Pullman was too subtle, to the point where it became confusing. The whole book was about how Lyra was part of a prophecy. "Her destiny would end all destiny". The prophecy states that Lyra would have to make a choice, similar to Eve, Mother of all. It said that her choice could save or raise all of humanity, and all life in all worlds. However, even after all of the build-up, I finished the book and didn't know what 'the choice' was. I thought it was going to be a lot more obvious what the choice was going to be, but it was very anticlimactic. I looked it up after

reading the final book of the series, and it turns out that she made the choice way after the peak of tension in the book. At that point I thought it was just Pullman wrapping up a few loose ends, and not the part that the whole series was leading up to!

Overall, I think that His Dark Materials was a fantastic series, and is definitely worth reading (if you haven't already). With the combination of the clear, accurate, and inspiring progression of Lyra's character throughout it, and also with the familiar feel of Oxford in a world seemingly belonging 400 years before, Pullman wrote a mind-blowing story that was one of the greatest pieces of literature that I have ever read. However, I think that I would have enjoyed it more if the build-up had led to something more clear. I feel he could have done lots more at the end, which I would have liked to read. However many other critics have praised Pullman's subtlety and believe that's what really makes the book a masterpiece.

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## The Book Thief - Markus Zusak by Felipe Bonchristiano



The Book Thief, written by Australian author Markus Zusak, is a revolutionary young-adult novel. Teenagers might at first be put off by the book's length and somber tone, but will quickly be absorbed by the intricately crafted words.

Readers are first introduced to this concept of Death itself as a narrator, but quickly realise that this is no grim reaper, but rather a gentler and sympathetic death. However, this book isn't just about the gentle Death, but much, much more.

Mainly, it's about a small girl called Liesel Meminger, who is left stranded in the world after her brother dies and her mother leaves her alone with her new foster parents in a dull town in Germany. Little is told about Liesel's father except that he was taken away for being a communist. Liesel's new family consists of Hans Hubermann, or as fondly referred to by Liesel, Papa, and her new foster mother, Rosa.

Hans is a saint like figure, perfect in the reader's eyes with his endless comforting of Liesel and kind actions. Rosa, on the other

hand, is practically the opposite to Hans, but is still rather generously loved by him. Rosa looked, as told by death "like a small wardrobe with a coat thrown over it. There was a distinct waddle to her walk. Almost cute, if it wasn't for her face." Her new mother often beat her with her memorable wooden spoon and called Liesel and even Hans some foul names. But, even after all of this, the reader can see that she still cares for Liesel and Hans.

As Liesel finds comfort in this strange town, she begins to be able to cope with her tragic losses, but she also becomes a troublemaker both in school and outside, fighting other students and stealing things. Her first theft, a handbook, "The Grave Digger's Handbook", marks a new beginning for Liesel. Since the girl can't read, her father begins to teach her at night and the books she steals become her salvation in her cruel world.

At this point many young readers may find the book going too slow for them. But this all changes very quickly when Max Vandenburg, an old Jewish boxer shows up at their doorstep. Max's appearance is definitely an unexpected one, and proves many challenges for the small family.

Max has abandoned his family in order to hide from the wrath of the Nazis and comes to Hans' house looking for refuge since he owed him an old favour. Max's tragedy is more complicated, since he has to live through the guilt and of leaving his own family, while Liesel's grief is a lot less complicated, since she must live with the choices of her now gone mother. Max must live with his own.

This piece of writing is a wonderfully balanced piece of work in many senses. Sometimes

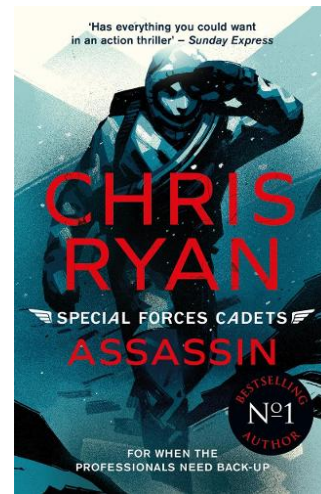


misleading in its delicate words, while sometimes too real. All types of German are spotlighted, truly committed Nazis to men completely against them, such as Hans Hubermann. Sadness is quite clearly an enormous part of this book, but it does a few moments of happiness and comfort.

Zusak has said that he was inspired to write the piece, very different from his previous ones, by two real events that involved both of his German parents. The first being the bombing of Munich and the second one of his parents witnessing a teenage boy offering bread to a thin Jew being marched through the streets, concluding with both involved being whipped.

This book is without a doubt one of the best books I've read in my life. Saddening, depressing, unsettling, thought-provoking, this is a novel of breathtaking quality, beautifully written. It is important and serious, while also extremely enthralling. I cannot recommend it enough.

## Assassin - Chris Ryan by Jack Veal



Chris Ryan is a very talented man. Not only did he achieve the longest escape and evasion by an SAS trooper during his time in the military, in a mission where 4 of his colleagues were killed and the other 3 captured by Iranians, but he has now gone on to be a worldwide bestselling author who has written over 70 novels of fiction and nonfiction. Arguably his most famous piece was “Strike Back”, which has been adapted into a highly acclaimed TV drama for Sky One. However, he has written some children’s fiction as well as this, including the brilliant Agent 21 series but the series I will be talking about today is the six novel long Special Forces’ Cadets series, which I have enjoyed a lot over the past year or so. In particular, I will be discussing the final book in the series, “Assassin”.

The whole series is based around the 5 teenagers that are used for espionage when adults may stand out, but children will blend in perfectly. But the main character is Max Johnson, who lost both his parents to Iranian terrorists/spies but never quite knew the full truth of their death. Under the supervision of

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one of his dad's closest colleagues, Hector, he is put into life-threatening positions time and time again, just like his parents. The books are short and sweet, due to the very fast paced nature of them that keep you gripped from the start to the end. My favourite thing about this book was the complex plot. The plots in the series were always gripping but this one just had something special, especially an unexpected twist right at the end of the book. The main storyline in this edition of the series is based around Darius, the son of an Iranian immigrant based in a very rich school in Zermatt, Switzerland. Darius is a very shy boy and he is in serious danger as the Iranian government wants him captured in order to blackmail his father, a nuclear specialist, back to his native country. However, under the guidance of the cadets, he is the centre of a day-night manhunt up and across the Alps. The whole plot is full of suspense and the reader is always tense throughout the long chase as the cadets and Darius attempt to escape from the team of assassins sent to hunt them down.

During the book, Chris Ryan does an excellent job of not only describing the scene but the characters' emotions and feelings as well. Although Max is the main character and his feelings are shown more explicitly, Ryan shows us the other cadets' feelings through speech or even very in depth descriptions of their body language. Being able to see the thought process of Max, as well as his fellow cadets gives us an insight into how highly trained army cadets think their way through tough times together. They have trained and trained and trained for the last 3 or 4 years and the chemistry that they have developed as a group really shows through as they guide Darius up the mountain, keeping him warm and hydrated

as night falls and the temperature drops even further. The cadets are not only fast but smart, even with emotions and fear running through their veins, as they use their skills that they have learned to fight through the cold with their new companion. The cadets are supervised by their watchers, whose emotions are also portrayed very well throughout the novel and you can clearly see the tight bond that they have formed with their younger counterparts. One man in this group is Alfie Grey, who becomes a very important character in the novel as he is working at the school in Zermatt and knows the surrounding areas very well. He also knew Max's parents very well and this is evident during the course of the story as he gets very close to Max. Alfie plays a big role from the start to the very end in the Alps of Switzerland.

Along with the great portrayal of emotion and the constant suspense, Chris Ryan creates an action-packed plot from the start to the very end of the novel, full of tension and twists. But, a different side to the novel was the survival knowledge that Ryan intertwined into the storyline. As I said earlier, he was part of the SAS for a long time and because of this, he was able to describe extremely clearly how the cadets tackled the different obstacles from the icy conditions. For example, Ryan explicitly told us how the cadets crossed a crevasse, dealt with hypothermia and even how they were able to climb a glacier. I enjoyed this part of the novel because of the information and extra detail in this regard whilst mixing it with the constant emotion and adrenaline that the kids faced. There were also some strong morals in this novel and the series in general. This was highlighted in the last book as the group moved through the mountains but weren't

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able to move with as much pace as they would have wanted as they were only as fast as their slowest member, which was Darius. Chris Ryan has an expert understanding of the military and this shone throughout the series.

Overall, I absolutely loved this book and the series in general. Through the clear conveyment of emotion, unforeseen plot twists and heart in the mouth drama, Chris Ryan has been able to create a truly remarkable series of novels, which I would definitely recommend to anyone who enjoys reading action books or spy thrillers.

## SCIENCE

### **An Introduction to Noetic Science** by Sammy Jarvis

*“The day science begins to study non-physical phenomena, it will make more progress in one decade than in all the previous centuries of its existence.” – Nikola Tesla*

In 1971, Edgar Mitchell became the sixth man to walk on the moon during the Apollo 14 mission. Travelling into space was a dream fulfilled, but it was the journey back that became one of the most transformative events of his life. As he peered towards the rotating Earth before him, Mitchell reported experiencing an unexpected “ecstasy of unity” that ancient mystics such as Plotinus have spoken about for millennia. As he looked down to Earth, he saw a single living breathing entity. Yet as beautiful as this planet was, it was filled with crippling issues like war, famine and countless other man-made problems. He recognised that these global issues stemmed from our inability to realise how interconnected we all are. Indeed, there is plenty of food and water for the Earth’s inhabitants, but portions of the world are starving. Similarly, social constructs such as national borders lead to numerous wars and millions of deaths. Mitchell assumed that if more people were to share the epiphany he had felt in space, these issues would naturally find solutions. When he returned to Earth, he consequently founded the Institute of Noetic



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Science (IONS) to address these problems and further explore the science of interconnection.

Noetic Science is a field of study that bridges the gap between science and spirituality, bringing scientific tools and techniques together with subjective inner knowing to study the nature of reality. Noetic Science values knowledge gained through scientific exploration and through direct experience to strengthen our overall understanding of reality. The discipline has been supported in the past by some of the greatest scientists, philosophers and artists, including Thomas Edison, Immanuel Kant, Jean-Paul Sartre and Leonardo da Vinci, who all revealed that noetic experiences had been central to their scientific and cultural breakthroughs.

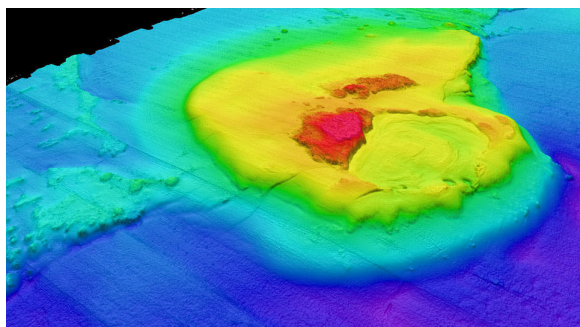
The subject gained its most media coverage after the terrorist attack on the World Trade Centre on September 11, 2001. In 1998, Roger Nelson, a researcher from Princeton University, developed the Global Consciousness Project in an endeavour to study the function of Noetics in our world. The project examined data retrieved by a Random Number Generator (RNG), choosing between the numbers zero and one. The data provided was then translated to a histogram where the number results were represented graphically. The frequency of zeros and ones presented a bell-shaped curve indicating an equal production of both numbers. Nelson chose to employ 65 RNGs located in 41 different countries in the Global Consciousness Project. For eight hours on September 11, 2001, beginning two hours before the attack, the generator began to produce results that did not follow the usual random pattern of zeros and ones. Before the World Trade Centre was hit, the bell-curve flattened, possibly indicating a

sense of premonition felt by the general population. The curve then rebounded and became very thin. When viewed through a noetic lens, this deviation in numbers chosen by the RNG may signify mass focus on a central concept. The change in appearance of the bell curve from one generator would not be noteworthy. However, on September 11, the fifteenth largest intercorrelation ever experienced by the Global Consciousness Project occurred between all 65 generators. The findings from September 11, 2001 imply that focused, concentrated thoughts may have the power to alter the physical environment. However, it is important to acknowledge that the data gathered on this date could represent a statistical coincidence or an incorrect analysis. For example, the similar performances of the RNGs could also be explained by an increased cell-phone usage on a day with major news events, and therefore increased electromagnetic interference.

Today, The Institute of Noetic Science examines noetic phenomena to gain a deeper understanding of the interconnected nature of reality. The way that we understand ourselves and our world is always changing. As such, Noetic Science is becoming an increasingly relevant framework we can use to engage with our daily reality. While the subject has only recently gained wider attention, lots of research has already taken place to transcend the limitations of our current worldview and help decipher the unexplainable.

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## Bathymetry by Rupert Matthews



Knowledge of the seas and oceans has been useful to humans for thousands of years. In diluvial times Noah used a dove to assess the water level. Since then methods for gauging water depth have greatly improved and we have moved on from birds.

Water covers more than 70% of the Earth's surface. The term Bathymetry is derived from the Greek word 'bathus', deep, meaning measurement of the deep. It is performed mostly from boats, which transmit soundwaves using either a single or multibeam echo sounder (SBES or MBES respectively) down to the seabed. An echo sounder emits sound waves and then measures the distance to the seabed via the echoes that are returned. SBES's can gather data quickly, but not much of it at a time. MBES's gather more data but at a slower rate: they are preferred generally, but not always used. Satellite radar can also dramatically assist Bathymetry, providing an accurate representation of the sea levels. This data can then be used to work out the topography of the underwater landscape. It is subsequently turned into a survey (map), and disruptions such as boats, fish and pontoons are edited out.

Measurements used to be taken by lowering weighted ropes, into the water until they touched the seabed: they would then record how much rope length was needed before reaching the bed. However, this was very laborious and inaccurate: after some time the surface could have greatly changed and the measurements would be useless. In the late 1930s sound waves were used for the first time for bathymetrical purposes, with SBES technology. It wasn't until the 1970s that the MBES system was used for the first time.

More experimental methods of measurement are now being put to use in the field of Bathymetry. In recent years, planes have been used to gather information about lakes and rivers, as they can easily fly to where they are needed on quite short notice. However, drones are now being used for the first time in some areas, allowing mapping to be done very easily.

One of the most important uses of Bathymetry is to provide accurate recordings for safe navigation in shallower areas, such as harbours and coastlines. It is also vital for submarines traversing the deep, allowing them to travel safely in the darkness. As we have seen recently, the Suez Canal is an example of a place where this is essential in order for it to function properly. Being only 24 metres deep and around 200 metres wide, the Canal can be extremely hard to steer through safely without the proper guidance. Bathymetry measurements help the pilots who steer the ships to navigate the Canal with relative ease for the most part.

Bathymetry can also be used to measure the rate of climate change, to some extent, providing information on changing water

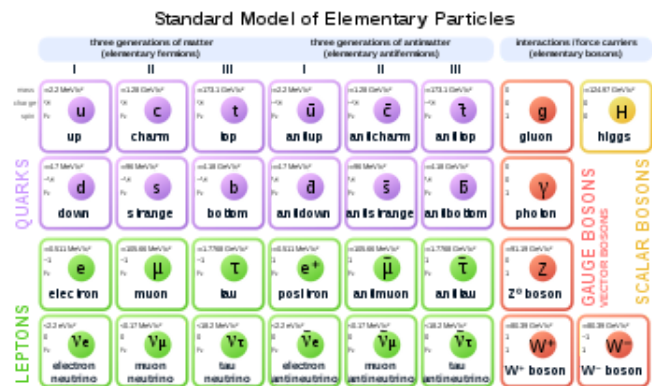
levels. This is useful both when examining the rate of polar ice caps melting and, in the case of lakes and other solitary bodies of water, how human activity is resulting in aridification. An example of this is the Aral Sea. What used to be a large sea between Kazakhstan and Uzbekistan is now almost completely dry due to cotton production. This is measurable with the use of satellites, enabling us to record its decline over time.

Data is recorded and stored by offices around the world. The UKHO (United Kingdom Hydrographic Office) does much of the surveying across the world. The USA's NOAA (National Oceanic and Atmospheric Administration) also maps many locations: they have more than 650 data sites that they map. The name evokes the aforementioned biblical figure.

Clearly extremely important to our lives, Bathymetry allows us to map the depths and thus steam across the sea in the knowledge we won't run aground. It has allowed us to do extraordinary things such as navigating the ocean floor and moving huge quantities of goods from place to place, greatly assisted by containerisation. We have been able to discover more about the undersea world, although we still have much to learn: currently we have mapped less than 20% of the world's oceans. It is also a vital information tool in our race against climate change.

## Could the Results of the Muon g-2 Experiment Defy Known Physics?

by Alex Mapplebeck



On April 7th 2021, physicists at Fermilab, Illinois announced the results of their first run of the Muon g-2 ( $g$  minus 2) experiment, an international collaboration between CERN, Fermilab, the Brookhaven National Laboratory and other organisations around the world. The purpose of this experiment is to measure the 'g factor' of spinning muons with high levels of precision to determine whether the results agree with current predictions. If the results showed any signs of deviation from predictions, it would show signs of the existence of a new, undiscovered subatomic particle, potentially challenging the Standard Model, which describes three of the four fundamental forces and is the backbone of particle physics.

The Standard Model is the theory in particle physics that describes three of the four known fundamental forces: electromagnetism, the weak interaction and the strong interaction and also classifies all known elementary

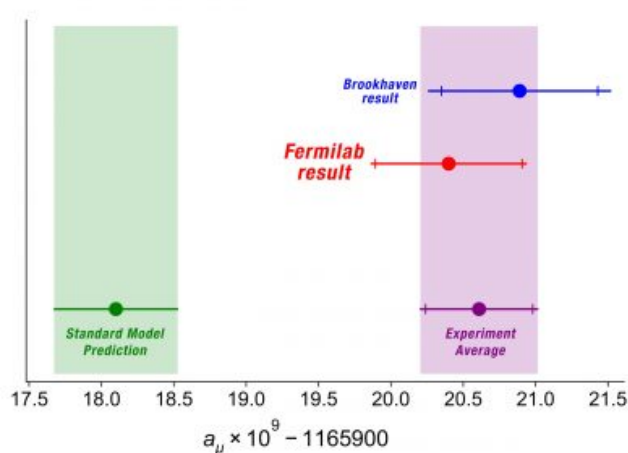
particles into four main categories: quarks, leptons, gauge bosons and scalar bosons as well as their respective antiparticles. Together, these particles make up all matter and antimatter in the universe and control the forces with which they interact. For example, when two up quarks and one down quark combine, they form a proton, and between these particles are gluons, which bind them together via the strong nuclear force. In the Muon g-2 experiment, the particles used were muons, which are often referred to as ‘cousins of electrons’ because they have the same charge of -1, but have a mass that is over 200 times larger than that of electrons. In fact, an atom of helium was created that contained two protons and two neutrons in its nucleus, but had one electron and one muon orbiting it. Because of the larger mass that the muon lends the atom, muonic helium could be known as helium 4.1, though this is more often used colloquially than scientifically.



Muons, like electrons, possess an spinning internal magnet; when exposed to an external magnetic field, the internal magnet precesses, or wobbles similar to the top of a spinning top. The ‘g-factor’ is a number that describes the strength of the internal magnet and the rate of precession and can be calculated with

extremely high precision. In the experiment, physicists used the same uniformly calibrated magnet used in the Brookhaven experiment a decade before, after transporting it from Long Island to Chicago, to make use of Fermilab’s particle accelerator, which produces the most intense beam of muons in America. In 2018, its first year of operation, Fermilab collected more data than all other g-factor experiments combined and has now analysed the motion of over 8 billion muons in its first run. As the muons circulate in the magnet, they interact with quantum foam, tiny fluctuations in spacetime due to particles appearing and disappearing in and out of existence. This could affect the muons’ g-factor, though the Standard Model allows for this by predicting the anomalous magnetic moment very precisely. The results from the experiment at Fermilab shows the g-factor to be  $2.002331834122(82)$ , compared to the predicted g-factor of  $2.00233183620(86)$ ; and the anomalous magnetic moment to be  $0.00116592061(41)$  compared to  $0.00116591810(43)$  from the Standard Model prediction. The results from this experiment show that the muon might be sensitive to quantum foam or another force that has yet to be discovered. However, the deviation of these results is not enough for the physicists to confirm a new discovery, however, because the combined results from the Brookhaven and Fermilab experiments show a standard deviation of  $4.2 \sigma$ , just shy of the  $5 \sigma$  needed, though this is still compelling evidence in the world of physics. The chance that the results are statistical fluctuations, fluctuations in quantities from many identical random processes, is 1 in 40,000.

The Fermilab experiment is still underway and all the data collected so far is only from the first run of the experiment. Analysis of the second and third runs is still continuing and the fourth run is being conducted, with a fifth run planned if necessary. The combined result will give a more precise result and may lead to more discoveries about what causes the deviation. So far, the Muon g-2 experiment has only analysed 6% of the data that it will collect in the years to come and much more will be learned about what causes the precession of muons.



## Vera Rubin and the Discovery of Dark Matter by Josh Price

Evidence for the existence of the ‘missing mass’, which has since become known as dark matter, first came to light through the meticulous and groundbreaking research of American astronomer Vera Rubin. She spent years, with her collaborator Kent Ford, painstakingly researching the behaviour of stars on the outer edge of galaxies, eventually concluding that there must be a large amount of invisible and undetectable matter holding much of the universe together. The thoroughness with which she went about her research meant that scientists were forced to rethink the entire composition of the universe.

In the late 1960s, Rubin was at the Kitt Peak National Observatory near Tucson, Arizona, in southwest America, where she was tracking the motion of the stars in Andromeda, the nearest major galaxy to the Milky Way.

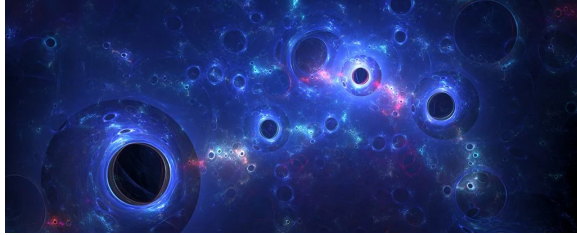
Newton’s laws of physics meant that stars closer to the dense centre of the galaxy should have been orbiting far more quickly than those at the edge of the galaxy, similarly to the planets in our solar system. Mercury, the closest planet to the sun and therefore the most influenced by the sun’s gravity, orbits at approximately 106,000 mph; Neptune, the furthest planet from the sun and less influenced by its gravity, orbits much slower, at around 12,000 mph.

So it came as a massive shock when, completely contrary to what they had expected, they observed that the stars at the



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edge of Andromeda were going the same speed as those towards the centre of the galaxy.



This led to a huge problem: the stars simply couldn't be moving that fast on their own.

At those speeds, the stars on the outer edge of the galaxy should have been flying off into space, the galaxy ripping itself apart. To explain why this wasn't happening, there had to be some other source of gravity holding the galaxy together; and according to the laws of physics, there had to be a source of mass for all that gravity.

This information suggested that there was an enormous amount of mass in the galaxy that just could not be seen by astronomers. Rubin concluded that there must be something else generating enough gravity to hold the galaxy together whilst propelling the outer stars at such speeds; we now know this as dark matter.

At this point, she had a few options. Option one, she could dismiss it; Rubin recalled being "afraid of making a dumb mistake," and thinking "that there's just some simple explanation." Option two, she could make a grand, sweeping conclusion based on limited data, and risk being potentially disregarded by the rest of the science community. Option three, she could collect more data to prove her findings. This was the option Rubin went for: she never assumed anything; she wanted to

find more data to support the evidence that she already had.

This is one of the reasons Rubin is so admired: she had the chance to amaze the scientific community, but she waited until she had enough data to back up her theory.

So, Rubin and her collaborators studied more and more galaxies (20, then 40, and then 60) and they all showed the same bizarre thing: stars far out from the centre were moving way, way too fast not to fly off into space.

By 1985, Rubin was confident enough that she was right to declare her results at the International Astronomical Union conference in New Delhi. "Nature has played a trick on astronomers," she is paraphrased as saying, "who thought we were studying the Universe. We now know that we were studying only a small fraction of it."

The sheer amount of data that she collected meant that scientists were forced to reconsider the entire structure of the universe, and had to reckon with the rather daunting concept that most of the mass in the universe was unknown.

Some have described this as an 'anti-eureka' moment, as she did not announce a discovery, but an enormous gap in our knowledge of the universe.

Even now, no one has 'discovered' dark matter, as such. The problem is that it is apparently invisible and untouchable; it just goes straight through your body, ghost-like. This is what makes it so hard to find.

However, several studies are now trying to prove the existence of dark matter. This might sound impossible, but, in fact, it's just shy of

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impossible. Scientists have, in simple terms, created an extremely sensitive ‘bell’ in the hope that a dark matter particle might just ‘nudge’ the nucleus of an atom of ‘normal’ matter and ring this bell.

Vera Rubin died in 2016, at age 88, and, as yet, there is no hard proof of dark matter, but there is still hope that we might, one day, find something to prove her game-changing theory.

## **The End of the Standard Model? by Luca Zurek**

The standard model of physics is the current model that describes the universe at a subatomic level. It encompasses 17 particles, 6 quarks, 6 leptons, 4 gauge bosons and the Higgs-boson particle, as shown on the right. Three of these particles make up everything in the universe. These three are the up quark, the down quark and the electron. The up and down quarks make up protons and neutrons which combine with electrons to make atoms. Electron neutrinos are almost undetectable particles that are given off in radioactive decay. The other two columns of quarks and leptons are unstable copies of the first column and can only be created in particle accelerators. The gauge bosons are the particles which are transferred when two other particles interact via one of the fundamental forces. These forces are the weak nuclear force, the strong nuclear force, the electromagnetic force and gravity. The weak and strong nuclear force only really operate on distances smaller than a proton. The electromagnetic force operates on a much larger scale as this incorporates electricity, magnetism and the electromagnetic spectrum. Gravity operates on a still larger scale as this operates on unimaginable scales as every particle in the universe affects each other. The Gluon is transferred for the strong nuclear force, the photon for the electromagnetic force and the z boson and the w boson for the weak nuclear force. The standard model has several shortcomings, one of which is that so far it has been unable to incorporate a particle for gravity as when this is tried the model falls

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apart. The Higgs boson particle is different from the rest as it is what gives all of them their mass as when each of them is given their own mass independent of a Higgs boson particle then the model once again falls apart.

The problem with the muon:

Some of these particles have an electric charge. Electrons for instance have an electric charge of -1 which causes them to interact with electromagnetic fields. A non-quantum charged object will align itself with a magnetic field. This can be seen with a regular magnet, if hung on a string, its south pole will point towards the earth's north pole and vice versa for its north pole. The force at which it rotates is called the magnetic dipole moment and the equation for calculating this is

$$\mu = (q/2m)L$$

where  $\mu$  = magnetic dipole moment,  $q$  = the object's electric charge,  $m$  = mass and  $L$  = the angular momentum of the object.

This equation is almost the same for quantum particles, the only difference is that it needs to be times by  $g$

$$\mu = g(q/2m)L$$

$g$  is a number that is calculated from the number of ways particles can interact and is different for each type of particle. For an electron it has been calculated to be 2.001159652181643 and this has matched up exactly with results from experiments. The muon, which is a far heavier version of the electron, does not match up with what has been calculated. This has been known for a couple of decades but the recent results from

FermiLabs Muon  $g-2$  experiment has once again shown that the calculations do not match up with the results. The recent experiments have been able to measure it with a greater level of accuracy than any previous experiment however it is not quite precise enough that a discovery can be announced. The chance of it being a fluke that the results do not line up with the calculations are a little over 1 in 100,000. For it to be considered a discovery then it needs to be over 1 in 3.4 million. This can only be accomplished by more experiments by different teams of scientists at different labs.

*How does this affect the standard model?*

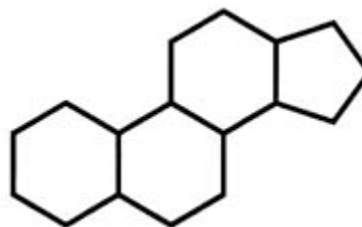
The Muon is 200 times heavier than the electron, the chance of it interacting with something is the square of its mass and therefore it is 40,000 times more likely to interact with particles than electrons. If the results are accurate then this could mean that an unknown particle or force was acting on the muons during the experiment as all known particles and forces were accounted for in the experiments. This could lead to the discovery of a 5th force or another type of particle or another column for the leptons and quarks. This probably will not fundamentally alter the core of the standard model but could extend it to include another force or more particles. It is possible that it could lead to the standard model being able to combine with Einstein's theory of general relativity and therefore combine the two major explanations for everything in the universe as previously the two theories were not compatible in the same model. If it is found that the standard model falls apart when trying to account for this extra

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force or particle then it could mean that a new theory has to be created to account for it and possibly this new theory could also incorporate Einstein's theory of general relativity. So although the results are not quite conclusive enough, it is possible that the standard model will be expanded, altered or even scrapped in favour of a better model.

## Why are Steroids used so much in Nature? by Joseph Conway

A steroid is a class of molecule with a certain base structure (meaning they can be synthetic or from organic material). This base structure has 17 carbons arranged into 4 rings, 3 hexagonal rings and one pentagonal ring, ordered in a particular way as shown:

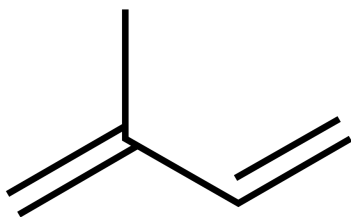


Steroids are of great importance in biology and medicine. Not only are they used for anabolic (growth stimulating) agents, associated with drug use in sport; but also in animals for a multitude of hormones, including sex hormones such as testosterone and estrogen, bile acids (which are used in the production of bile salts, responsible for the neutralisation of stomach acid and the emulsification of lipids both of which are extremely important for digestion), in inhalers for asthma treatment and to act as a messenger between cells. They are also used widely in plants and other areas of nature. For example, steroids such as cardanolide are used in plants to ward off predators which cause vomiting, visual problems and slowing of heart rate in vertebrates, acting as deterrents. This goes on to cause birds and other predators to instinctively shy from certain butterflies and grasshoppers which contain these steroids of the plants from which they feed.

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This shows that the steroid base molecule is used ubiquitously in nature, common throughout all animals, presenting itself in completely different species, on different parts of the globe. This means that, over millions of years, living creatures have evolved to use this base molecule, showing how useful the chemistry of the molecule is to carry out its purposes. This is similar to how animals have evolved to have eyes despite being on different evolutionary paths (for example, both humans and squid have eyes), demonstrating that the structure of the eye is ubiquitously useful; or how the structure of the amino acid is used to build proteins and is the basis for complex life (proteins are used in haemoglobin, repairing and producing cells and tissues, transport across the cell membrane, maintaining the pH of the blood, blood clotting etc).

It is speculated that the cell membranes of the ancient, single celled organisms were terpenoid (a class of molecules derived from isoprene, as shown) based compounds



rather than the fatty acid based cell membranes used today in nature. This could have meant that steroids, a terpenoid based compound, evolved from these early membranes, so it could recognize what was happening around it (an essential part of life: the ability to sense and respond to changes in the surroundings). Therefore, the protein receptors of the cells that receive the

information carried by the steroid, may have just evolved alongside with steroids. Even if this is not the correct order of events in the production of the first steroids, it is likely that, like many other base molecules, the steroid molecule was produced by a random reaction at the early stages in the creation of life.

This means that due to the chemistry of the steroids, which enabled early single celled organisms to receive information of its surrounding better than others, survived and reproduced, and so over the course of evolution protein receptors have also evolved and more complex steroids have been produced. Therefore, it is due to the certain chemistry of steroids produced by the random, which enabled the early single celled organisms to beat the competition, and so are used ubiquitously in nature.

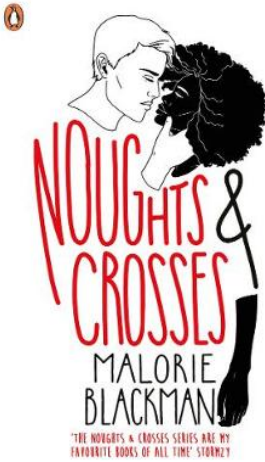
In conclusion, I believe that the steroid molecule was randomly produced in a reaction in the first stages of life, this molecule then gave an advantage to certain single celled organisms due to its particular chemistry; then through the course of evolution, steroids are used hugely in nature.



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## SHORT STORIES

### Matt and Joanna by Ben Morgan



*A short story based on the book 'Noughts and Crosses' by Malorie Blackman, written in 2001. It is set in a dystopian future where the African 'Crosses' are superior, and the 'Noughts' are forced into poor and violent lives for being 'colourless'.*

Matt's eyes snapped open to the sound of shouts and screams. Echoing around the dull stone walls, the shrill cries drilled through his brain as his body jolted awake. A familiar cold bead of sweat dripped down his forehead as the sharp light of a winter morning sliced through the small window on the wall above him. His grey eyes darted around his prison-cell of a bedroom as he stumbled out of bed, a second round of daggers of sound shooting through the cracked glass above. He made out the word "Help!", repeated in a panicked cry, barely a word anymore.

Today was his 11th birthday; not only his height disabled him from being able to look out of the window, but fear coursed through

his body, nailing him to the spot. He finally came to his senses, still shivering from a mixture of intense cold and shock, and hurdled onto the lonely bed - a used mattress balanced on a frame of rusted steel bars - to get a glimpse of the cacophony.



Earlier in the morning, on the other side of the village, Joanna listened to the songs of chirping birds as she held a velvet duvet to her face. She rolled out of bed and got dressed, smelling the soothing aroma of cooking food floating below her tall bedroom door, which stood opposite her curtained French doors. They led out to a balcony, with a railing lined with golden patterns looking out over the garden.

"Good morning!" shouted her maid Emily joyfully, as she walked down the spiral staircase into the grand hall of silver sculptures and marble floor below. "How would you like your eggs done?"

Joanna was very hungry, however she had promised her friend that she would meet with him before school started. Well, his school - Noughts were separated from Crosses like her - who had complex education systems which sprouted many politicians - from a very young age, so she was forced not to speak to them, let alone walk with them.

"Sorry, I'm not hungry!" she lied as she dashed out the front door after grabbing her school bag, trying her best to ignore the inviting smell of sausages and the disappointed look on Emily's face.

The problem with meeting her Nought friend was that it was very frowned upon - if she was

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caught, she would surely be punished by her parents, who spent all day working in the government; they were amongst the people who kept these harsh rules running. She walked fast and purposefully, with her head down in the hope that she wouldn't be spotted. Only her friend's birthday would give her the motive to do something as risky as this.

"This is stupid..." she thought to herself as she began to cross into Nought territory. Grand mansions of carved stone walls and water fountains with crystal water faded into dull blocks of grey and brown, withering away into the ground. The buildings seemed to plead for help as she walked past in her neat clothes and clean hair. But they were not the only things that had noticed her.

Due to their superiority, the Crosses towered above the Noughts, living lavish lives and often not caring about the Noughts' pain. This caused many Noughts to grow to hate Crosses with burning passions. Joanna was gradually getting surrounded by them as she made her way into the dying heart of the Nought suburb.

"You're nearly there," she tried to tell herself. "Just keep going." She had previously convinced herself that there would be no one around, which had clearly been a lie. A shiver down her spine matched the sweat beginning to form. That's when she heard the screams.



Matt's eyes shot around as he looked out the window. There was a police van parked outside his house. Many uniformed Cross officers were gathered round two writhing lumps on the ground, rolling around the frosty pavement. For good reason, too - the officers all held long batons and were beating them relentlessly.

Matt was thrown into a state of even further panic when he realised that the 'lumps' were people - right outside his half-destroyed front door, which was hanging open. The intense cries began to morph into more humanic and familiar voices; voices that he could recognise anywhere.

He dashed out of his room and bolted down the stairs, which creaked in irritation as he stormed past. He stumbled out of the door, screaming at the officers. But they carried on hitting his parents as he tripped over an uneven cobble, his momentum still carrying him forward. His vision blurred as his head smacked the hard concrete, his heartbeat pounding in his ears. As his head lay on the ground, he barely made out the silhouette of a young girl, a Cross girl, appearing round a corner. A circle of angry Noughts began to enclose her, blocking out the sun.

"Joanna..." he mouthed, but no noise escaped. She was the last thing he saw before the baton hit his head and his world went dark.

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## The Journey by Joseph O'Sullivan



*This short story was inspired by The Silverwing Trilogy by Kenneth Oppel about a bat's search for his father.*

Up, the wind takes me. Crisp evening air rushes under my spread wings, propelling me towards the black abyss we call the sky. The nearby buzzing of insects clogs up my echolocation and it takes me a few seconds to adjust myself to the world. I spray out sound waves in search of soft ripples of water that match the shape of my echo. Gentle arched branches grasp desperately at scorched and charred trunks, secreting the horrors of the past. Mesmerising flowers have been replaced with piles of forlorn foliage that cling to the dry earth, trying to find hope in despair. Yes! I catch sight of a moth, it dashes under the canopy as soon as I twitch my nose. I dive down after it, crashing through layers of leaves and see its bronze haze fly off to the right with my limited eyes. My sound reverberates off its fuzzy wings and I fly with haste after it. Crunch! I snapped it up mid-air as it flew low over the forest floor and I hungrily munched on my prized possession. Later that evening, after I had finished my feeding, I descended towards my home. A humble oak tree that fulfills its need, nothing more or less, but I loved it. It was a warm

haven after a hard night's hunt but it also reminded me of my dad. Two years ago he had left without a word, to never return. That loss, my hurt had begun to fade yet I carry it with me on every journey.

The sweet serenity of sleep embraces me with its mellow arms of tranquility. The warm glow of the evening sun wakes me up, just as planned, as I am usually up quite early. Tonight I am going to do something attempted by very few nocturnal animals, especially bats. I was going to fly in the sun. I had taken my bearings over the past few months so I knew which way was South and where to go if I got lost, although that was unlikely. I had planned to fly in a straight line. Due South. I take the leap. The everwatchful burning eye glares rays down at me as I plummet towards the cooler ground. The heat is overpowering as it rages over my skin threatening to tear me down from the daylight where I do not belong. After about an hour the sun goes back into its hiding place, yet to be seen for another night. I plunge down to the silvery surface of a murky pond that reflects the fresh gleam of the emerging moon, and I sweep so low my furry belly can feel the faint vibrations of the water created by the crisp breeze I have been riding on. Invigorating liquid washes down my parched throat and I pull out of my dive. Oh! How exhilarating earth's natural elixir is.

As I further my journey South the air started to become warmer, thicker and moist; the trees started to become more tropical and the leaves changed shapes. The angelic call of the nightingale was merging with the raucous call of a vibrantly coloured parrot. The faint rush of meandering rivers was now a rough

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pitter-patter of weeping clouds that sounds like someone is dropping thousands of bullets overhead. I glimpse some other bats, with wing spans twice mine, through the luscious greens and yellows. I fly up to the tree line where I had heard some foul crunching. A limp, blood-covered bat face hangs helplessly from a pair of colossal jaws. Fear takes hold like a black cloak enveloping me, strangling me with nightmares. The thick, pungent aroma races up my nose, clawing at the insides of my nostrils, scraping moisture from my eyes. Bat blood. Blood-shot eyes flash open and blood bubbling and spurting like a fountain from its mouth whispers with a silent urgency, "GO!" I lit from my post as fast as the lightning that had struck our home but without ferocity... with terror. That memory brings back shrill screaming echoing through my head. Agony. Air whistles past my pointy ears, blurring my echolocation. The world around me begins to disintegrate as I drop like an over ripened fruit, gravitating towards the earth's core.

Alive. Reviving air rushes into my lungs, inflating them like a balloon. A warm but temporary sensation of safety rushes over me, like small waves on a beach. A fern blanket cuddles me. On my left is comforting greenery. On my right... nothing. The ground falls away into a gaping hole as if the earth is trying to swallow up its own creation. I know what I must do.

Jump.