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COASTLINES

The Geography of Where Land Meets Sea

Latitude 51°

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Santorini Coastline

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The beautiful island of Santorini, just South-West of Greece, is the largest island in a circular archipelago with the same name, it is unusual however as it is the result of many volcanic eruptions in that area which have changed and shaped the whole formation. As well as that, it is thought that many different civilizations throughout the ages have inhabited the island, developing and collapsing as time pasted by.

It is believed that the island originally started out as one larger island which would have covered the whole area of the current archipelago. This was formed by continuous volcanic activity under the ocean which resulted in areas of land being lifted from beneath the sea and erupted as magma many hundreds of thousands of years ago. However, rather recently in a geological timeframe, about 1600BC, the central magma chamber on the island collapsed in on itself which led to a huge gas build up resulting in the Minoan eruption which caused the formation of two new channels which allow entrance into the centre of the ring of the archipelago.

This eruption had a VEI (volcanic explosivity index) of 7 which is a very significant event. The VEI is used to measure the magnitude of a volcanic eruption, it categorises the size of an eruption based on the volume of ash erupted and the height of the ash column, but it is not used to categorize the amount of lava released from a volcano. For reference the VEI of the most famous eruption by Mount Vesuvius had a VEI of 5, whereas the Minoan eruption had a VEI of 7. Also, an eruption with a VEI of 7 is so rare and massive that it is approximated that one will occur once every 1000 years.

The reason Santorini has such large volcanism is that it is very close to the Hellenic Trench subduction zone, an area where two massive pieces of rock called plates slide under one another. The trench is positioned at the northern point of the African plate which is sliding under Greece and the Aegean Sea. The less dense oceanic plate subducts below the continental crust and is melted by the heat of the earth's core. As its heated it rises as magma forming the volcanoes that morph the archipelago. The islands were formed the eruptions of these multiple shield volcano, a type of volcano which is very flat but erupts large quantities of magma, resulting in the formation of large landmass.

There have been links made between Santorini and the myth of Atlantis. This theory arose in the 1960s when archaeological excavation revealed that there was once a larger central area to the island which then sunk, which we know was due to the collapse of the magma chamber, but lead many people to believe that this could be representative of the mythical lost island of Atlantis.

Today Santorini is a swarming hub for tourism with its beautiful vistas and black sand beaches making a great holiday destination. It's ranked by many travel magazines the best island to visit in the world. With all the quarries that formerly spoilt the landscape having been shut down, it is now a brilliantly peaceful, sunny resort where you can enjoy a holiday of culture and relaxation by the beach without any kind of distractions, except the stunning geography.

Santorini owes it very existence to the monumental forces and volcanic activity that occur beneath the island however the beauty of the island is threatened by that very volcanic activity and earthquakes resulting from the destructive boundary on which the islands lie. The people of Santorini live on the historic relics of the volcanoes, in the current shadow of the volcanoes and under threat of the volcanoes future but for now Santorini is an island of dramatic culture and stunning beauty.

Jurassic Coast

Eliot Beresford 9BR

The Jurassic Coast is England's first natural UNESCO World Heritage Site, receiving the title in 2001. A World Heritage Site is a natural or man-made site, structure or area, recognized as being of outstanding international importance and therefore deserving special protection. This includes places such as Yosemite National Park in the U.S.A and the Great Barrier Reef in Australia. In a nutshell, the Jurassic Coast is a history book 95 miles long. It covers 185 million years of Earth, including a near complete record of the Triassic, Jurassic and Cretaceous periods. As stated by the Jurassic Coast team themselves, 'It's the story of the making of rock, from soft beginnings piling up layer upon layer and hardening into the stone. Of vast, red, baking deserts. Of oceans rising and falling. Eroding landscapes; of swamps and lakes and early life cavorting. Of forests growing up and dying down. Adding yet more layers to the toothsome cake of time.'

Let's start at the beginning. At the western end of the coast is the Orcombe Point. Its cliffs formed 250 million years ago, the start of the Triassic period, are composed of red mudstone and sandstone. Unfortunately a walk here would not find you with your hands full of ancient fossils as they only formed once 95% of all Earth species were wiped out, which was after the time of Orcombe Point. This event was called the Great Dying. Not to be confused with the meteor that killed the dinosaurs 65 million years ago, the Great Dying was the worst stage in the Permian period as 9/10 marine species and 7/10 land species went extinct. Nobody really knows what happened but there are two theories; one is that, similar to the dinosaurs, a 9km asteroid hit the Earth's ocean. This theory is supported by recent evidence stating that geologists studying Permian period rocks discovered 'fingerprints,' left by objects from space. The other theory is that 'A deadly epoch of volcanic eruptions left a million-square- mile fingerprint in Siberia. Below the town of Norilsk lies a two and a half mile thick pile of lava, overgrown by conifers,' said Hillel Hoffman who writes in the National Geographic.

The Jurassic Coast is not entirely comprised of steep cliffs and high altitudes, it also contains beaches. For example, Chesil Beach which is in the more middle section of the coast fairly near to Dorchester, is a stretch of shingle which is under 20,000 years old, and perhaps near its death, as one day it will break apart due to the forces of the natural world. Running 18 miles long, with 180 billion pebbles, it's no surprise that it is valued among people including the author John Fowles, who within his works described it as both powerful and beautiful.

Another different kind of fossil that you can find on the Jurassic Coast is a plant fossil. As the Jurassic period started to end 145 million years ago, a forest of only conifers, tree-ferns and cycads grew, as plants with flowers had yet to evolve. When a lagoon rose the forest was swamped and many plants including trees died, only to be encased in limestone by sticky mats of algae. This process thus created strange round shapes and holes known as 'algal burrs'. Unfortunately, some of the broken trunks of trees would be found preserved but were probably collected by Victorians over a century ago.

Of course, there weren't just plants in the Jurassic. There were also sea creatures, one of which, the Pilosaur, was the biggest ever found. Pilosaurs were immense creatures, between 5-25m with four flippers, at the top of the marine food-chain, which existed around 155 million years ago. In Dorchester, in the Dorset County Museum, is a 2.5m long Pilosaur skull, one of the largest and best preserved in the world that helped people tell how the jaws and bite of the Pilosaur worked.

To finish off talking about fossils, let's talk about the most impressive one. Because most of southern England was underwater throughout the Jurassic and Cretaceous periods which is when dinosaurs roamed around, the rocks of the Jurassic Coast tend not to contain dinosaur bones or fossils. However, between the stretch of coast between Charmouth and Lyme Regis, people have found a medium-sized plant eater called a Scelidosaurus, meaning 'limb lizard.' It lived 208-194 million years ago, and is 4 metres long. What's so special about it is that it is completely unique to Dorset, and thus can be found nowhere else on the Earth. The best specimen composed was discovered in December 2000 by a local collector named David Sole, and it is the most complete dinosaur skeleton ever found in England – you can see it on display at the Charmouth Heritage Coast Centre. Scelidosauruses are one of the earliest armoured dinosaurs in the world, and are ancestors of the Ankylosaurus and perhaps the more commonly known, stegosaurus.

The most interesting structure in the Jurassic Coast in my opinion is the Durdle Door. The Durdle Door is a tall arch of rock coming out of the sea. Normally, the layers of limestone that formed Durdle Door would have been created horizontally – but they're not. When the African tectonic plate collided with the Eurasian, vast ripples were eminated outwards, folding the lands surrounding them. The subsequent folding of the landscape contorted the rocks of Durdle Door, gently folding it into the unique rock structure we see today. Its arch was created when the sea eroded through the hard middle limestone, and then washed away the softer rock, thus making a hole. At the very eastern end of the coast is the oldest part whose formation has been dated to approximately 100 million years ago, in the Cretaceous period. Through the course of 35 million years, a huge number of plankton skeletons drifted to the bottom of the nearby tropical sea, which then formed a thick layer of chalk over the cliffs. These chalk deposits are responsible for some of the most famous and popular landforms admired along the whole coastline; the stack formation of Old Harry Rocks and Handfast point. In conclusion, the Jurassic Coast is a marathon of pre-human history. Not only is it a wonder to read about, but also fascinating to explore. Not only are there daily events, but there are also museums and towns right next to the coast, making a stay there relatively stress free. If you want to learn more, check out their website at jurassiccoast.org, where you can browse through their fossil database, learn more about the area and book and learn about events.

Coastal Flooding

Tom Clapp 9BR

Global warming is a subject which has gripped scientists ever since the industrial revolution, but only now are we starting to realise the consequences that greenhouse gases will pose to our ever expanding population. Current estimates predict the level of sea level rise to be 0.2-0.4 metres by 2050. Figures from the UN add up to 44% of the world's population living within 150km of a coastline, and many of the most iconic cities in the world, such as New York, Mumbai and Miami are all in the top ten for flood risk. This is caused by a mixture of shrinking poles and world temperatures soaring. The World Bank based in Washington has estimated a total loss of $1trillion of flood damage a year for the largest 136 coastal cities if they are unable to adapt.

Coastal flooding usually occurs due to natural disasters such as hurricanes or tsunamis, and it is because of this that coastal flooding is very difficult to prepare for, though scientists can say with certainty that humans have increased the risk of coastal flooding by inducing global warming. Coastal flooding is split into three main categories: direct inundation where the sea height exceeds the height of the land. The overtopping of a barrier – this generally occurs when an attempted flood defence has been put in place, but because of the height of the swell in the waves, it is easily bypassed. Finally, breaching of a barrier which arise because the flood defences have been broken.

However, there are various ways of protecting coastal cities from flooding, as demonstrated most recently in New York. A group of Danish designers called the Bjarke Ingels Group (or BIG) created an audacious plan which includes the introduction of a green belt around New York. This seemingly inconspicuous design will hide the network of deployable walls and barriers which could be used against flooding. This attempt at flood abatement has come after recent storms which threatened New York's coastline in 2014 and 2015. The main motivation for this complex scheme came after Hurricane Sandy and Katrina, both of which caused widespread damage and left many parts of New York in lockdown due to the huge tidal waves sweeping in from the Atlantic and New Orleans having suffered immeasurably after its own infamous tropical storm in 2005.However, the key to the project, Ingels says (the manager of BIG), is that people will not notice the flood barrier is there: "You won't see it as a flood wall that separates the life of the city from the water," he explains. "When you go there you'll see landscape, you'll see pavilions, but all of this will secretly be the infrastructure that protects Manhattan from flooding." The company took nine months discussing the with communities within Manhattan, as the 8 mile long park which could one day surround New York, will not be without its consequences to the 2 million strong local population (not including those who commute in and out of the city every day).

One of the most devastating forms of coastal flooding is a tsunami. This 'big wave' can sweep inland and destroy homes and infrastructure miles away from the coast. The 2011 tsunami off Japan was the most catastrophic for years, causing many to abandon their homes, 230,000 of which were still not re-housed even by 2015, and it almost sparked the most devastating nuclear disaster since Chernobyl. On the morning of the tsunami a 9.0 magnitude earthquake along a subduction line caused the seabed to shift upwards of 50m. This sudden change to the seabed sent shockwaves through the water, allowing for an enormous wave build up. Because of Japan's early warning system, the residents of Tokyo were given about a minute of advanced warning, enough time to stop fast moving trains, turn off power and send alerts on people's phones. This combined with the tsunami caused just over 15,000 deaths, compared to the 2004 Boxing Day tsunami in the Indian Ocean the figure is fairly small. However, a level 7 meltdown at the Fukushima nuclear power plant was the reason that Japan continued to make world news.

Japan has been able to combat this though with its own tsunami flood defences. Kamaishi which took the brunt of the 2011 tsunami has well built coastal flood defences, which extend from the bottom of the seabed up to 63m high and stretches almost 2km around the bay. This is true for 40% of Japan's 30,000km coastline. Though these are good for smaller storms, another approach other than sea walls needs to be taken to combat tsunamis. One of the schemes that the Japanese government has devised is a technique called 'vertical evacuation' which relies on those in the way of a tsunami climbing to the top of the building and waiting to be rescued. This requires tsunami proof buildings and an abundance of air rescue teams. Japan can supply the latter, but because there are no strict tsunami guidelines, there are only a few tsunami proof buildings in tsunami prone areas. This meant that many lives which could have been saved by these buildings were lost as only a minutes warning meant that most people in the normal buildings could not get out them and escape to high ground unlike the few lucky ones in tsunami proof buildings who were rescued from the roof tops.

Coastal flooding is going to become more of an issue as global warming starts taking its toll on the environment, and events such as Hurricane Sandy and other examples of extreme weather are just going to become more common. Britain should be just as concerned as other locations worldwide as continued and increased erosion from coastal flooding is accelerating the rate of coastal retreat significantly and many coastlines are rapidly shrinking by over 1m a year. Maybe coastal flooding should be taken more seriously with better flood defences around the world to stop our already crowded land mass from shrinking, or maybe we should try to curb global warming which is causing the poles to shrink and allowing sea levels to rise, exacerbating the problem and leaving scientist and policy makers alike striving for more effective and wild ideas of how to cope with what is beginning to seem like and inevitable outcome: the rise of

The Bermuda Triangle

Sahil Mukherjee 9BR

The Bermuda Triangle. A menacing yet mysterious area apparently formed from the points of: Miami, (Florida); San Juan (Puerto Rico) and an island of Bermuda. Due to the mythical nature of the triangle, opinions of the triangle's area vary - ranging from 1,300,000 km2 to 3,900,000 km2. According to the US navy, the triangle does not even exist, and the US Board on Geographic Names will not recognise it! Nonetheless, it is still internationally famed, mostly due to the fear of sailors, whom reportedly face certain death should they enter the triangle.These claims are not unsubstantiated as The Ellen Austin, USS Cyclops, Flight 19, Star Tiger and Star, Ariel, Douglas DC-3, KC-135 Stratotankers, Connemara IV are only few vehicles that have gone missing in the seemingly troubled waters. Despite the area's history, the triangle is still home to one of the world's most used shipping lanes as several types of transport pass through this area daily: cargo ships (delivering to America, Europe etc.); ferries and cruise ships peacefully going in and out of the Florida region; and private or trading aircrafts to Florida or the Caribbean.

The rumours all started when unusual disappearances in the Bermuda area in September 17, 1950 were published in an article in The Miami Herald. Following that, magazines started reporting on the mystery of the loss of several planes and ships, which included an interesting story about the loss of Flight 19, a group of five U.S. Navy TBM Avenger bombers on a training mission:

On Dec 5, 1945, 5 TBM Avengers (Flight 19) took off from Naval Air Station Lauderdale (Florida) on a navigational training mission. There were 14 men aboard the 5 planes, each of which were full of fuel. The aircrafts could fly for about 6 hours and the day was calm, with clear skies and the weather looked unlikely to change until after the flight returned. Everything seemed perfect.

This was the case until 15:45, when the Lauderdale control tower expected requests about landing instructions. The Flight Leader reported of no land in sight and how he thought they were off-course and when the control tower asked for their position, there was no reply. After a while, the Flight Leader concluded that he was not sure where they were. Contact was lost for around 10 minutes and the next few transmissions were from the other planes, talking among themselves, sounding very confused. Seeing that things may had taken a turn for the worst, the Flight Leader gave up command. The new Flight Leader reported that they were still lost, unsure of their position, and that everything looked 'wrong'. Contact was then lost for around 20 minutes.

The next and final transmissions from Flight 19 made no sense. The Flight Leader exclaimed they were flying into "white-water'.

Some believed causes of the disaster is that the compasses stopped working. The control tower suggested that the team on board should fly west, which would have taken them to Florida eventually. The pilot headed for what he thought was west, but in reality the plane travelled northwest, almost parallel to Florida. Others say, by viewing the wreckage of the planes, that an explosion took place. Bad weather is also said to be an important factor.

Beliefs about the Triangle

Even though there are some paranormal theories behind the dangerous nature of the area (the lost city of Atlantis or UFOs), there are more realistic concepts people believe in which could help to explain why the area is the cause of so much chaos:

Magnetic Fields: Compasses have natural alternating relations with magnetic poles, something we have been aware of for centuries. Magnetic (compass) north and geographic (true) north are only exactly the same for a

small number of places. This would have caused the disruptions of the compasses in Flight 19.

Gulf Stream (A surface current, from the Gulf of Mexico to Florida into the North Atlantic): It is basically a river within an ocean that can carry objects. It has a surface velocity of up to about 5.6 mi/h! A small plane making a water landing or a boat having trouble can be carried away from its reported position by the current.

Human error: There were many people disbelieving this. Lawrence David Kusche, for example, had frequently said how the Flight 19 disaster could be because of human error. Mistakes and inaccurate measurements, analysis and observations could have been the cause.

Violent weather: Tropical cyclones are powerful storms which form in tropical waters and have historically cost thousands of lives lost and caused billions of dollars in damage. There was bad weather forecast at the time Flight 19 was lost.

Cold Air: A powerful downdraft of cold air was suspected to cause the sinking of the Pride of Baltimore on May 14, 1986. The crew noted the wind suddenly shifting and increasing in velocity from 32 km/h to about 120km/h!

Mr J. Lushine (National Hurricane Centre satellite specialist), stated "“The downburst of cold air can hit the surface like a bomb, exploding outward like a giant squall line of wind and water”.

Methane hydrates (a form of natural gas): Laboratory experiments and some documentaries have proven that bubbles can sink a scale model ship by decreasing the density of the water. This is possibly why it took so long to find the remains of the flights.

Dragon’s Triangle

While sensational theories for the curious disappearances speak of extra-terrestrials, UFOs and lost kingdoms, others believe that the region displays the same magnetic anomalies just like the Bermuda Triangle. The area (made by connecting Japan, Taiwan, and Yap Island) has become known as the Dragon's Triangle, after a centuries-old Chinese myth, according to which dragons live deep beneath the surface and their sudden movements cause sudden waves, whirlpools, thick fog, and storms. Scientific theories believe that undersea volcanoes influence the area's sudden environmental changes.
In 1950, Japanese officials declared the triangle a danger zone for shipping. In 1952, a research vessel, the Kaio Maru No. 5, sent by the Japanese government to investigate the troubled waters, vanished without a trace and 22 crewmen and nine scientists were lost. This is just like the calamity of the air-ship that went looking for Flight 19. The Dragon Triangle and The Bermuda Triangle are unbelievably similar.

The coastal areas of the Bermuda Triangle have been excessively tricky, threatening and treacherous, but with a significant improvement of our knowledge of Geography and Science, we have solved most of the issues and dilemmas and we can now use it more safely than ever before. The Bermuda Triangle has been written about in books and plays and and, as a result, we understand a lot more about these ‘abnormal’ activities. Yet the similarity of the Dragon’s Triangle and Bermuda Triangle intrigues me. Like the Bermuda Triangle, the Devil's Triangle area may be volatile, victim to sudden weather changes and the storms and ocean swells are not yet understood. Considering the extremely unique history of both regions, it can't be coincidence that both are positioned on opposite locations on the globe. The only other places on earth that are in exact opposite locations like this are the Poles. If someone can understand this weird connection between the two triangles, we could make a scientific and geographical breakthrough but even without the desired knowledge, it is hard to deny that that the two triangles are fascinating places.

The Migrant Crisis

Lampedusa

William Frost 11GR

Once a thriving tourist resort, the Italian island of Lampedusa is now facing one of the biggest immigrant crises in the world. A couple of decades ago Lampedusa was known only for its tranquil clear teal sea, stunning sandy beaches and gentle hubbub of a tourist retreat. Small sightseeing yachts and fishermen's boats littered the peaceful shorelines, while westerners sunbathed on TripAdvisor's 'world's best beach 2013'.

However, Lampedusa's location in the middle of the Mediterranean makes it a prime position for a different type of traveller. Since the early 2000s, migrants mainly from North Africa have begun to flee to Lampedusa in search of a better life. For many in the early 2000s, this was a journey to escape poor conditions, low educational facilities, low employment and poor economic situations. Controversially in 2004, the Italian government made a deal with the Libyan government to deport thousands of refugees arriving in Lampedusa to Libya, without even allowing them to apply for asylum. This bold move, condemned by many humanitarian groups, meant that asylum seekers could be collected straight from their basic and overcrowded boats and then taken to the airport where they were given one meal and then flown to Libya, even if they were not Libyan. However, due to pressure from the European parliament and other powerful groups this deportation was to be swiftly ended, despite the growing number of immigrants arriving on Lampedusa's coasts.

The numbers of immigrants continued to rise, with Lampedusa's immigrant reception centre attempting to house over twice the designated 850 people capacity during 2009. This was seen as a major crisis for the people of Lampedusa and the UN's department for refugees, but was only a shadow of the crisis that was about to ensue. In 2011 the turmoil in Tunisia and the civil war in Libya forced hundreds of thousands of refugees to migrate in the hope of finding safe new homes. Within the first half of 2011 almost 50,000 people entered Lampedusa. Aside from fervent discussion within Europe as to whether these people were refugees or seasonal immigrants for work, the vast number of entrants was clearly an issue.

Contrary to some senior figures predictions, 2011 was by no means the end of the problem. Thousands of immigrants have continued to arrive on the island every year, often having paid smugglers extortionate sums to ship them across the Mediterranean from North Africa in dangerous and overcrowded boats. From Lampedusa the immigrants tend to be taken to mainland Italy by the authorities and from there they can make their own journeys into Europe in search of a new start.

What's not to be overlooked is the huge impact on the Lampedusan residents, as well as the suffering refugees. The permanent inhabitant population of Lampedusa is only 6000, tiny in comparison to the vast numbers of immigrants. The locals suffer the impact that such a large immigrant population brings. When the refugee centre is particularly full, which is now almost constantly, the pollution from human waste amasses on the island, and the policemen roped in to organise the immigrants cannot contain the litter problem, ruining the natural splendour of some parts of the island. Furthermore there have been allegations that among the many innocent refugees are dangerous gangs, carrying with them drugs and causing severe violence. This has created a huge divide among the local people and authorities; many see the pain of the North Africans and only want to help them flee their dangerous homelands, whereas others see the immigrants as the cause of the ruined local economy by driving away tourists.

The immigrant issue on Lampedusa in many ways shows to a greater extent the continued migrant issues that the whole of Europe is facing. The constant struggle between refugees and locals is a relevant challenge to our governments, having to find the balance between helping those in need whilst not overlooking the needs of the residents. Ideally, the governments will be able to find a happy medium which should be able to integrate migrants into the complex European society, whilst utilising the opportunity that the immigrants create to fill jobs and create a better dependency ratio.

Lesvos

Zac Rooprai 7P

Located off the coast of Turkey, in the Aegean Sea, Lesvos measures 1632km 2 making it the third largest Greek island in the Mediterranean. It is famous for its beautiful beaches, impressive wildlife, excellent cuisine and unchanged landscapes, which attract masses of tourists each year. However, a more recent addition to Lesvos is an entirely different diaspora of people, who have come with quite a different agenda – refugees.

Within this article I shall look at the two different sides to Lesvos. Lesvos the tourist resort and Lesvos the refuge.

The migrant crisis struck everyone with quite a shock as millions of refugees flocked from other countries (mainly Syria) as asylum seekers, to find a better life and escape the desperate conditions they face every day. Different countries have had a range of reactions to this crisis; some putting up borders and denying the refuge and safety of migrants, others welcoming them with open arms. (Germany alone has already given permission to 27,000 to reside within its borders; others, such as Bulgaria, have pushed back migrants from their borders, denying them asylum) The Aegean Sea has received many migrants on their shores and coastlines. Lesvos in particular has many welcomed visitors arriving with over 570,000 arrivals from January 2015 and around 30,000 refugees from Syria, Iraq and Afghanistan arrived this February alone doubling the population of the capital, Mytilene. Situated on the east coast, Mytilene, has become a focal point in the crisis, with the Moria refugee camp, northwest of the town, hosting many of those who manage the trip over the waves of the eastern Aegean Sea.

Refugees, most from Syria, arrive exhausted at the Moria Camp in Lesvos, where they await registration in order to transit through to Athens. It can take up to two days to walk to Moria Camp from the northern coast of Lesvos where the smugglers dinghies land from Turkey. Almost 4,000 people have left this camp with registration papers allowing them to buy ferry tickets to Athens. Translators are stationed at the island to help people fill in the forms.

Over 2,000 refugees arrive daily in Lesvos. Sometimes, up to 4,000 refugees land on the island. In the usually quiet coastal village of Skala Sikaminias, the shoreline becomes littered with rubber dinghies and lifejackets as an ongoing sign of the search for safety in a tumultuous and ongoing homeland battle. In the Moria detention centre, Greek army and police exercise strict control over who goes in and out. The camp, which now houses around 3,150 people, is closed off from the outside world by several layers of fencing topped with barbed wire. The migrants' worries aren't over after arriving as they face the terrifying journey from reception to detention, never truly knowing if they will be granted the asylum they so desperately seek for their families and themselves.

Riots are also common in refugee camps and usually break out after a fight. On one occasion a policeman reportedly hit or slapped a minor, causing clashes between police and residents of the camp. The riot escalated out of control and the police fired tear gas injuring many of the residents. Over 4,000 refugees and migrants are kept in the camp (including children and women) and the camp is guarded by police and soldiers and is ringed by a razor wire. The living conditions are awful and void of

sanitation. Though the conditions are terrible the residents would accept this than going back to the environment of
being trapped in a war. Greece has struggled financially to supply the food, water and shelter desired. They say the problem is that the resources they have can only feed so many people and are constantly in hope of donations from other countries.

Many different helpers are stationed all over Lesvos and other countries not so affected by the crisis have sent police forces, doctors and nurses to keep people well and in order. There are also many volunteers and shop owners supplying food, water and physical and emotional comfort. Despite their holiday, tourists also flock to help the migrants.

Despite this picture of strife and desperation, Lesvos still maintains a charm and attraction to holiday makers.For example, Lesvos is home to the fascinating Archaeological Museum of Mytilene. The purpose of the museum is to provide tourists with a view of the daily, social, economic and religious life of visitors and a brilliant insight into Greece and its wonders. Three of the rooms comprise of various sculptures, reliefs, portraits and statues and in the halls there are finds related to the Romans. It is perfect to capture the history of Lesvos and what has been discovered.

Another major tourist attraction is the petrified forest of Lesvos, which in these terms petrified means “wood”, or “stone” or “wood turned into stone”. It is now a protected natural monument. The forest itself was formed from fossilized remains or plants. Local to the villages of Eressos, Antissa and Sigri are large amounts of petrified trees. The tree is managed by the Natural History Museum of the Lesvos Petrified Forest. Isolated plant fossils can also be found on other parts of the island. Finally my article would not be complete without the village of Petra. In the middle of this village there is great rock on top of which lies a church. The rock has been landscaped also with 140 steps to visit the church at the top. The church can be seen from right out at sea, and from the little beach of Avlaki, along the coast. The steps go up 114 meters and are rather uneven but the view and the church are worth the climb.

The worry for the inhabitants of Lesvos is the impact that the current migrant crisis may have on its tourist industry. As an island that has become dependent on tourism as the predominant contributor to the local economy’s Gross Domestic Product (GDP), the migrant crisis could herald the beginning of a negative degeneration of the tourist economy. Despite having some fascinating and attractive pulls for people worldwide, Lesvos needs to consider how it continues to help the search for asylum versus the need to maintain a healthy and productive tourist industry.


ÉGALITÉ
À LA
GLOIRE
DE LA
RÉPUBLIQUE
JE SUIS
CHARLIE

Norwegian Fjords

Benjamin Hebblethwaite 9RD

What is a Fjord and how is it created?

Fjords are narrow steep inlets that can reach depths of 1300 meters. These are mostly found in Norway, a country famous for its beautiful fjords and elegant, yet expansive, mountain ranges. Evidence of fjords' prevalence in Norway is evidenced by the effect which they have on the length of the coastline, which is a mere 2500km without fjords, but an astonishing 29000km when they are taken into consideration.

These fjords are formed when a glacier is forced to travel through a valley and the sheer force of the ice (with embedded debris) acts as sandpaper, eroding the valley sides through the process of abrasion. The rate at which it deepens and widens is determined by the thickness of the ice, and hence the amount of friction that acts on the rock. As a result of this, the valley would then be smoothed as the glacier moves out of the valley, creating what is known as a U-shaped valley. Because the thickness of the ice determines the speed of the erosion, smaller tributary glaciers take longer to erode the valley. When these tributary glaciers melt, they create hanging valleys. When the glacier moves on (or when it melts), it leaves the U shape valley behind which is then filled with water, from either meltwater or precipitation, creating a fjord.

What are Fjords used for?

Fjords were originally used as natural harbours and these were very convenient for the Norwegians, for they provided all the things a harbour needed – the fjord would have been difficult to access for intruders, would have led right out onto the sea and would often have been in a sheltered area area too. Using fjords was considered cheaper than building many new harbours for the Norwegians which made them common across the country. Fjords were used for transportation too as they were, in a sense, natural canals and for transporting goods and people, considering cars were not invented, and later not readily available, and other means of transport were hard to find.

Today fjords serve as marvellous tourist attractions and, as a result, fjord tours are very popular because the landforms are known for their natural beauty and can be visited all year round. 30% of all tourists who come to Norway come specifically to see the fjords and 1 in 15 people work in the tourism industry, which gives an idea of the fjords' importance. Therefore, it is safe to say that the fjords not only benefit the country's economy through tourism but improve the lives of the people too.

Wildlife in the fjords

What not many people know is that there is a wide range of wildlife that live in the fjords, namely polar bears, walruses, Eurasian lynx's, killer whales, brown bears, artic foxes, mooses, reindeer, Atlantic puffins and colonies of gannets that all reside there. The natural beauty of the landscape is stunning so it's not surprising that a wide range of species want to live there. Norway also has a wide range of habitats that an animal can inhabit, so large varieties of species arrive every year.

Future of the fjords

Despite their popularity with both people and animals, Norway's fjords are in danger. On April 2015, the Norwegian government gave its concession for an open-pit mine to be in a mountain called Engebø. The mine will dug spill more than 250 million tonnes of chemicals and waste in the taintless Førde fjord. To combat this proposal, for 3 weeks in February, more than 100 protesters blocked their way which led to a multi-million-pound lawsuit against the protesters. However, the activists were still determined and, on February 1st, locals and environmental activists blocked the way of the drilling; 14 were arrested but the next day they all returned to the site to physically stop the drilling. After the protests ended on the 21 of February, more than 80 people had been arrested. The determination of the people to act against the destruction of the fjords only goes to show the value that they possess.

It is sad to think that this isn't the only mine planned that would destroy fjords, as in Kvalsund another copper mine is being debated about. We can only speculate what might happen to Norway's fjords in the next century but the harsh reality is clear, if businesses continue to exploit the fjords, Norway may not have any of its pristine fjords left in the future.

Bridges to Civilisation

James Quayle 7P

Our world today is separated into continents, and continents into countries. These anthropogenic borders are how people are able to make sense of place and belonging on earth. However, long ago this myriad of lines and boundaries was not that as clear. The existence of land bridges changed the very nature of the land on which we live. Land bridges are pieces of land that link together continents and large groups of countries. Today, you can still find examples of land bridges. There is the Isthmus of Panama that links North and South America, and there is the Sinai Peninsula that links Asia and Africa. But once there was: Adam's bridge, which linked India and Sri Lanka; the Doggerland, which linked Britain with mainland Europe, and the Bering Land Bridge, which linked Asia with North America.

It is these paths that we believe early humans took to colonise the world. The group of species Hominidae originated about two million years ago in what we now call Africa. A variety of different types of genus arose from this group: one of which was the genus Homo. From this evolved the last extant species of human, Homo sapiens. To get from Africa to the rest of the world, they used the land bridges of the time to explore and populate regions.

Their transition through the Sinai Peninsula gave them the opportunity to travel westward and to explore Europe and later Great Britain using the Doggerland (a land bridge formed primarily of chalk between England and France). When man travelled east into Asia, they reached Oceania (a continent that was less split up by islands than it is today). Further northern exploration brought them to the Bering land bridge. This was the only way into the New World: North and South America.If land bridges, such as the Doggerland and the Bering land Bridge were still around in modern times, the territorial rights and sovereignty of countries could have looked much different. For instance, during the Elizabethan Times, King Phillip of Spain sent the Spanish Armada to conquer England. This failed due to rough seas and strong winds over the English Channel. If the Doggerland had still been around, the Armada would have instead been an army that had invaded England by land: potentially having succeeded in their intentions. In the twentieth century, both World Wars would have been affected by these land Bridges. Germany, whilst occupying France, would have been able to continue their blitzkrieg into England. The fact our nation is an island was the main reason why this did not happen. On the other side of the world, the Bering land bridge could have influenced the Cold War. The borders of the USA and Russia would have been blurred due to this sinew of land, joining two powerful enemies together by the physical landscape.

If land bridges, such as the Sinai Peninsula and the Isthmus of Panama, did not exist, it would be the same story. Without the Sinai Peninsula, the spread of the Abrahamic religions would have been slowed. The Isthmus of Panama not existing would have delayed animals and man's migration into South America. This decrease in animal species could have limited the biodiversity that can be found in the Amazon Rainforest and may have changed the very nature of human evolution.

Land bridges as a whole have had a great impact on our coastlines: shrinking them, expanding them and being responsible for a variety of other geographical divisions that are integral to peoples identify, culture and understanding of the place in which they live. Over time we may see more land bridges disappearing due to sea level rise as a consequence of climate change. Over millions of years we may see new land bridges forming, disrupting political boundaries and changing the face of earth as we know it.


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The 'Box'

Mr Pletts

The 'Box'; the most important technological advance enabling the march of globalisation. You have probably heard this before about the humble shipping container, or at least words to a similar effect, to describe its vital role in global trade. There seems to have been a recent fascination with them in popular culture. Channel 4's Grand Designs has witnessed cutting edge architecture forged of these steel building blocks. Shows such as 'Container Wars' and 'Storage Hunters' feature collectors bidding for the contents of various containers. BBC News even painted and tracked one of these 'intermodal containers' on its journey across the globe for a year. However, the development and proliferation of the shipping container, whilst changing the world dramatically and providing the means for rapid development, was not, at least initially, good news for everyone. In this article I will look at how the container came to be, how the development of the technology affected the world's coastal areas and what the future holds for stackable cuboids.

In the 1930s, London's Docklands was the centre of the world's maritime freight, employing over 100,000 dockers and other workers. The hive of activity enabled Britain to import and export goods to and from the rest of the Empire. The job of the dockers was to load and unload goods from the many thousands of small barges and ships that entered the large number of enclosed docks along the Thames, such as St Katherine Docks. The work was physically challenging but relatively unskilled and provided income for the large working class population of East London. Meanwhile, in North Carolina, USA, a young haulier named Malcolm McLean was transporting empty tobacco barrels to port. Waiting for his lorry contents to be loaded onto ships inspired him to develop a more efficient method; the lorry itself needed to be placed on to the vessel. Although his plans were to be modified over the next twenty years, by 1956 McLean had purchased and modified a World War II tanker and converted it to carry metal trailers. The SS Ideal-X was the world's first container ship and would transform commercial shipping forever. These vessels quickly grew in size and by the mid-1960s, they were already too large for London's upstream docks. The importance of London as a global port diminished, whilst deep water harbours around the world began to dominate. The impact of this change was far more significant than simply a shifting geography of trade; the socio-economic transformation in port towns was dramatic. The inability of ports such as London and Liverpool to adapt to containerisation led to a decline in heavy industry, exacerbated by the gradual disintegration of the British Empire. The loss of the docks and related industries in the East End of London saw the area experiencing the phenomenon of urban decline. This process involves a negative feedback loop or spiral of urban decay, where unemployment associated with the closure of industries, such as the docks, leads to less investment in the area, less tax income for local government, reduced maintenance of properties and infrastructure, a reduction in house prices and a wider loss of pride by residents in their own area. Crime can often flourish where there is a sense of despair. This creates the conditions for no-go areas and further decline. Many former industrial cities of Britain suffered this similar fate to the East End during the mid-twentieth century. The 'Box' was making a big impact on shallow ports around the world only months after its first voyage.

However, the shipping container, despite creating initial setbacks for some areas, should certainly not be looked upon as an overwhelmingly negative invention. Regeneration projects were established to convert the closed docks and other industrial brownfield sites (sites previously built upon) into homes and commercial spaces. Perhaps ironically, the technology that had led to the collapse of the Docklands economy was now enabling the transportation of materials for the construction industry, which was redeveloping these rundown areas. In 2015, around fourteen billion pounds worth of imports arrived from across the world to support the construction industry; much of it by Lift-on- Lift-off (Lo-Lo) ship. The UK exported just over six billion pounds worth to the rest of the world in the same year. In 2014, just over five million shipping containers travelled between UK major ports and international ports, with freight totalling 61.3 million tonnes. These containers carry not only large construction items, but all the essentials (and non-essentials) of life from toilet rolls to televisions and sofas to rubber ducks. In 1992, a single container fell from a ship in the Pacific Ocean, spilling 29,000 rubber ducks (which have since made journeys around the globe, washing up on every continent's beaches over the past twenty-four years!). The scale of this spill from one container highlights the incredible transformation in trade that this uniformly-shaped box facilitated. The quantities that can be accommodated in easily-stacked containers enable economies of scale to be achieved and this reduces the cost of the goods we buy. It has also enabled access to products that were not previously exported due to their size or shape. Of course it is not just one shipping container, but thousands, that are transported in a single voyage and the cost of transportation continues to fall. Products bought on websites such as Amazon from as far afield as China, can now arrive in the UK for no more than a pound or two in delivery costs. The low transportation costs per item have given foreign companies access to our markets and allowed them to develop retailing spaces on the high street and the internet. The same is true of a number of UK firms who have implemented a Despite this, many of us never really give a thought to the fact that our online order is just one of maybe mil

lions of individual products being exported on a single ship. Malcom McLean's SS Ideal-X had a capacity of just fifty-eight containers. Since 1956, the size of the world's largest container ship has grown exponentially and it continues to grow. In 2015, the CSCL Globe made her maiden voyage. This behemoth is capable of holding 19,000 containers and is 400m in length. Just imagine the number of rubber ducks it could accommodate – you do the maths! The size of the modern generation of container ships may have opened up world markets; however, it has limited the number of ports that are large enough to handle them and transformed the locations of these ports from rivers and shallow seas in developed countries to deep water harbours in industrialising nations. Ports in China and in South Korea have become amongst the most important in the world. In fact, of the ten largest container ports in the world, nine are in East Asia; Dubai is the only exception. Within Europe, many of the countries' ports rely on smaller Roll-on- Roll-off (Ro-Ro) ships transporting lorries, due to the geography of their coastlines and seas; the Solent, for example, is treacherously shallow (at low tide) for the massive container ships, as they head for Southampton. Larger ships have meant ever-larger shipyards to build them; ever-larger cranes to manoeuvre the parts and containers; and ever-larger docks to accommodate them in port. Shanghai's Yangshan terminal was built on reclaimed land out at sea to allow Shanghai's port to become the biggest in the World, whilst Hyundai's Ulsan plant in South Korea is home to the largest dry dock in the world for ship construction, measuring 672m in length and 92m in breadth. Nevertheless, despite the negative impact that containers had on its Docklands in the mid-twentieth century, London's financial clout and maritime history means that it remains the global leader in shipping services. It controls a third of the world's shipping insurance market and it also handles the majority of maritime dispute arbitration, according to Maritime London, a non-profit industry group. London's new deep water port in Essex, DP Thames Gateway (with capacity for the biggest ships in the world and

excellent links to the City of London), aims to rival Southampton and Felixstowe and re-establish London as a world top-fifty port in the coming decade.

n summary, the shipping container has clearly had a dramatic impact on economic and social geography, as well as transforming some of the world's coastal geography. However, the container has also had an impact on urban geography in a more surprising way; it has been used as a building material itself. In the heart of Docklands, 'Container City I' was established in 2001, providing twelve work studios for local businesses. It completed the urban development cycle in the region from decline-by- container to renewal-by- container and proved what a multifunctional structure the 'Box' can be. Similar projects have sprung up across the UK and the Iworld to create sustainable buildings from these waste products of shipping (especially during the slowdown in global trade, which had begun in the early 2000s and took a nosedive following the recession of 2008). The shipping container proved vital to the city of Christchurch following the earthquakes of 2010 and 2011, when much of the city centre was damaged. Brightly coloured containers were brought in and stacked to house much of the retail district in a new development known as 'Re:START', which has grown to host over fifty business in the central business district. A development, which began life as a temporary measure, has become so iconic and popular, that it is likely to remain a component of Christchurch's geography indefinitely. Much the same could be said about the starring role in trade that the shipping container plays globally. It is possible that its status may be challenged in the future by cargo planes; however the impacts of flying on global warming and the current physical limits to the size of aircraft, mean that the container ship will continue to be a leading mode of freight transport, unless someone emulates Malcolm McLean and 'thinks outside the box'!

Coastal Reefs

James Wainwright 11GR

For centuries the coastal reef habitat has provided sanctuary for a plethora of undeniably beautiful marine creatures. Reefs are paramount because they bring in billions of dollars to the world's economy through tourism, protect coastal homes from storms, support promising medical treatments, and provide a home for millions of aquatic species. However, even as I type this article right now, some of our world's greatest natural beauty is being destroyed.

The coastal reef is an incredibly fascinating ecosystem; but how do coral reefs come to existence?

Coral reefs begin to form when free-swimming coral larvae attach to submerged rocks or other hard surfaces along the edges of landforms. As the corals grow, the reef will take on one of three defining characteristics: fringing, barrier or atoll. Fringing reefs, which are the most common, protrude seaward directly from the shore, forming borders along the shoreline and surrounding islands. Barrier reefs also border shorelines, but at a greater distance. They are separated from their adjacent landmass by a lagoon of open, often deep water. If a fringing reef forms around a volcanic island that subsides completely below sea level while the coral continues to grow upward, an atoll forms. Atolls are usually circular or oval, with a central lagoon.

In addition to being some of the most biologically diverse habitats in the ocean, barrier reefs and atolls are also some of the oldest. With growth rates of 0.3 to 2 centimetres per year for massive corals, and up to 10 centimetres per year for branching corals, it can take up to 10,000 years for a coral reef to form from a group of larvae. Depending on their size, barrier reefs and atolls can take from 100,000 up to 30,000,000 years to fully form.

The coastal reef occupies less than 0.25 percent of the world's marine environment, yet it harbours twenty five percent of all documented marine fish species. Nonetheless, reef degradation is occurring at an alarming rate. The world has already lost 27% of it's reefs. If present rates of destruction are allowed to continue, 60% of the world's coral reefs will be destroyed over the next 30 years. Furthermore, coral reefs are found in 109 countries; significant reef degradation has occurred in 93. These disconcerting figures suggest not only has the rate significantly increased over the past century, but humans are inadvertently to blame.

There are two different ways in which we as humans have contributed to the degradation of the Earth's reefs; both indirectly and directly. Indirectly we have destroyed their environment, coral reefs can only survive in very clean clear water. So the large influx of dense coastal populations has lead to: the silting of reefs, pollution has lead to algal growth that has smothered the coral and overfishing has lead to an increase in predation on the coral.

Furthermore, the warming of the ocean causes corals to sicken and die. Even a rise of one degree in the average water temperature can damage the coral. Due to global warming, 1998 was the hottest year in the last six centuries henceforth 1998 was the worst year for coral.The most obvious sign that coral is sick is coral bleaching. That is when either the algae inside die, or the algae leave the coral. The algae are what bestows coral its color, so without the algae the coral has no color and the white of the limestone shell illuminates through the transparent coral bodies. People have been noticing coral bleaching since the turn of the century, but only since the 1980s has it begun to become detrimental.

Moreover, directly humans are deliberately physically killing the coral. All over the world, but most prevalently in the Philippines, divers catch the fish that live in and around coral reefs.
Often they blow up a coral reef with explosives and then catch all the stunned fish swimming around. This completely destroys the reefs, killing the coral polyps that make it; as well as many of the plants and animals that call it home. In addition, the creatures that do survive are left homeless.

With immediate and strong action, however, there is hope that coral reefs could find a way to rebound. These actions include stricter government regulations on greenhouse gas emissions, overfishing, and water pollution, which could take years to implement. However in the shorter-term, 3D printing technology just might be the answer. At the Larvotto Marine Reserve in Monaco, home to hundreds of diverse plants and water animals, six new 3D printed coral reefs have just been revealed that, once submerged 27 meters below the water's surface, promise to maintain biodiversity and allow marine life to thrive, restoring hope that our ocean life can still be saved.

While the concept of artificial reef ecosystems already exists, they are traditionally made from concrete poured into a mould, and lack the complexity of caves and connecting tunnels that appear in natural reefs, prohibiting wildlife from safely settling in. What makes these reefs stand apart is that rather than concrete, they were 3D printed with actual sand, allowing them to better mimic natural formations. Initial tests have shown that compared to the concrete versions, marine life quickly appropriated the sand-based constructions. Each reef required 13 hours of printing on a machine installed in Italy, using natural sand from the Dolomites.

A few years ago, an Australian-Bahraini team produced the world's first 3D printed reefs with the same intentions, showing that the technology can be duplicated around the world and implemented in various conditions. Nevertheless, these 3D printed reefs are just the beginning of a long but necessary process to restore our coral reefs and thereby save marine biodiversity.

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7th June

Amazon Reef

Nathan Livingstone 9BR

A recent article on an "impossible coral reef in the Amazon" grabbedmy attention and sent me on a journey of discovery. The Times reported that, "a vast reef 600 miles long and covering almost 4,000 square miles has been found at the mouth of the Amazon river, in a place where oceanographers thought coral could never grow."

Researching more I learnt that corals mostly thrive in clear, sunlit, saltwater. Corals require a certain balance of salt to water which is why they don't live in areas where rivers drain fresh water into the ocean, such as estuaries. Corals also require clear water so that the zooxanthellae (algae) which form part of the symbiotic relationship with the coral can photosynthesise. If the water is too cloudy the coral will die. Despite this, the waters near the mouth of the Amazon are murky, muddy and full of sediment and constitute one of the biggest riverine estuaries in the world. Each day, one fifth of all of the water flowing from the earth's rivers into oceans does so as the Amazonian flume. Over the course of the Amazon's 6400km, sediment accumulates and is washed down the river before being deposited into the Atlantic Ocean.

A team of scientists, led by Dr Patricia Yager (Professor of Marine Science at the University of Georgia) originally set out to sample the new reef at the mouth of the Amazon but met with resistance from the Brazilian Navy, in both 2010 and 2011 being denied access. However, after teaming up with Brazilian colleagues including Dr Rodrigo Moura (Reef Ecologist from the Universidade Federal do Rio de Janeiro), they were finally given permission to go ahead with their research.

Having been inspired by previous studies from the 1970's which reported catching reef fish along the Continental Shelf, Dr Moura persuaded the team to shift focus and concentrate on trying to locate the illusive coral reefs. Two further expeditions in 2012 (on board the ship Atlantis) and in 2014 took place.

Remarkably, during just one week of 'ship time' the 30 oceanographers on board were able to survey the Outer Amazon Shelf and discovered a unique carbonate reef system of approximately 9500km. The area lies between the French Guiana Brazil Border and the Maranhao (Maranhão) State in Brazil.

An extensive range of sampling techniques was used to survey the reef including:

- Side scan sonars to obtain sonographic images of the Amazon floor

- Rosette samplers, which are deep water sampling devices comprising of 12 to 36 sampling bottles arranged around a central cylinder, where additional sensors can be added

- Dredging, both heavy metal dredges and bottom trawl nets

- Sponge microbe sampling

- Virus filtration

I contacted Dr Yager hoping to learn about the teams work and plans for future research. I posed five questions about her discoveries and her responses are summarised below.

1- How do you plan to complete the full map of the reef? How long do you think this will take?

We only had about one week of ship time to survey this area and we figure that we have only covered maybe 10% or less of what we think is there. Some extensive surveying will be required and it will likely take at least a month or more. The first thing to do would be to use a high-resolution Multibeam system (a type of sonar that is used to map the seabed. Like other sonar systems, multibeam systems emit sound waves in a fan shape beneath a ship's hull. The amount of time it takes for the sound waves to bounce off the seabed and return to a receiver is used to determine water depth) to make a map of the seafloor. In the shallower waters of the shelf, the swath size isn't as wide as in deeper waters, so it will take a lot of miles of transiting to make a good sea floor map. The reefs show up as slightly elevated (shallower) features on the map. Here's a screenshot from the computer that found the first reefs in 2010. The red indicates shallower, the blue is deep. You can see the outline of the ship (a pointy rectangle near the center of the image) for scale. The ship is about the size of a soccer field. Once we have a good map, then I think it would be good to use a Remotely Operated Vehicle (ROV) to photograph or video the reef rather than dredge. Dredging is destructive, so I hate to use that more than we have to. The ROV will have to be very powerful because the North Brazil Current is quite fast there. At some point, we do need to take some samples of the animals (you can't always tell what they are just by looking), but sometimes the ROV can have a robot arm to do that. The reefs are deep (50-100 m), so they are very difficult to dive on (not impossible, though).

2- Do you suspect that there could be other hidden coral reefs in the world? If so, where do you think they might be?

Absolutely. I think humans have observed a smaller fraction of the seafloor than we have of the moon! It is a vast undiscovered part of our planet. We know that reefs can be found quite deep. Some cold-water coral reefs in the deep North Atlantic, for example, are entirely independent of photosynthesis.

3- What ecological impact does your team's discovery have?

These "marginal reefs" may help us understand how corals and other reef animals live in what we might think of as "suboptimal" conditions. They may also provide previously unknown connections or refuges be

tween other reef ecosystems (e.g. connecting the southern "blue water" Brazil and the northern Caribbean reefs). These reefs are also very important nursery grounds for many open water fish species. It's important to keep track of these areas so that we can set anappropriate number of them aside as "marine protected areas" (MPAs). These have been shown to be important for fishes across the world (even those not living in the MPAs).

4- Have you faced any opposition to your research? If so, how have you convinced others to allow you to continue your research?

This is an interesting question. All good science is peer-reviewed so there can often be disagreement, especially when it comes to funding or publication, but peer-review usually improves the ultimate outcome and the science is stronger. I have not personally faced political "opposition" from anyone to my science, only to the logistics. In the US, our core research program was funded by the US National Science Foundation (NSF) and the private Gordon and Betty Moore Foundation (GBMF). Both of these proposals were peer-reviewed and received scientific community support. There was initially some difficulty in convincing the oceanographers that we needed to sample the river before we could understand the plume in the ocean, but eventually we overcame that hurdle (thanks to GBMF, who do a good job of filling high-risk science gaps that NSF has a harder time funding). The Brazilian Navy, several Brazilian science agencies, and even the oil company Brasoil, provided funding and logistic support for the second expedition in 2014 to sample the reefs more completely than we could do in 2012 onboard the Atlantis. They needed a much bigger team and a way to get the samples back to Brazil (which would have been almost impossible from a US ship). This effort was a very important part of the project and made the publication this year possible. Now, I understand, some of the oil companies are not so happy about the paper, especially the part at the end where it talks about how we should probably map the area better and establish environmental impacts before drilling there. There are also some ramifications to any fisheries there, most of which are artisanal at this point, but could ramp up in response to knowing about the reef. I don't know if there is "opposition" to the surveys though. It seems like they would want to support the effort. There may be some areas they can drill safely and they will want to know that.

5- And finally, what was the most exciting species you discovered in the Amazon Reef?

I think my favorite sponge was the blue and yellow Verongia they found. But I also like the rhodoliths. These are the bright pink "rocks" made from calcareous algae. I didn't know much about them before this discovery, and certainly had no idea how important there were in this area.

The National Oceanic and Atmospheric Administration have reported that we are in the throws of the third major coral bleaching event on record, with factors such as; pollution, overfishing, ocean acidification and climate change already taking their toll on the world's rivers. Dr Yager and her team's findings may mean that in the next few years there will be similar reefs found in the Nile, Yangtze and Mississippi Rivers. The Mediterranean, Yellow and East China Sea and Gulf of Mexico are all suffering similar challenges with loss of coral reefs. These findings highlight once again the importance of understanding anthropogenic impacts on the world's ecosystems and the need to understand their importance fully, before damage or exploitation of these areas render them defunct. However, the exciting discovery of the Amazon reef gives us hope for the future of the world's coral reefs.

Oil Exploration

James Hudson 12GR

Drilling for oil is undoubtedly a subjective, even controversial topic. Therefore, many opposition groups, like Greenpeace, exist to protest about drilling. Drilling is a risky process, with the possible impacts devastating if a spill was to occur and coastal areas are particularly vulnerable to this. This is because the use of large petroleum tankers (in 2007, the Central Intelligence Agency estimated there to be 4,295 tankers with a dead weight of 100,000 tonnes) means that a lot of crude oil is transported by sea and any oil slicks will severely affect the marine environment and oil can be washed ashore by currents and the waves. Similarly, the high number of offshore rigs poses the same potential problems as the tankers, if any accident were to take place.

In August 1859, Drake and Bissell became the first people to successfully drill for oil, and since then, the oil industry has boomed, playing a major part in the industrialisation of the more economically-developed world. As oil is a reliable and high-density energy source, it has allowed these countries to enjoy their high standards of living in a consumerist and materialistic society. Oil has allowed great demographic advancements to occur such as decreasing death rates, lowering infant mortality and greatly increasing life expectancy. This is because the exploitation of the resource has allowed us to develop many new materials and devices, such as polymers for plastics. Even more basic things, such as central heating, which has greatly reduced winter deaths, especially amongst the elderly in the developed world, have hugely impacted upon our lives. The importation of this technology into the developing world means transition has also begun here and thus oil has become a very important, highly sought-after, resource across the globe.

Oil spills have happened before. In 1989, a tanker struck a reef in Alaska (the Exxon Valdez disaster), which ultimately led to 100,000 marine wildlife deaths. This wide-scale devastation occurred because many species, such as sea otters are dependent on their fur being clean, in order to stay warm. Then as they clean themselves of the oil, poisoning ensues. From oil rigs, there were 125 spills from the USA's Outer Continental Shelf during Hurricanes Katrina and Rita alone, discharging over half a million gallons of crude oil into the ocean. This certainly has a severe negative environmental impact on the affected area, as the populations of marine species have been drastically reduced. Moreover, these events lower the biodiversity of these species, making them increasingly vulnerable to other man-made problems; for example, rising mean sea temperatures and global warming.

Additionally, the entire ecosystem will be impacted by the spill, indirectly if not directly, because decreasing

numbers of certain populations will impact upon the whole ocean food-web for a considerable time. As the most heavily affected species slowly recover, less food is provided for higher up the chain, causing a population slump, and uncontrollable population growth may happen lower down the trophic levels if there are fewer predators.

However, what is so important about the environmental impacts is that they are prolonged and even worsened by the ineffectiveness of current clean-up methods. Hence, a significant percentage of the oil remains in and around the area of the original spill, massively slowing or even preventing the recovery of the environment. Following the Exxon Valdez spill, 20,000 gallons of oil still remain in the vicinity, still causing long term pollution and damage. Similarly, the drilling for oil itself is a constant basis of pollution, as one well, on average, releases 40,000m 3 of oily waste, along with many toxic gases into the atmosphere.

Drilling can also severely impact upon the local economies of areas, as the opportunity to earn income (through fishing and tourism) is reduced. In the case of fishing, the inevitable pollution caused from even the most careful of drilling can contaminate the fish stock, making it unsafe for consumption and thus crashing the economies dependent on fish from these areas. In terms of tourism, the destination becomes less attractive to holiday-makers, when the natural view out to sea could be blighted by rigs and furthermore, if a spill does occur, then the entire coastline for miles (the oil from Exxon Valdez travelled to shorelines up to 600 miles away) is hugely damaged, because of the toxicity and adhesion of crude oil, which prevents usage of the beach and scars the landscape.

Consequently, the economy of these coastal settlements could be badly hit, having great social implications; for example, the standard of living of the locals may be reduced and the areas may go into a spiral of decline. In Florida in 2008, there was around $170 million worth of commercial fishing landings and the estimated value of tourism to the coastal state was $62 billion, with this industry providing employment for just fewer than one million people. However, as a result of the Gulf of Mexico Loop Current, the Floridian coastal areas are at a severe risk if a major oil spill in the Mexican Gulf were to occur. Whilst it is true that this is all hypothetical and an event like this has not yet happened to the area, in 2012 this region contributed 19.5% of the USA's total oil production for that year. This means it is a heavily active area with the potential for things to go wrong. Moreover, there are estimated to be 27,000 abandoned wells in the gulf too, so it is highly possible that unmonitored leaks could be occurring even right now. The 2010 Deepwater Horizon spill in the Mexican Gulf exemplifies the dangers to Florida and nearby coastal states.

If we are unable to harness sufficient energy through renewable sources, although more could easily be produced in this way, then drilling for oil will need to continue to enable our current lifestyles to continue. Despite these concerns and past incidents, modern methods are improving and directional drilling, where there are more wellheads in one location lessening the impact for an increased amount of produces, has shrunk the environmental risk. This helps to protect ecosystems and coastal resorts. More techniques can be, and are being, employed to limit the impact of drilling on the environment. As a result, it could now be argued that the issue is less about the impact of drilling, but more about the limited amount of oil, a finite resource, which we have left to extract.

In conclusion, the transport of oil over water, and the increasing prevalence of offshore rigs, have increased the risk of oil damage to coastal environments, the fauna which live there and the societies which are dependent upon these areas. Yet, while there have been tragic accidents, given the sheer scale of drilling, there are relatively a minimal number of incidents, which are highly publicised when they do occur. Therefore, whilst the impact needs to be further limited and better clean-up methods need to be utilised and researched for, drilling is a necessary process in the technological age in which we live.

Geo Grad

Matt Tiplin

Matt left Sutton Grammar in 2002 with A levels in geography, history and physics. He went on to study an undergraduate degree in geography with economics at the LSE before training to be a teacher in Canterbury. Having joined a south west London school as an NQT in 2006 he went onto hold a number of posts before leaving there as acting deputy headteacher in December 2015. In that time Matt completed a postgraduate Masters degree in education and is now one of Her Majesty's Inspectors of Education, working for Ofsted.

Is wind power a sustainable solution to our energy demands?

It feels like all too long ago that I left Sutton Grammar School, having completed my A Levels, looking forward to a long summer holiday with the football World Cup in South Korea and Japan to kick it all off. My studies at A level were a solid foundation for my degree which was focussed squarely upon 'human geography' and our interactions with the physical world, scrutinising how we exploit the World's resources in order to advance our standard of living. Learning from experts in their fields, whose research was at the cutting edge of socio-economic and geopolitical thinking, was exhilarating and made me realise what a difference individuals can have, particularly when they collaborate towards a greater goal. That realisation heavily informed my decision to become a geography teacher because I wanted to help young people, some of tomorrow's decision makers, better understand the world around them and their role in it. Throughout my career I have worked towards that ambition with the belief that by enhancing our collective understand of fundamental issues we can make a positive difference.

One of the most significant and persistent issues in that time has been how to sustainably meet our energy demands. Within a context of ever increasing demand from an increasingly affluent population whose standard of living is crucially underpinned by labour saving and leisure devices that demand energy, supplying the demand requires new thinking.

This is a global issue that requires collaborative solutions but I am going to focus upon our country's approach and discuss some of the arguments involved. Specifically I'll be discussing electricity production because despite our lingering love affair with gas hobs and boilers, electricity is considerably more versatile with the option for feasible sustainable production. Is wind power generation the answer?

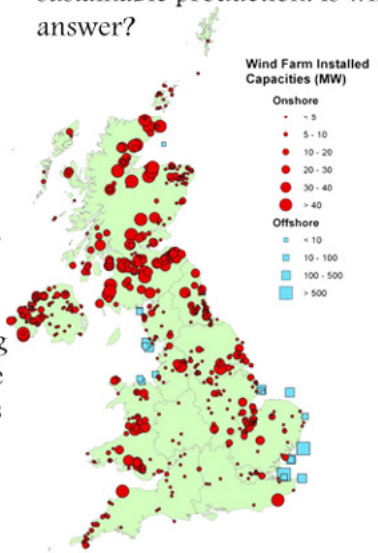

Figure 1 Location of wind farms UK

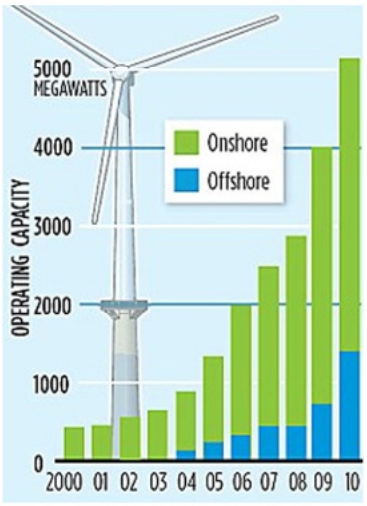

Figure 2 How wimd farms have grown in the UK

Figure 1 shows where the UKs wind farms are located today and the map informs part of my decision to focus upon wind energy in this piece. We are an island nation both physically and now perhaps even more so figuratively too. We have a natural resource at our disposal that is barely exploited. Unlike Iceland that has grasped the renewable energy bull by the horns, we aren't in the same rodeo.

Today, most of the UK's household and commercial energy demand is met by coal and gas fired power stations, but as figure 2 shows, wind is on the rise. The problem with generating electricity is that it is incredibly difficult to tap into natural sources (e.g. a lightning storm) and it is also very energy consuming to create not to mention very inefficient; around half of the energy from gas and two-thirds of the energy from coal and nuclear power stations is lost as heat during electricity production. Despite this, as recently as 2012 over 1/3 of the UK's electricity production came from coal fire power stations. But this came under increased pressure due to the impact of coal burning on the UK's ability to meet its climate change emissions target pledge. While it is now likely that the UK will no longer have to meet any EU carbon reduction targets, one can assume that more broadly commitments made at the Paris Conference in 2015 will continue to be honoured UK government obligations. So the need for change is there, not just because

of the reality of dwindling fossil fuel stocks.

What is the UK's current energy mix? I mentioned before most of our electricity currently flows out of coal, gas and nuclear power stations. Very little of our electricity is imported and the government's target for 2020 is to meet a 15% goal for renewable production, most of which it is hoped will come from wind power via on-shore and off-shore wind farms.

The UK's position on the Earth's surface is ideal for exploiting wind power. While there are certainly windier places on the planet's surface (the Sothern Ocean for example, but let's face it that is a very long way away), the combination of having a large energy thirsty population located on the edge of an economic hub (attracting more people), surrounded by water (long fetch prevailing wind) and located within the Ferrell global atmospheric cell (daily changes in weather conditions – rarely calm all over the UK) creates a superb mix of factors that make wind a favourable option. Indeed, it is for those very reasons that wind power has been an essential source of energy (and thus development) for populations of Western Europe for a long time; windmills in the Netherlands and the sea faring nations of Portugal, Spain and the UK. So why doesn't the UK produce more electricity using this ubiquitous supply of natural energy – a source of energy that will not expire until the sun does? I would suggest that there are three major (albeit not exhaustive) reasons – economic cost of production, storage of the surplus and NIMBYism. (NIMBY = Not In My Back Yard)

There are two types of wind energy production – on-shore and off-shore and the location of the UKs current turbines is described by Figure 1. Depending upon which flavour one focuses upon the relative benefits of cost, impact upon people and the environment and storage vary. As such the overall benefits of wind energy vary when compared to traditional sources. But let us consider an 'aggregate' for comparison i.e. on-shore and off-shore combined.

The most obvious issue associated with wind turbine electricity production is similar to the problem associated with any form of electricity production that requires nature to play its part – if the wind dies down then the turbine stops turning, electricity stops coming down the line. This makes wind energy a costly proposition, not just because electricity produced by wind turbines can be more than four times as expensive per kilowatt hour than natural gas, coal or nuclear, but there is also an opportunity cost associated. i.e the cost of the turbine sat there doing nothing. Compared to fossil fuel and nuclear sources, wind isn't currently very efficient working at around 18 to 25% capacity in the UK at the moment.

An altogether more challenging problem is that it would take approximately 7000 wind turbines (costing about £2.7m each) to match the electricity output from one nuclear power plant (costing about £2.25bn each). To put that into context, the UK currently has a total of 6857 costing £18.5bn already – all of which need to be supplemented by conventional methods every time the country enjoys a high pressure heat wave. It is a fact that even in Iceland, where 100% of their electricity comes from geothermal or hydro power, oil is still relied upon as a reliable back-up.

One solution to the variability of supply from wind energy might be to store electricity from windy days for use on calm ones. Typically it has been difficult to manage energy production from wind and other natural renewable sources. Unlike a gas, coal or nuclear stations where engineers can control the production rate to suit demand (imagine engineers turning up the gas tap when the FA cup final kicks off), we can't control the speed at which the wind blows, the river flows or the sun radiates. We either use the energy as it is produced or much of the over-supply is wasted from renewables. Batteries are growing, both in size and efficiency but there comes a limit. However, a recent innovation out of Rhode, County Offaly in Ireland could be the answer here because scientists have developed a new system using a motor-generate flywheel mechanism to store surplus electricity as kinetic energy that can then be fed back into the grid at will. The obvious draw back again is cost of production but at least a solution is emerging to the storage conundrum. A solution that can also be located close to high demand population centres but be fed by distant wind farms.

So if we can assume that power will become more economically viable as time goes on because technological solutions become more cost effective and as fossil fuels become scarcer, then how will people feel about having turbines popping up all over the country? Currently power plants are, for obvious reasons, peripheral to most of the country's large urban centres. Wind turbines, by contrast, are potentially more people friendly, no? Well not exactly. When plans were first published for the wind farm on the Kentish Flats, significant opposition came from people who lived and worked in the region because they felt and continue to feel that windmills are unsightly (up to 150m tall), noisy and disruptive to existing habitats. The NIMBY argument is a tough one to resolve unless you experience the impacts first hand, but it is certainly true that how turbines look, sound and operate are a significant barrier to their proliferation around the coastline. But there is hope because despite off-shore turbines costing more initially that on-shore versions (hence there far more on-shore currently in operation) there is far less public opposition to wind farms out at sea.

The energy debate is a complex one and certainly far more developed than I have been able to detailed here. However, the need for the UK and all other nations to considerably increase their investment into non-fossil fuel based electricity supply is both clear and obvious. I haven't touched upon the geo-politics involved in the global energy market and that certainly plays a significant, if the not the most significant, role in governments' decision making today. Figure 3 outlines the UK's energy mix today; the problem is self-evident. But as time goes on and fossil fuels become scarcer and thus more costly, all the while new technologies find innovative solutions at falling prices, then there is no doubt increasing room for wind in the UK's energy mix.

It seems inconceivable that a country that happens to be located within the subtropical high pressure belt wouldn't consider investing into solar energy. Similarly it would seem foolish to ignore the obvious, free source of energy that the UK could further exploit. Costs will fall, storage will improve and people will become more accepting if wind is combined with other renewable solutions. By the time you sit down to reminisce about Euro 2016 (perhaps not the football itself but the fun of watching it with friends) then perhaps the electricity powering your 4D Ultra HD TV will be from a coastal wind farm.

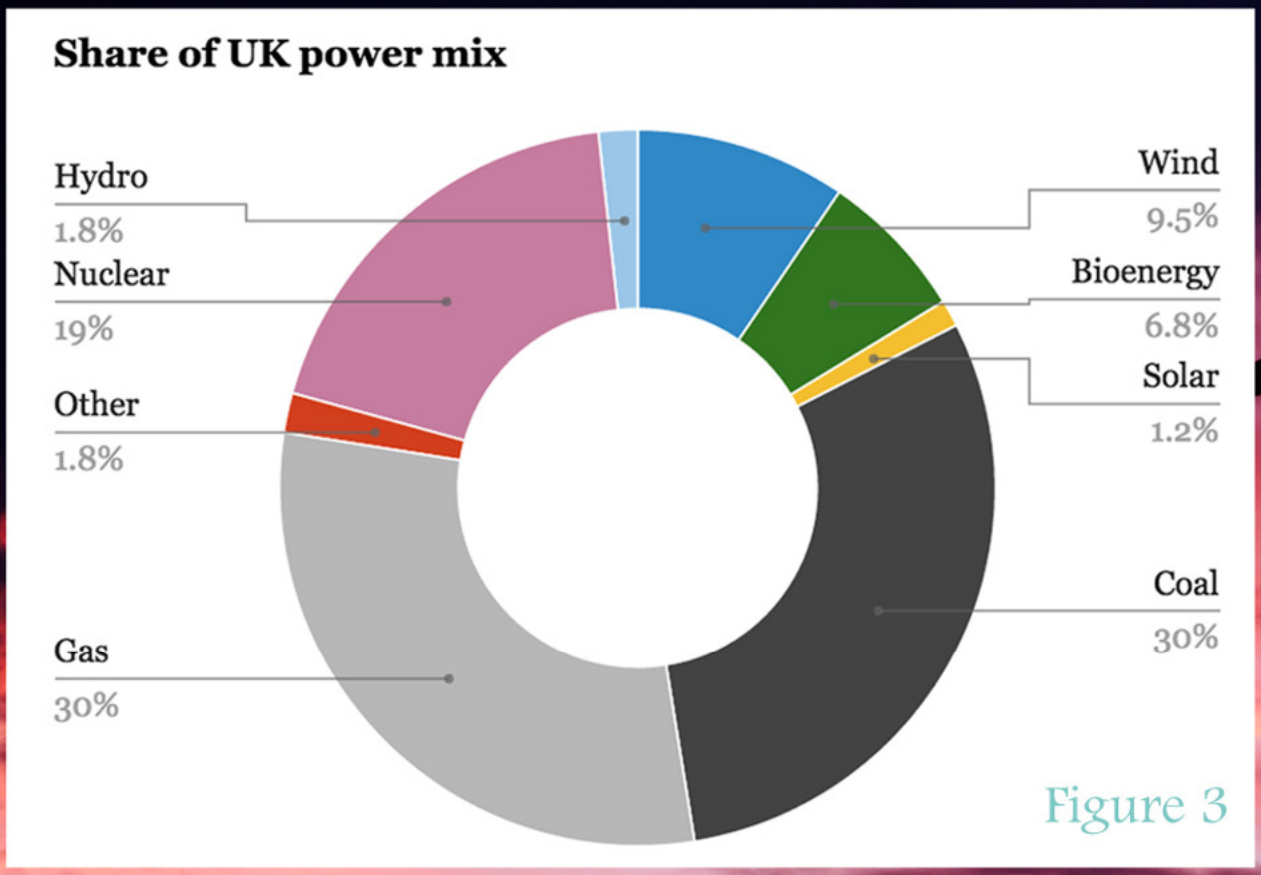

Figure 3

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