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Untitled
Mixed media, foam

Looking at my piece, you are probably asking yourself what in the world is *that*? It is a Copepod. Copepods are a subclass of aquatic crustaceans and the most common type of zooplankton. Most are only around a millimeter in length.

Copepods come in more fun colors than simply black. I wanted my piece to represent oil so I sanded and spray painted it many times to make it shiny. There may seem not to be any connection to oil, however all petroleum oil is composed of the remains of ancient zooplankton and phytoplankton. The main reason I chose to do a type of zooplankton is because most phytoplankton are single celled plants. They only come in basic shapes and I didn't want to be the person with only a shiny ball on a stick. I want my piece to represent the history of the formation of oil. I chose to create a modern-day copepod to tie the ancient history of oil to its present use.

Most of my artwork this semester has been more abstract and emotion based, but I wanted to come back to my roots. This is my fascination with the environment and every type of science. I was a nine year old that came crying to me and my sister's therapist about climate change. There are rumors that humanity is entering the next mass extinction through global warming. We may not yet know if that is true, however our oceans are currently in the process of losing oxygen. Oil and natural gas form from periods when parts of the ocean lose some or all oxygen. Many of these ocean anoxic events (OAE) are connected to previous mass extinctions. Most of the greenhouse gasses emitted in the US come from the burning of fossil fuels (mainly oil and natural gas). This may convey a grim tale, but at least it would be fitting that we may be creating the very thing that might end us: oil.

Building on Bones

Ancient to Modern History of Oil

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The Oxbow School

OS46

Writer's Note: Oil is the most common source of energy in today's world and yet there is considerably little study on its formation millions of years ago. How can knowing this history help us understand its impacts in the present and near future?

It is currently nearing the end of April and the gas price at the nearest AM PM, the one my parents always go to, is $5.69. The average gas prices in California at the end of last year was $3.76 per gallon (U.S. Energy Information Administration, 2021). In my opinion, it seems like a good time to phase out gasoline and switch to electric cars. Maybe. Unfortunately, there are many things that make that difficult, and besides, how do we really know that electric cars are that much better? America, being America, is pretty adamant about continuing to support Big Daddy Oil. I am not talking about you! I am talking about the oil companies that have run our economy since the 1800s, the oil companies who still run our economy, and the oil companies that will most likely continue to run the economy for years to come. Knowing this, what may be the future of oil in our economy and in our environment in the coming years? I would like to know the answer to this question as much as you do, probably even more. Unfortunately, all we can find is clues. With this in mind, how can the history of oil, from its formation on the seafloor to its usage in powering technological production lend clues of the impact of petroleum oil in our current and future world?

Let's start at the beginning. Around 550 million years ago, much of life was in the ocean. Life was primitive, consisting mostly of early plankton. Oil was formed from the remains of those plankton. As those creatures died and fell to the ocean floor, they formed sediment. Over time that sediment would form oil. However, not all plankton died, fell to the bottom of the ocean, and suddenly became oil. Oil only has the possibility to be created in Ocean Anoxic Events, or OAE (Cey, Edwin, et al., 2019). When you put plastic wrap over a slice of unfinished lasagna it does not go bad as quickly as it would open in your fridge. That is because the plastic prevents any more oxygen from interacting with the slice. When the ocean experiences OAE, plankton do not decompose as quickly. As sediment with high total organic carbon from those plankton was buried under the ocean floor, water was forced out and proteins and carbohydrates broken down. What remained was oil shale. Oil shale contains a black waxy substance called kerogen and natural asphalt (Public Education and Outreach). When the shale was buried a mile or two beneath the seafloor at temperatures between 90 degrees and 160 degrees Celsius, shale oil was formed (Cey, Edwin, et al., 2019). That oil formed reservoirs buried beneath former seas. Around 70% of oil found today is from the Mesozoic era, 252 million years ago to 66 million years ago. Only 10% is from the Paleozoic era, starting around 550 million years ago and ending around 252 million years ago. The remaining oil was formed in the last 66 million years (Cey, Edwin, et al., 2019). Both petroleum oil and the olive oil you use to saute onions are formed from more or less similar compounds. All oils are composed of hydrocarbons derived from living or formerly living organisms.

Most mass extinctions are associated with mass OAE. Layers of black shale at the bottom of former oceans indicate periods of complete anoxia or hypoxia (meaning less oxygen). The first mass extinction happened in the Late Ordovician Epoch around 445 million years ago. The whole Ordovician period lasted from 488.3 to 443.7 million years ago with the extinction (Avildsen, Christina, et al., 2002). Like all of the major extinction events, the Late Ordovician Extinction was not one huge event where everything was wiped out in one fell swoop, rather, it was a combination of smaller events over a few million years. The result was that around 85% of all species went extinct (Cottier, Cody., 2021). Gondwana, the super continent consisting of what are now referred to as southern Europe, Africa, South America, Australia, and Antarctica, started moving towards the South Pole. As glaciers formed, the shallow tropical seas covering the continent drained. The tropical seas at that time had layers of ocean with different chemistry. These layers formed the water column. Certain layers had less oxygen, but were not well mixed because of sluggish circulation. As the glaciers formed, the water column was no longer stable and anoxic waters mixed with oxygenated waters (Melchin, Michael J., and Charles E. Mitchell., 1991). Multiple OAEs along with climate fluctuations resulting from global cooling, made species not adapted to a rapidly changing environment die off in great numbers. One of the species that went extinct were graptolites, tiny toothy structures that evolved over time to be able to drift about the oceans. They were planktonic organisms that lived in colonial structures (similar to coral) and fed on other tinier plankton (British Geological Survey, 2021). Although black shale formed under those former seas, Ordovician era oil is not common. Most pockets of shale with kerogens formed natural gas instead, most likely a result of greater temperatures (Bowman, Thomas D., and Prasanta Muki K. Mukhopadhyay., 2014).

The only thing clear about the Late Devonian Extinction is that it was associated with multiple OAE. Of these events the Kellwasser Event is the most extreme. Out of all the extinctions it was the least catastrophic (House, Michael R., 2017). The period lasted from around 419.2 - 359 million years ago and the extinction events mainly occurred in the later half of the period. The climate was unstable and oceans went through periods of anoxia and hypoxia producing signature black shale. At the end of multiple OAEs and environmental fluctuations, around 75% of species lay extinct (House, Michael R., 2017).

The next extinction happened around 252 million years ago at the Permian-Triassic boundary. At the very beginning of the Permian period the supercontinent Pangaea formed, assembled from all the major continents of today's world (Encyclopædia Britannica, 2021). The end-Permian extinction is attributed to a couple of conditions: anoxic oceans, high ocean acidity, and global warming (Hickey, Hannah., 2018). The eruption of the Siberian traps released clouds of carbon dioxide arributing to at least some of the rise in temperature. The water chemistry changed as more carbon dioxide was dissolved in them and as warmer waters were unable to hold the same amounts of oxygen. Permian-Triassic boundary sediments hold high total organic carbon content (TOC) signatures of anoxic environments (Encyclopædia Britannica, 2021). For many types of phytoplankton (species of algae), this was not a problem. Many species of algae prefer warm anoxic environments leading to mass algae blooms in the shallow seas covering Pangaea. As algae bloomed in the warmer waters and then died in large numbers, they decayed, sucking even more oxygen out of the ocean and intensifying already hypoxic conditions (Bergeron, Louis., 2011). Over 95% of marine species went extinct, creating what has so far been the greatest mass extinction in earth's history (Encyclopædia Britannica, 2021). Most of the world's oil reserves have been produced between the Permian Extinction and the most recent K-T extinction. The most productive oil fields in the US spans an area covering 75,000 square miles between West Texas and southeastern New Mexico in the Permian Basin (Railroad Commission of Texas, 2022).

Beginning directly after the Permian Extinction, the Jurassic period was a time of new life. However, life was not meant to last and the end-Jurassic extinction killed off a good 76% of all species at the time (Encyclopaedia Britannica, 2021). That period ended around 201 million years ago. The extinction was triggered by massive volcanic eruptions from the Central Atlantic Magmatic Province (CAMP), which filled the atmosphere with ash and carbon dioxide as well as other gasses (Chu, Jennifer., 2013). Oceans acidified, absorbing the carbon dioxide that was released into the atmosphere. Mostly of the creatures that went extinct were marine invertebrates (creatures without backbones) along with shelled marine creatures (Encyclopaedia Britannica, 2021). Dinosaurs continued to survive, but the earth would later correct that mistake.

The Cretaceous Tertiary Extinction, or K-T Extinction for short, ended the Mesozoic era. The Mesozoic era began around 252 million years ago and ended around 66 million years ago. When you think of the giant fireball that supposedly ended the dinosaurs you are thinking of the K-T extinction. The most probable explanations for K-T mass extinction are the outpouring of the Deccan traps along with the impact of a large meteorite. The Deccan traps are located near the fault line around what is now India. The outpouring of the traps straddles both sides of the boundary line between the Cretaceous and Tertiary periods, so it is unlikely that they are the sole cause of the extinction. Clouds of ash were released into the atmosphere and pouring lava created massive basalt flats (Cowen, Richard., 2000). In K-T boundary rocks, high levels of iridium and tektites show proof that a meteorite did indeed hit earth at the end of the Cretaceous period. Iridium is an extremely rare metal and is only found in earth's mantle or extraterrestrial rocks. Tektites are bits of odd shaped sand or glass formed on impact. They form when rocks are instantly melted and splashed out of impact craters (Cowen, Richard., 2000). The meteorite hit in the Yucatan Peninsula near Chicxulub, Mexico forming a crater 112 miles in diameter (Encyclopaedia Britannica, 2020). The meteorite hit with such force that it caused a massive tsunami that tore through the land and sea near the site of the impact (Cowen, Richard., 2000). In total, the extinction wiped out a good 80% of species.

Oil remained buried beneath former seas for the next 66 million years. Early civilizations used crude oil for various purposes and the earliest known wells were drilled around 350 CE in China (National Geographic Society, 2013). The first modern oil well drilled in America was in 1857 in Titusville, Pennsylvania and around a century later, coal was overtaken by oil. Around the start of the Industrial Revolution coal was a major source of power. Coal powered steam engines that in turn powered trains, steamboats, and all sorts of industrial machines. Coal was not without its problems however, burning the stuff produced noxious smog that left gray clouds hanging over cities. Mining coal was also dangerous as tunnels collapsed and were filled with noxious fumes. Oil, unlike coal, is impossible to mine by human hands alone. Instead, above-ground oil rigs suck crude oil out of the ground, providing a much safer process. In America, one of the first people to revolutionize oil was John D. Rockefeller, who became one of the richest men in the world, controlling standard oil throughout the Gilded Age, which began after reconstruction in 1870 and lasted until the turn of the century. Rockefeller used horizontal integration to create the most powerful oil company at the time. In other words, he bought out almost every other oil company in America. Rockefeller's Standard Oil built up huge refineries to turn crude oil into petroleum. The creation of the gasoline engine and the first automobiles in the middle of the Gilded Age further fueled the oil craze. Rockefeller's Company only lasted up to the end of the Gilded Age, but new companies took its place, continuing the oil industry. Demand for oil only grew and, to fuel demand,the US started importing oil. Most of the oil in the world lies in Argentina and the Middle East. The US became increasingly dependent on importing oil, especially from the Middle East. Between 1973 and 1974, during the Arab-Israeli War, the Organization of Oil Exporting Countries (OPEC), which controls the oil of the Middle East, started an oil embargo with the US. The United States supported Israel in the Arab-Israeli War of 1973, thus angering the Middle East and OPEC. Other countries in the middle east did not recognize Israel as a legitimate country and were not happy that the US kept restocking Israel during the war and as a result refused to sell oil to the United states. With rising oil prices, the US economy suffered and entered a period of stagflation in which the economy was at a stand still and prices continued to rise. The US economy was completely dependent on oil to function. The same can be said today, more or less. Petroleum is in almost everything, from the nail polish you wear to the Aquaphor you use to moisturize your skin. Plastics and rubber (the rubber we use nowadays is synthetic) are both petroleum products.

It is pretty clear that petroleum provides plenty of environmental problems. Burning gasoline through the tubes and engine that make up your car releases massive amounts of carbon dioxide into the air. According to the Environmental Protection Agency, transportation accounts for around 29% of total U.S greenhouse gas emissions (2021). Most plastics may not actively release greenhouse gasses into the air, but they don't decompose quickly. Most plastics take hundreds of years to decompose, some even thousands. If around 80% of the energy the world uses is composed of fossil fuels (primarily oil), then how do we even imagine switching to renewable sources? In order to transition away from oil the same corporations that sell us oil will have to push the large scale shift (Handley, Lucy, and Sam Meredith., 2021). The question of how easy it will be to switch away from oil rests on how dependent we are on oil. Oil prices in the U.S. have shot up in the past year and yet our economy does not seem to be going into recession as it did in the seventies. The economy may not be as good as pre-pandemic levels, however unemployment levels are practically the same as in 2019 (U.S. Bureau of Labor Statistics, 2022). Inflation however, is averaging around 8% this year. Most fingers point to the pandemic and supply chain shortages as reasons for the recent spike in inflation (US Inflation Calculator, 2022).

Oil and other fossil fuels account for mass amounts of greenhouse gasses released into the atmosphere. Oil is a cause of climate change. This being said, how can seeing oil as an effect help us see the bigger picture? With human involvement extinction rates have gone off the charts. The climate is changing faster than even previous extinctions. Whether we want to admit it or not, it is most likely that we are entering the sixth mass extinction or at least preparing for it. Since the industrial revolution our oceans have had around a 30% increase in acidification (National Oceanic and Atmospheric Administration, 2020). The ocean acidifies when it absorbs excess carbon dioxide in the atmosphere. Although coral reefs are disappearing quickly, plankton do not seem to be disappearing at rates suggesting the middle of a mass extinction. Moreover, our miniscule ocean buddies seem to be telling us we are at the edge of entering a mass extinction rather than actually in a massive extinction event. If we do indeed enter a sixth extinction, our plankton will become the next source of oil. The next source of fossil fuels will form from the remains of life as we know it.

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