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Plastic: What's on the Menu

Nature is an inescapable part of our lives. It is where we all originated at some point. Yet, the temporal disconnect between man and nature has never been greater. This is undoubtedly due to the many technological advances that have come to fruition over the years, breaking the bond that was once shared between the earth and its inhabitants. On a social level, playgrounds have been left abandoned by children who would rather stay indoors and use an iPhone. Environmentally, plastics and other manmade materials are disposed of without thinking of the contribution being made to the size of our landfills. Our advances have undoubtedly made life more comfortable, but at what cost? In many ways, we are losing our personal connection to the earth, which has led us to make unconscious yet drastic decisions that have launched us into a new age. This new age is being defined as the Anthropocene, a geological epoch that links human activity directly to the gradual destruction of the environment. Despite the potentially terrifying consequences, science writer Ben Valentine argues that understanding the Anthropocene means to accept responsibility and admit guilt, which has the potential to move people into making more environmentally conscious decisions (Valentine).

The start of the Anthropocene is debated to have started as early as the industrial revolution in 1610. However, as this event did get the ball rolling, many historians point to 1964 as the beginning of the "'Great Acceleration' [which] is marked by a major expansion in human population, large changes in natural processes and the development of novel materials from

minerals to plastics to persistent organic pollutants and inorganic compounds" (Lewis). While the beginning can be debated, the fact that a new age has occurred cannot be. Changes to our climate, decreasing biodiversity on our planet, and deposits of trace elements not found in previous ages (such as mercury and chlorine deposits in glaciers, nuclear fallout, and plastics) all point to a change from the current geologic time period known as the Holocene. With all of this abuse, the planet is trying to adapt. Evidence of this adaptation within the Anthropocene can be seen through the discovery of plastiglomerate within the environment.

Plastiglomerate is a material that combines natural and unnatural components through geologic processes. The actions made as a result of our disconnect with nature, has actually forced the planet to attempt to make a reconnection through its own adaptation. Kelly Jazvac, an artist and Anthropocene researcher, is credited with the discovery of this new material, and brings this paradox to light through her artwork. Jazvac collected her samples in Hawaii, where lava had created molten plastic that combined with stone. The bright colors and blend of the natural and unnatural are aesthetically pleasing. Yet, when we consider the implication behind these rocks in more depth, it becomes more than just art. The rocks are evidence of the earth's way of coping with the garbage that we have suffocated it with, which is meant to elicit an admission of guilt in the viewer. The Styrofoam, plastic ropes, and other easily recognizable pieces of trash within her pieces bring out that guilt and bring to light the connection between our actions and pollution. This connection brings the issue close to home, showing how everyday disposable objects are never really disposed of. By bringing back objects that were thrown away, Jazvac takes away the "out of sight, out of mind" euphemism used when we "unknowingly" exacerbate the problem of pollution.

Plastic makes up a huge majority of the pollution pumped into our oceans and dumped in

our landfills, and throughout the Anthropocene, the earth has been littered with plastic, a substance foreign and indestructible to it. However, a new discovery could be slowly eating away at this problem. The earth seems to not only be coping with and adapting to the plastic problem, but also actively breaking it down. The discovery and future bioengineering of plastic eating organisms raises a lot of questions regarding our own safety, the threat of invasive species, and ethics surrounding biotechnology.

Polyethylene terephthalate (known as PET) makes up one fifth of the annual production of plastic. It is most commonly found in plastic bottles and other packaging due to its strength and stability under heat (Mohdin). These qualities make PET especially hard to decompose. However, throughout the globe, many microorganisms have been found to be actively eating and digesting PET. Fungi in Ecuador, worms in China, and bacteria in Japan have all been observed feasting on this waste. A strain of fungi discovered in Ecuador can live off of PET entirely in an anaerobic environment. Adaptations made by Common mealworms have given them the ability to digest PET in factories in China. Most recently, a bacterium has been found in Japan that can ingest and break down the plastic. “If you put a bacteria in a situation where they’ve only got one food source to consume, over time they will adapt to do that,” proclaimed Enzo Palombo, from Swinburne University, “I think we are seeing how nature can surprise us and in the end the resiliency of nature itself” (Mohdin). However, the real surprise should be that we have created such an environment where animals are forced to adapt to eating garbage because it is more abundant than their natural food sources.

Instead of serving as a great biological breakthrough, the discovery should serve as a warning. Superficially, the rocks presented by Kelly Jazvac are pieces of beautiful art work. However, the purpose is to make people realize that their actions are suffocating the planet, not

to encourage their actions because something beautiful comes as a result. The same is true regarding the discovery of plastic eating organisms. They would seemingly be a great solution to underwater waste in our landfills and oceans. However, their adaptations cannot be congratulated as this wonderful change that demonstrates the earth's resilience. The implication of this discovery is actually rather grave. The earth's inhabitants are being pushed to their limits, starting from the bottom up. These microorganisms are in an environment where microplastics are more abundant than natural food sources. Instead of regulating pollution and ensuring that this adaptation will no longer have to be taking place, we further hope to cash in on the discovery. We have caused an unnatural change in the earth's ecosystem and instead of reversing it we want to amplify it and use these animals to combat our waste problem. Instead of admiring their adaptation, something needs to be done to ensure that pollution does not continue. If we keep polluting, nature's way of coping with the destruction done to the planet can come back to hurt us in a very direct way.

This change is far from being isolated to the animals beneath the microscope. A determination would have to be made as to whether these animals are legitimately destroying these plastic particles, or converting them into microplastics. The prefix "micro" ceases to make the problem any less daunting. On the contrary, microplastics can deal a much more direct blow to the human population than the regularly seen plastic bottle floating in the ocean. It is known that many of the chemicals used to make plastics are toxic to humans. Biomonitoring conducted throughout the years has determined that many of the chemicals used to create plastic are embedded in the human population. These chemicals have been linked to adverse health effects including reproductive abnormalities (Thompson). Currently, there is no root to this current contamination, but it is clear that it can only become worse if we continue to ingest plastics from

our food. Even if we don't directly ingest plastic, the chemicals can cause changes within the tissue of our food sources. Due to the rising levels of pollution and microplastics in our oceans it is extremely likely that larger organisms will become contaminated over time. Studies have shown that krill and other microorganisms inadvertently ingest these microplastics as they siphon in water in search for food. These animals in turn are eaten by larger organisms, larger organisms that we actively hunt. Therefore, it isn't difficult to see the progression of microplastics through our food chain, from amoeba to shrimp to fish to human. On this level it would appear that the cultivation of these adapted species for the use of pollution cleanup would actually be counterproductive and even detrimental to the human population. However, steps are being taken to biologically engineer bacteria that can in theory completely eliminate any signs of plastic or their deadly chemicals in our landfills, posing no threat even if they are consumed.

College students at The University of California in Sacramento are hoping to do just that. It has become part of the world's premier collegiate synthetic biology competition. It's hosted by iGEM, the UC David International Genetically Engineered Machine, which has bred a new scientific field called "synthetic biology." According to the competition guidelines, "[t]he end product is supposed to operate in a living cell. That means a living cell from some organism gets implanted with some type of bacteria that likes to eat, degrade, or devour plastic garbage such as soda bottles and bags" (Hart). Taking the animals that have already been observed eating plastic, and genetically engineering them to break it down even further at a faster rate would be very beneficial. The anaerobic fungi in Ecuador could be genetically modified to break down plastics with oxygen as well, proving useful where tides rise and fall. Synthetic biology could also hope to prevent the conversion of microplastics. This would ensure that one plastic bottle is systematically broken down into a non-harmful substance rather than shredded into thousands of

smaller pieces. Yet, there is still something off about having microorganisms do the dirty work. Genetically modifying animals to eat our waste raises some ethical questions. It would be similar to creating a clone for the sole purpose of doing housework. Yes, the job is done, but certain boundaries were crossed for those means to be met. Ethically speaking, the means of genetically modifying animals to eliminate our waste may not justify the end of a cleaner ecosystem.

If plastic eating organisms are going to be introduced into landfills and places of dense pollution, the scientific community would have to come together to establish whether or not they can do more harm than good. Introducing genetically modified creatures into an environment to ensure a complete disintegration of waste with no adverse effects to the human population would be a major factor in the decision making process. However, something would have to be done to test whether organisms in the surrounding ecosystem can survive with the introduction of this foreign species. Far too many times invasive species have been introduced to ecosystems on purpose in order to solve a problem. For example, lungworms were introduced in Australia to curb growing cane toad populations. However, the worms attacked more species of frog than just the cane toad, forcing them onto the endangered species list and creating unintended consequences.

Yet there are in fact ways to introduce species in a responsible way, as demonstrated by the Washington Department of Fish and Wildlife (WDFW) as they combat Eurasian water milfoil in their lakes and ponds. They have observed the eating habits of carp and acknowledged that Eurasian water milfoil (an invasive aquatic plant) isn't high on their food priority. Therefore, they advise that they only be introduced into bodies of water where the eradication of all aquatic vegetation can be tolerated. They also permit only sterile fish to be introduced to prevent the fish from breeding and taking over the lake due to a lack of natural predators (ECY). If steps could be

taken to modify plastic eating organisms as to prevent them from multiplying, they could potentially be less likely to take over and become an invasive species. The scientific community would have to come together to modify the organisms' rate of reproduction. Creating pseudo-ecosystems to determine whether or not the naturally present organisms can live symbiotically with the introduced species would help project success rates in different areas. For example, sea birds could contribute to unexpected expansion by transporting debris with plastic eating specimens from one landfill to another. However, if the perfect organism were created, such a factor would not be detrimental due to the fact that the organism either cannot reproduce and cannot become invasive or is not harmful to humans or other organisms if ingested.

Although organisms have naturally begun to adapt to the pollution in the world, we don't have to. Although using natural means to fight against pollution sounds logical and reasonable, there are far too many complications. To use these animals to combat our pollution problem would be a denial of our wrongdoing. Ego has replaced Eco, for which our ecosystem would struggle to sustain itself and our ecology would be further blurred. Plastics would continue to fill our oceans and landfills if we had the peace of mind that little microbes were eating away at them. This mindset would only encourage our destructive behavior, which would intensify the volume of trash, which in the end would demand better genetically modified organisms. If that organism's metabolism were to be amped up through biotechnology, we would be further separating ourselves from the source of the problem: ourselves. Ethical lines would be crossed and pollution would still continue. Instead of patching the hole in the bucket, we should stop the flow altogether. If, and only if, the pollution seeping into our ecosystems was halted completely, then these organisms could potentially prove beneficial to clean up current waste. However, this would still require a need to come to the realization that our actions need to change, not nature's.

Kelly Jazvac's artwork serves to raise awareness and bring to fruition the only thing powerful enough to combat the issue: guilt. Guilt has the potential to drive people to fix their wrongdoings and set themselves on a more environmentally conscious path. A simple admission of guilt however, is not enough to reverse the damage done. After the fault is accepted, productive actions need to be made to save the very planet that we and our future generations will populate. Condemning the use of disposable plastic bottles and using reusable bottles instead would have a huge impact. Recycling and repurposing existing plastic bottles can prevent them from adding to the waste in our landfills. Ultimately, if we are to truly solve the pollution problem it needs to come from within our homes and governments, not within our labs.

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