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Water Quality: Successes, Shortcomings, and the Future

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Lead poisoning in Flint, Michigan and droughts in the Rio Grande Valley are both well-known hallmarks of the water crisis currently faced by the United States. While these are real and pressing issues, they are only the beginning of what will come if actions are not taken to manage water more effectively. Issues with flooding, pollution, and ecological damage will become increasingly prevalent. In 2022 we saw several examples of this with record floods hitting eastern Kentucky, around a million living in California drinking water with unsafe levels of arsenic and nitrate (*State Water Resources Control Board, 2022*), and drought conditions in the western United States putting stress on both humans and wildlife. These are just a few of many instances where poor water quality and management led to issues gaining the attention of the whole country.

Our waterways are constantly changing---- water levels rise and fall, wildlife migrates, new chemicals and products are introduced, dams are built, and industries come and go. Through centuries of steady change, the aforementioned problems have been ubiquitous. The difference is that we are more aware of the factors that contribute to issues we see with our waterways. We interviewed Drs. David Wicks and Russell Barnett, professors at the University of Louisville, for their expertise on the current factors of our water crisis. Wicks and Barnett have both spent their careers in the epicenter of water quality in Louisville, Kentucky and deeply value the preservation and promotion of waterways. They have experienced changes of interaction with waterways and their management firsthand. Dr. Wicks has spent his career encouraging kids and adults to become more involved with water education and recreation. He works to promote engagement with these issues through citizen science and has trained over four hundred volunteers to help collect water samples. He and Dr. Barnett teach honors seminars at the University of Louisville that enable students to engage with the Ohio River and consider ways to promote further development, recreation, and preservation of the Ohio River and beyond. Aside from teaching, Dr.

Barnett has been involved with Kentucky's Environmental Protection Cabinet and worked on policy and research related to clean water and other environmental topics.

2022 marked the fiftieth anniversary of the Clean Water Act. This act arose from the Federal Water Pollution Control Act of 1948 after it failed to be effectively enforced and lacked in discharge standards, the Clean Water Act responded to these shortcomings and public dissatisfaction with the slow progress being made (Rasmussen, 1973). The Clean Water Act, often described as a technology-forcing statute, required industries to use the best practicable technology to aid in reaching a goal of no pollutants discharged into waterways by 1985 and "fishable and swimmable" water quality by 1983 (Houck, 2002). We know that the zero discharge was not accomplished by 1985 or even now. On March 8, 2023 the Biden-Harris administration announced a proposal to further limit the pollutant discharge of coal-fired power plants, enforced by the regulatory power given to the Environmental Protection Agency (EPA) in the Clean Water Act (US EPA, 2023). Although it has been fifty years since its passage, the Clean Water Act continues to work towards its original goals.

One quality that has made the Clean Water Act more successful than past pieces of legislation is its heavier involvement of state governments. Dr. Barnett has been involved with this significant piece of legislation since it passed in 1972 and was instrumental in its implementation in the state of Kentucky. He took classes to study the Clean Water Act to help him in this governmental role, noting the great strides made in different aspects of protecting and sustaining our water sources. Dr. Barnett mentioned the progress made in point source pollution which he describes as, "discharge of a pollutant into a water source from a single point, like pipes." The Clean Water Act successfully regulated these sources of water pollution, although this success was not without its battles. Dr. Barnett spoke of Louisville's resentment to implement the Clean Water Act and invest in man-

aging these sources. The EPA brought a lawsuit against the city of Louisville which ruled that Louisville was required to address these issues. This contributed to the Ohio River meeting the EPA's fishable and swimmable recreational standards, resulting in money being brought back into Louisville and surrounding cities through the recreational and tourism attractions now being possible.

Although advances in point source pollution mitigation was a major success of the Clean Water Act, there have also been some notable failures. One of these failures is addressing nonpoint pollution sources; these sources, such as runoff from parking lots and farms, are a result of precipitation picking up pollutants as it moves across the group, eventually depositing them into waterways (US EPA, 2015). Due to the nature of these sites, the runoff is difficult to regulate. Another issue remaining unaddressed is the lack of standards and regulations for many chemicals; this issue remains unresolved since it has a long history of politicization. In some states, there seems to be timely implementation of regulations and on the other side there is pushback on regulations and fighting their implementation at the state level. The state response largely depends on reliance of the state's local economy on things such as the fossil fuel industry, chemical plants, and other targeted sources of water pollution. This back and forth between the state and federal governments regarding the implementation of the Clean Water Act is another obstacle that has forced the previously mentioned timeline of the Clean Water Act off its original schedule.

An unanticipated problem that we are facing is that the negative effects of many chemicals observed causing trouble today were unknown during times of regulation drafting. As a result, these chemicals went unregulated or inadequately regulated by the Clean Water Act, one being dioxins. Most human exposure to dioxins is through its accumulation via waterways in animals and fish used as food sources; exposure to dioxins is known to cause reproductive and immune problems (*Dioxins and Their Effects on Human Health, n.d.*). The University of Louisville's Medical School is working to investigate other health impacts of dioxin. Dioxins remain unregulated by the Clean Water Act, but the EPA set a maximum contaminant level for drinking water in the Safe Drinking Water Act. Dr. Wicks introduced us to a lake in Louisville found to be contaminated with dioxin twenty-five years ago. Despite their awareness of this problem, the city of Louisville has only recently begun efforts to attempt removing this pollutant from the lake. The removal of pollutants is a difficult task, research is being done into methods of effective ways to remove pollutants from our water sources. Dr. Wicks mentioned a research project by the University of Louisville at

Beargrass Falls that is trying to understand the filtration of pollutants using a low energy input. Hopefully, this study's results will help to address a flaw with the Clean Water Act; in order for water to meet the EPA standards, there needs to be established ways to filter out pollutants.

Harmful, insufficiently regulated toxins are not the only issue lacking in legislation and methods of remediation. Currently, we are facing an intense example of why advances in chemical filtration are necessary. The train derailment in East Palestine, Ohio on February 3, 2023 was a demonstration of our lack of preparedness for environmental crises such as this. One of the most prevalent examples of this lack of preparedness was the poor communication between the local, state, federal governments, and the governmental agencies. The governments and agencies were not prepared to answer questions in a timely manner about how this problem would be mitigated, what the citizens needed to do to protect their homes and families, and the long and short-term effects of this spill. The varying information from different sources and lack of information caused panic and fear not only in East Palestine, but also in other Ohio River communities.

This fear was not unjustified. The chemical spilled into the Ohio River was vinyl chloride, a known human carcinogen. At the former B.F. Goodrich plant in Louisville, many workers exposed to vinyl chloride developed fatty liver disease and liver cancer (*Patients, Widows, Researchers Still Dealing With Toxic Legacy of Rubbertown Chemical, 2013*). This liver cancer, angiosarcoma, is extremely rare with only around 25 cases each year (*Angiosarcoma of the Liver Among Polyvinyl Chloride Workers -- Kentucky, 1974*). There were twenty-six confirmed cases of this cancer in the Goodrich plant workers, and all twenty-six passed away due to the angiosarcoma. This tragic exposure occurred in the 1970s, prior to regulation of vinyl chloride. While there is regulation on this chemical now—how do we address the aftermath when it is spilled into our waterways? The answer for East Palestine, Ohio was to do a controlled burn. Dr. Barnett voiced concerns with this method, noting that the burning volatilized the vinyl chloride, creating a greater chance of exposure and releasing dioxin. Due to the release of dioxin, he also expressed the necessity of dioxin contamination monitoring and a health program to assist and monitor individuals whose health has been impaired from vinyl chloride and dioxin exposure for the next decade.

The spill in East Palestine, Ohio has shown that in order to maintain clean waterways and a positive public opinion of waterways, there needs to be prevention measures and regulations beyond the Clean Water Act. In the situation of

East Palestine, one target for prevention would be to look at transportation methods of hazardous materials. Dr. Wicks said he believes the trains carrying these materials need as much regulation as the plants targeted by current regulations. Dr. Barnett added that future legislative actions will focus on train operational safety, tank car design, and potentially whether trains with hazardous material should be allowed to pass through urban areas. While this is only one example of something that can be addressed to decrease the likelihood of these instances, there are many other avenues for regulations and legislation to make a difference.

The Clean Water Act has had obvious successes and failures during its fifty years of implementation, ranging from successfully involving state governments with enforcement to falling short with addressing non-point source pollution. It can be easy to fall into the thoughts of our waterways not being clean for drinking, recreation, and other uses. Dr. Barnett uses the East Palestine, Ohio example to remind us that, “The Ohio River is so large that any contaminant that flowed in streams the twenty miles from East Palestine to the river would be diluted in the Ohio River,” he also goes on to say that nearby Ohio River communities did not detect more than background levels of vinyl chloride during this time. Although the media and others may appear to be panicking, Dr. Wicks emphasizes that the Ohio River and many other waterways are cleaner than they have been in decades and safe for recreation and other purposes.

Although the Clean Water Act made great strides in making our waterways safe, there is always work to be done. Dr. Wicks and Dr. Barnett have spent their careers promoting change and interaction of the public with their local waterways. The two have shared some ways to get involved with our waterways. Dr. Wicks encouraged us to stay on the lookout for water pollution related legislation and advocate for changes to be made in the legislative field. He also promoted research projects at the University of Louisville to get involved with investigating pollution filtration and chemical toxicity. Dr. Barnett, who trains citizens how to do water quality testing, recommended finding opportunities for citizen science engagement. Both Dr. Wicks and Dr. Barnett wanted to motivate people to get involved in water recreation and enjoy the cleanliness the Clean Water Act and other improvements have made available. The final question is, what actions will we take to ensure our city doesn't become associated with a major water crisis?

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