BLACK GOLD MAGIC

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ABSTRACT The reflections of a chemistry major on the pervasiveness of oil-based products and the role of chemistry as an impetus of this process.

As a Chemistry major, my field of study is intimately linked to petroleum and its derivatives. By its very nature, Chemistry is a branch of science that is more closely tied to industry and production rather than other similarly "pure" branches of science, such as biology or physics. Granted, all branches of science yield knowledge which is applicable to a consumer economy, but chemistry seems to lend itself more readily to manufacturing and the creation of the global economy than most other branches. I believe that this is because Chemistry is not as philosophical as other basic sciences. Biology, for example, seeks to understand the mysteries of life, and, similarly, physics seeks to unravel the fabric of our universe to reveal its most esoteric foundations. Chemistry, on the other hand, feels more "blue collar" by comparison. Its mission is more comparable to design, or perhaps architecture, with atoms as its canvas and reactions as its tools.

With creation as its goal and the study of atoms and bonding as a means to its end, Chemistry is more concerned with application and scale manufacturing than other basic science fields. Due to the actions of chemists, oil has attained its primacy in world affairs. Chemists are the ones who found the methods by which one can take a black chthonic sludge and turn it into medicines, fuels, weapons, electricity, technology, dyes, and the seeming myriad of other things by which we have constructed a modern existence. In this way, the utilization of oil is one of chemistry's most incredible contributions to the world. In the same breath, it is perhaps one of its greatest burdens.

In my studies of chemistry, I have found myself curious about the origins of the chemicals that I work with on a daily basis. I try to understand just how much of what we use every day, as citizens of a modern society, not just as chemists, is created from ultimately renewable resources. In my own research into the subject, several things became apparent to me.

Botanical sources of chemicals are an important part of chemistry, especially in synthetic organic chemistry. Synthetic organic chemistry concerns itself with the creation of complicated molecules composed primarily of carbon and hydrogen. Such organic molecules are often found within our own bodies; in this way, synthetic organic chemistry often focuses on the creation of medicines and other applications in which the creation of molecules that mirror those found in our own bodies is paramount. The creation of nerve gas, sadly, would be another such application. Certain molecules are just too intricate to be created by chemists from scratch. Due to this difficulty, plants are an important source of these molecules, many of which are necessary in the creation of important medicines.

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However, a majority of the chemicals used in my laboratory experience were sourced from the mining and petroleum industries. Even when one is working with molecules derived from plants, the reagents used to carry out these reactions will often be exotic and highly dangerous chemicals that could only be found through mining—for metals and other non-organic compounds— and through oil—in the case of organic compounds such as benzene, hydrocarbons, and natural gas. Through my work in chemistry labs, I am one step closer to the real witchcraft of oil—the process through which it mysteriously transforms from a toxic sludge into our world.

While not being directly involved in its extraction and refinement, I am involved in its secondary transformation from chemical "tools" to chemical products. This, I think, is perhaps the most mysterious step of the process. In this stage, oil transitions from something that could perhaps be identified with it in some form (its refined products) to the wholly removed products which we commonly use, such as plastics. Chemistry, being the art that it is, is using oil-based paint on an oil-based canvas with an oil-based brush.

My chemistry education has allowed me to understand what makes oil's allure so strong. In our universe, the tendency of all things is towards fragmentation, decay, separation, and dispersal. This process is made favorable on account of constantly increasing entropy, which dictates, to put it simply, that things will naturally move towards dispersal and fragmentation. Rust, erosion, and decay are all highly familiar examples of this process occurring. In the natural world, plants and animals represent places in which the process of entropy is being reversed in a small area, which is why plants can be important sources of chemicals, as the plants will produce the chemicals and then store them within themselves until they can use them—or until humans cultivate them. Palm oil would be a particularly pertinent example to illustrate this idea. The problem with living things, however, is that they are filled with a huge variety of other compounds that may or may not be useful, and must be separated. In consideration of the earlier point of entropy, I cannot overstate how troublesome the process of separation is—in separating chemicals, one is going against the natural order of the universe, and to do so can be a complicated process. The easier the separation, the more appealing a source will be to a chemist or to a chemical engineer.

In terms of separation, oil is truly an amazing substance. It is comprised of a large variety of molecules which are often classified in terms of how many carbon atoms a molecule contains. Despite this variety, and I am not refuting that oil refining is still a highly nuanced and complicated process, oil can be separated into its component parts through the relatively simple process of distillation, in which the crude oil is heated and the molecules boil off in succession, with the molecules containing fewer carbons boiling off first. Once a molecule boils off, it is collected separately and is effectively separated. On top of this relative ease of separation, the molecules contained in oil themselves each have their own utility and application to the engineer or the chemist. To illustrate the pervasiveness and broad utility of oil in chemistry, I will convey what could be a typical day in the lab: I would first clean my glassware with acetone derived from natural gas which could easily have originated at an oil site. Then I would dissolve my pyrrole (which comes from plants) in benzene, which comes from oil. I would then use a series of oil-based reactants to carry out the necessary reactions, and then, if called for, transfer my product to another solvent, suchas hexane, which also comes from oil, for a different reaction. The sheer variety of compounds found in oil, and uses of these compounds, has made oil an indispensable part of chemical research, and may well be one of the most important reasons for the vast progress made in the chemical sciences in the 20th century.

I sit here writing this reflection essay on my oil-based plastic keyboard while drinking from my oil-based plastic water bottle, wearing clothes with oil-based dyes and writing about an oil-based field. Being aware of the insidious pervasiveness of oil while simultaneously being complicit in it is what drives my search for alternatives. Acetone, as I mentioned earlier, was originally produced by fermenting agricultural by-products, as ethanol is now. Wood used to be a major source of substances that are now refined or derived from oil. Turpentine, taken from pine trees, is still used as a solvent in household settings, but used to be far more important before the oil era. It is a difficult position that we have placed ourselves in as a society. To produce what we get from oil with alternatives would place a large strain on other elements of the natural world: are there enough pine trees to feed our need for organic solvents? Can we create enough acetone from fermentation, when the single room where I work in my lab may go through several liters of the substance in a single day? Should we clear-cut our forests, just to cut our addiction and to be "carbon-neutral?" Conversely, did switching to petroleum save the whales from our previous oil addiction? I feel so overwhelmed by these questions that I feel at this point in my life I can only worry about enacting sustainability for myself. I have made biodiesel, going through the entirety of the process, from extracting the oils from plant matter to carrying out the reaction to produce the diesel itself. Yet, even then, I am using methanol from natural gas and organic solvents from oil. The rabbit hole goes deep. Yet, I am committed to sustainability—it is my debt to the world as an aspiring chemist. I can only hope that I will use what knowledge I may gain through my studies to help remove this burden from the world, and from chemistry as well. As I said earlier, the uses of oil were an amazing contribution to the world, and a terrible burden. I only hope that chemists can find a way not to contribute more amazing things to the world, but simply to rectify wrongdoing—since chemistry brought oil into prominence, bringing it out should not be viewed as an achievement, but as an expectation; not an act of heroism, but an apology.